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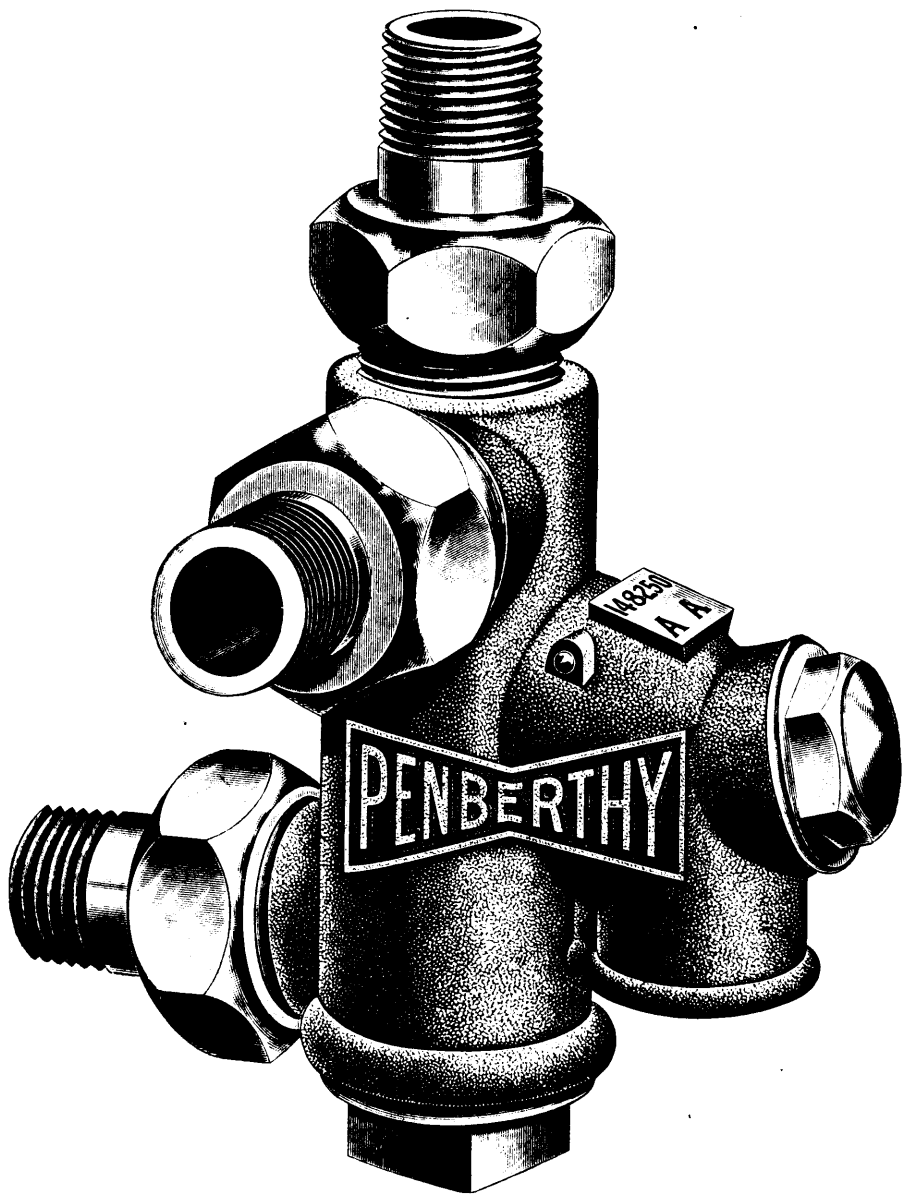

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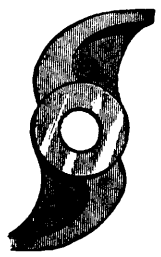

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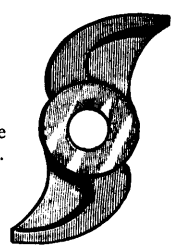

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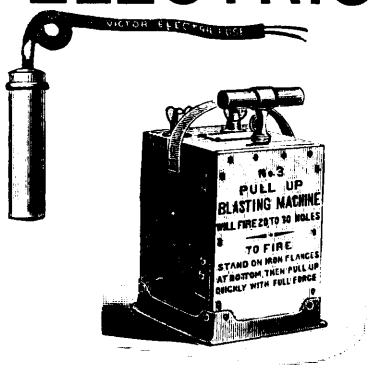

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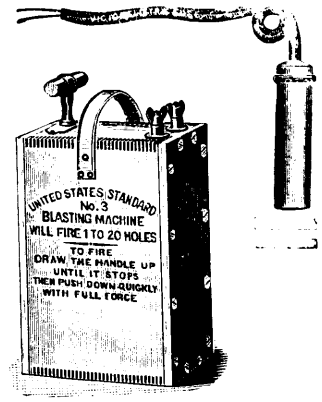

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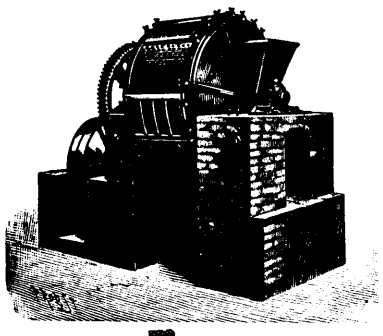

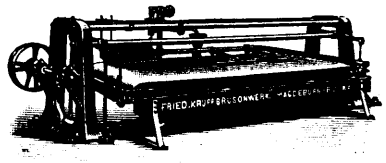

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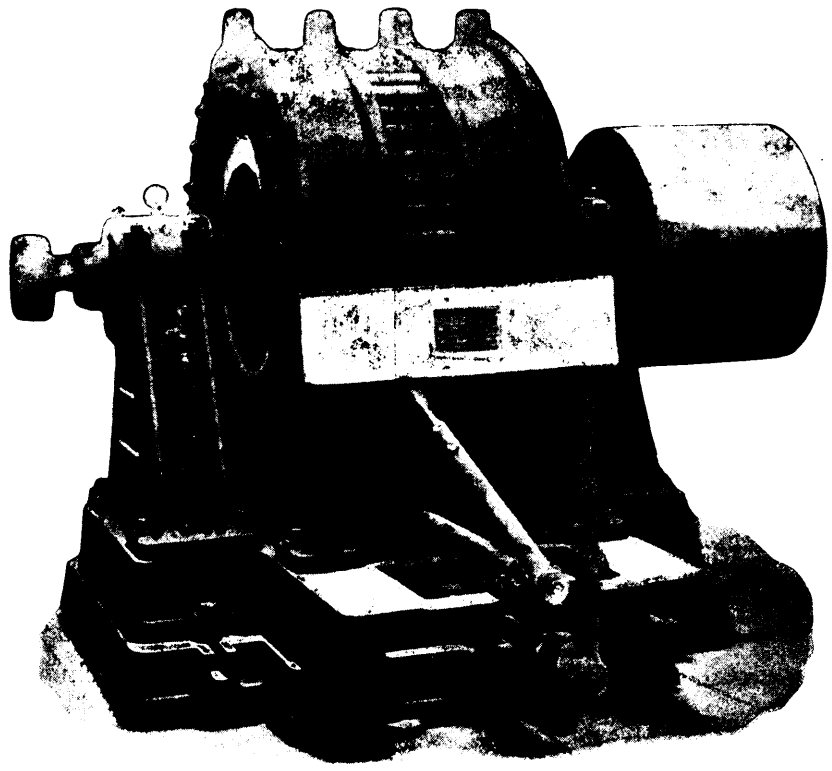

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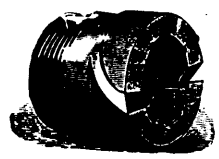

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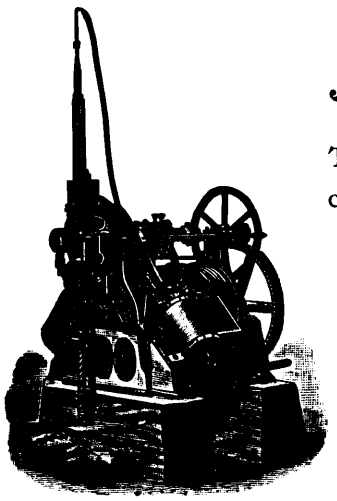

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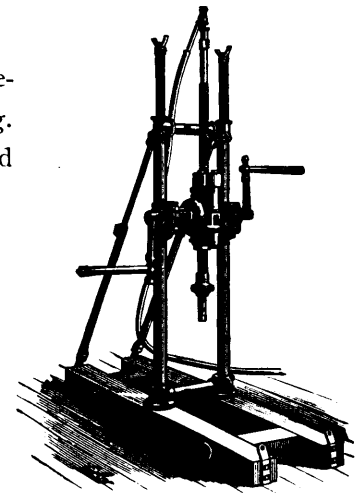

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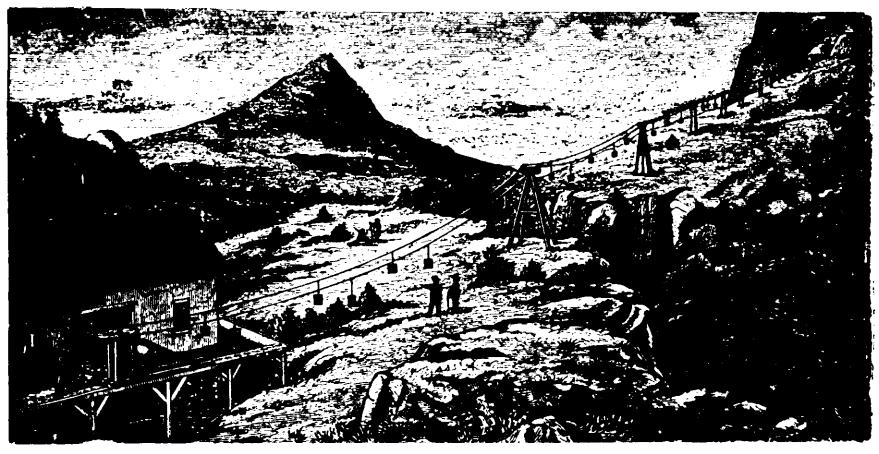

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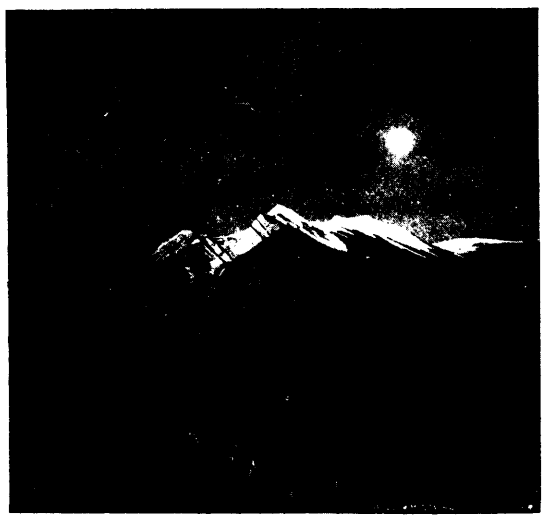

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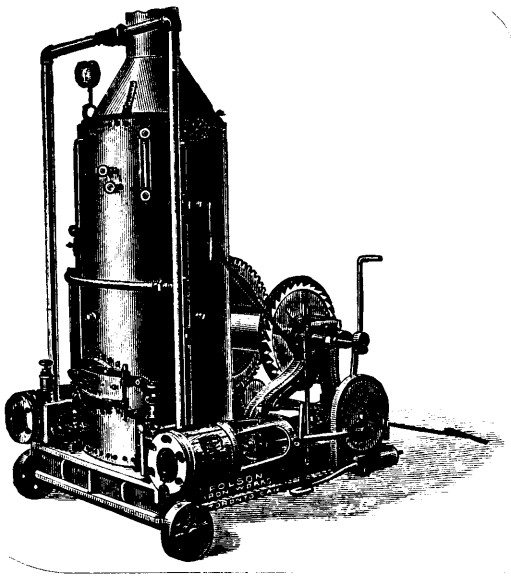

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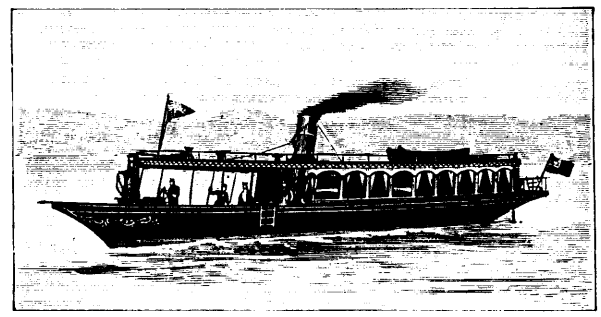

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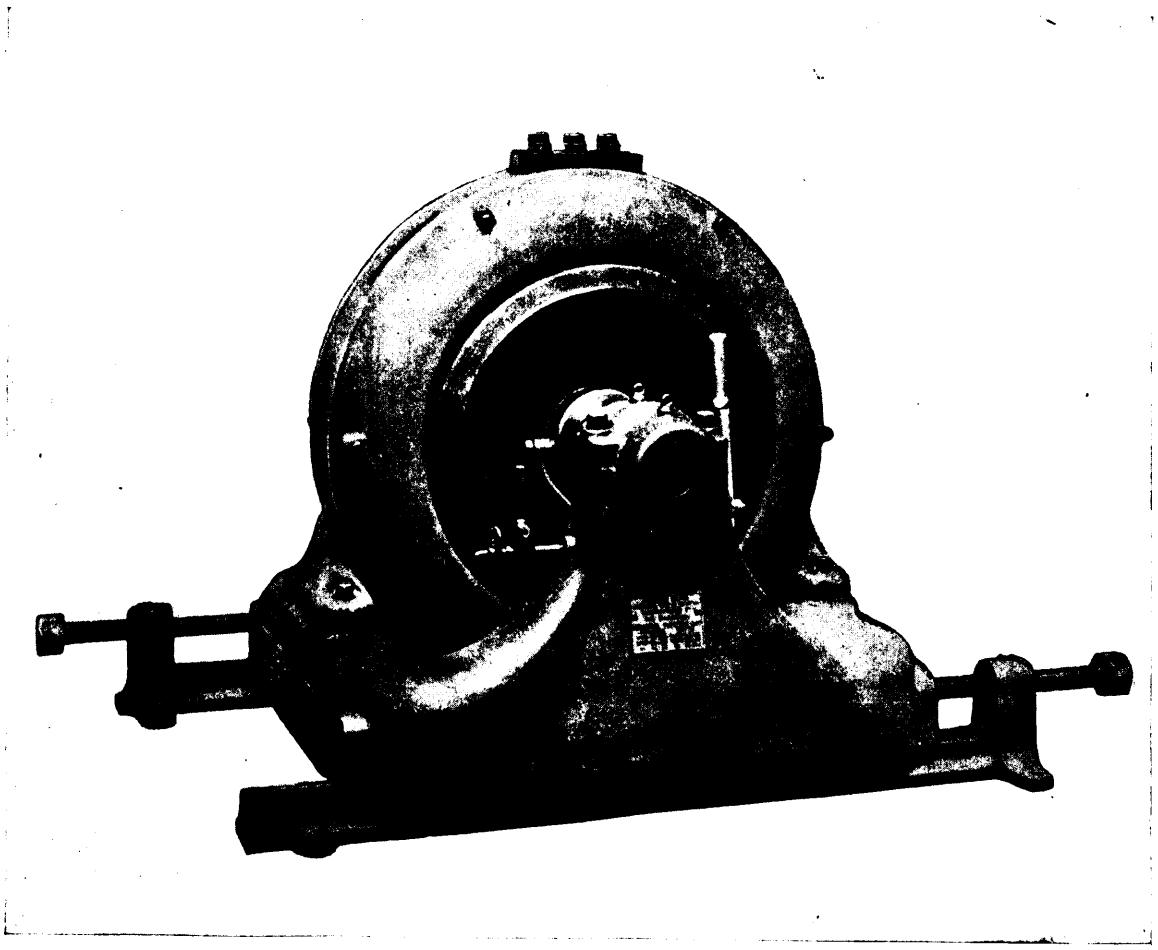

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AMOUNT AND VALUE OF MATERIALS PRODUCED 1896 AND 1897.

	Customary Measures.	1896. Quantity.	1896. Value.	1897. Quantity.	1897. Value.
Gold, Placer	Oz.	27,201	$ 544,026	25,676	$ 513,520
" Quartz	Oz.	62,259	1,244,180	106,141	2,122,820
Silver	Oz.	3,135,343	2,100,689	5,472,971	3,272,836
Copper	Lbs.	3,818,556	190,926	5,325,180	266,258
Lead	Lbs.	24,199,977	721,384	38,841,135	1,390,517
Coal	Tons	894,882	2,688,666	882,854	2,648,562
Coke	Tons	615	3,075	17,832	89,155
Other materials			15,000		151,600
			$7,507,946		$10,455,268

Production for 1890, $2,608,608; for 1896, $7,146,425; for 1897, $10,452,268.

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, $725,000 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 has much exceeded that of 1896, as such mines as the "Payne," "Ruth," "Whitewater" and other mines increased 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.

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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 OUT-FITS 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.

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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.

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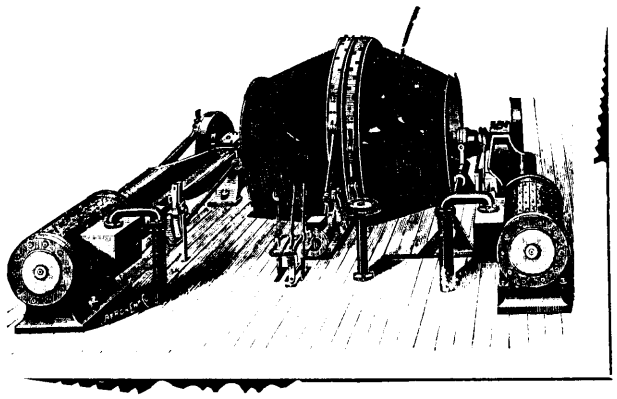

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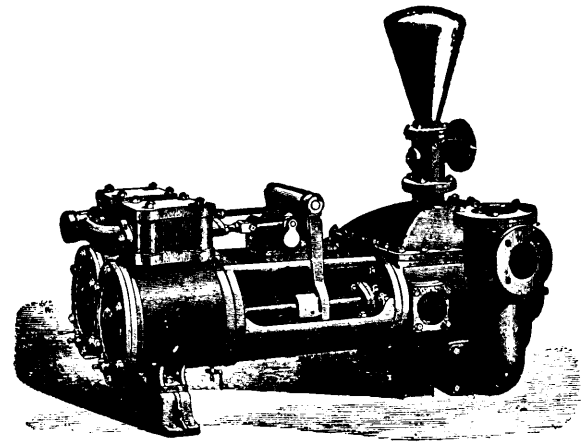

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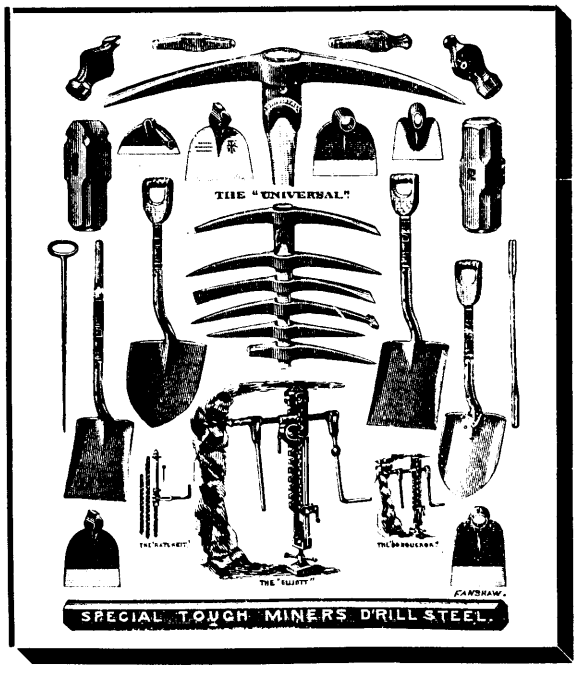

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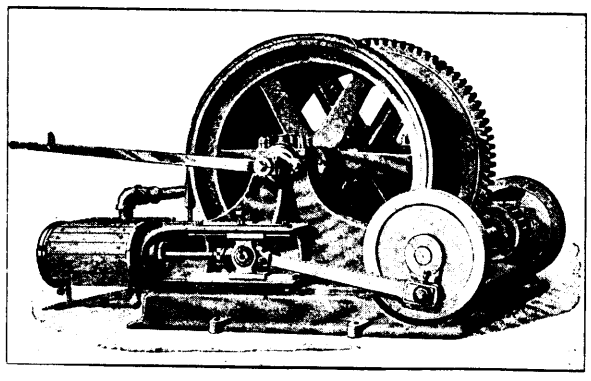

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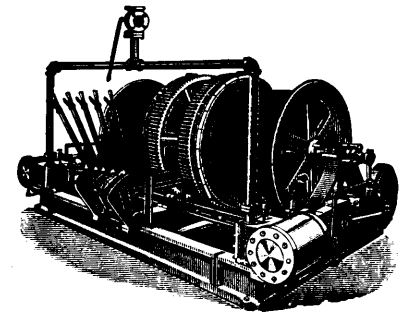

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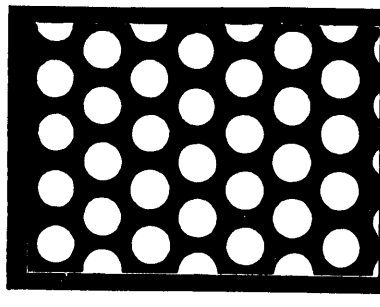

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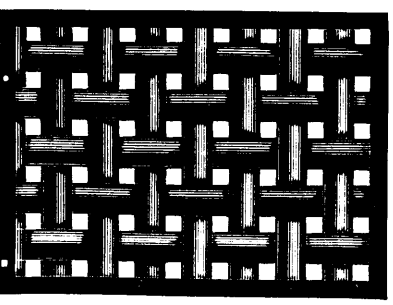

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VOL. XVII., No. 8. AUGUST, 1898. VOL. XVII., No. 8.

New Beauties of the Law of the Apex.

Our neighbours in the United States are now fairly beginning to realize the full effects of the obscure, absurd, and complicated law which governs mining titles upon the public lands in certain States and Territories. Fortunately for them, it is not in force over the whole of their country, and, as a consequence, by far the larger part of their mining industry is unvexed by uncertainty and litigation over the titles granted by the statute to locators, or conveyed by the formal deed of the government to purchasers. But the regions peculiarly interested in the mining of gold and silver are under the curse of this clumsy and mischievous statute; and for these regions (comprising roughly the Rocky Mountains and the Pacific slope) the latest decisions of the United States Supreme Court, which will have henceforth the full force of actual legislation, must have an ominous importance.

We refer to the decisions in the cases of *Del Monte Co* vs. *Last Chance Co.*, *Clark* vs. *Fitzgerald*, and *Walrath* vs. *Champion Co.*, all of which have been recently reviewed in the New York *Engineering and Mining Journal* by Dr. R. W. Raymond. We shall not undertake to state these cases in detail, or to follow, with regard to them, the searching analysis of the review referred to. It is sufficient for our purpose to point out the general effect of the decisions.

1. The so-called "extralateral right" (that is, the right of a lode-locater to the downward continuation of his vein, between vertical planes drawn through the end lines of his location), granted by the United States law, is, on the one hand, an enlargement of the rights of the ordinary common-law title to land, and, on the other hand (since it subjects every owner of a lode-location to the extralateral right of his neighbour), a diminution of that title. The all-important question is, upon what indispensable conditions does this peculiar modification of the common-law title depend? The statute itself seems to state explicitly three conditions, namely, that the location must be made "on" a lode; that it must be on the pubic domain, and that it must have parallel end-lines. And the Supreme Court has heretofore held that the end lines are those which cover the course of the lode, and that a location once made, and still in force, withdraws from the public domain the tract located. It would seem to follow that a locator seeking to secure parallel end-lines by placing a part of his boundaries within a tract already located would fail to secure his end, because he could not legally acquire any rights by an act of trespass, and because his location, as thus bounded, would not be on the public domain, as the law requires.

But the Supreme Court has now declared that such "imaginary boundaries" are valid as against all parties except the prior locator. It holds that the prior location (at least, until it shall have been actually deeded by patent) is not wholly withdrawn from the public domain, and that the establishment of new boundaries upon it is not necessarily a trespass.

2. Another question which has been in doubt hitherto, concerns the extralateral right of a locator whose lode, crossing in its course an end-line of his location, departs therefrom across a side-line. According to the court's previous definition of an end-line, this case would present two end-lines not parallel, and might be held to deprive the locator of his extralateral right. But the court now rejects this view, and declares that the locator shall still have an extralateral right, bounded as to longitudinal extent (if we understand the decision), at one end by a vertical plane through the end-line actually crossed by the apex, and at the other end by a parallel plane, through the point where the lode crosses the side-line, which line is to be taken as the end-line in such a case, *non constat*—probably, the one originally so designated by the locator.

The principle of this decision is, that the locator shall have the extralateral right, in depth, to no shorter and no longer portion of the vein on its course than is covered by the portion of the apex lying within his location. And this principle, one would think, must underlie the whole statute, as founded in the nature of the case and the necessary intention of the law.

But the law also gives to the locator an extralateral right, between his end-boundaries, upon all lodes apexing within his location, and the court has declared that the end-lines once fixed by their relation to the course of the located lode must be the boundaries also to the extralateral right upon the other lodes concerned. This would be fair enough, provided that in no case could the locator claim a greater length of any lode in depth than he possessed of the apex thereof within his ground. But in the last of the three cases named, the Supreme Court, after deciding what was the true end-line of a given location, has extended this line to cut an oblique cross-vein, in such a way as to give the locator, upon the said cross-vein, rights in depth exceeding in longitudinal extent the apex actually possessed by him—to the detriment of a later locator, who had actually located, upon unoccupied public land, the apex of the cross-vein. The ultimate effects of this startling decision it is not easy to foresee. For the present, we are content to congratulate ourselves that neither the Dominion nor any of its Provinces is burdened by such complicated and whimsical conditions of mining title, and to wonder how long our neighbors will endure a state of things so oppressive and so ridiculous.

We regret to learn of the serious illness of Mr. W. J. Nelson, secretary of the Intercolonial Coal Company.

Six Month's Crushing in Nova Scotia.

We are endebted to the Mines Department, Halifax, for the following returns of the gold yield reported for royalty from 1st January to 30th June last:—

Name of Mill.	Name of District.	Company or owner of Quartz	Quantity Crushed. Tons.	Cwts.	Yield of Gold. Oz.	Dwts.	Grs.	Remarks.
Cow Bay.. ..	Cow Bay. ...	Cow Bay G.M.Co.	3	.	19	1	22	2 months.
Oldham	Oldham.....	Tributers.....	260	..	491	17	18	4 "
Modstock	Isaacs Harbor	Modstock G.M.C.	1,168	..	765	17	.	5 "
Essex.....	Tangier.	Miner T. Foster and others...	435	.	552	7	.	4 "
Bluenose.....	Sherbrooke	Bluenose G.M.Co.	3,763	..	1,373	..	..	6 "
Stellarton	Sherbrooke....	G.A. Hirschfield *et al*.....	2,313	10	820	9	..	6 "
New Glasgow.	Sherbrooke.. .	New Glasgow G.M	950	.	230	..	..	3 "
Sutherland ...	Sherbrooke	Sutherland G. Co.	187	..	152	8	2	6 "
Crow's Nest ..	Sherbrooke	Crow's Nest M.Co	1,100	..	70	4	.	3 "
Moose River..	Moose River, Caribou ...	Moose Riv. G. M.	1,205	5	113	11	10	6 "
Touquoy.....	" "	Touquoy G.M.Co.	1,386	..	260	6	..	6 "
Dixon...	(Old) Caribou. .	Caribou G. M.Co.	253	.	74	4	14	5 "
Elk.....	(Old) Caribou. .	Elk G. M. Co...	238	..	72	.	..	6 "
Madill.....	Mount Uniacke	S. H. Mitchell *et al*	14	..	10	4	18	2 "
Withrow.....	South Uniacke.	J. J. Withrow *et al*	777	.	937	..		6 "
McMillan	Stormont.....	Hurricane Point Gold M. Co..	1,429	..	956	3	..	6 "
Richardson...	Stormont	Richardson G. M.	10,576	.	1,140	..	..	5 "
McConnell ...	Stormont	A. M. Bell *et al*..	178	.	194	..	..	2 "
Hopewell	Stormont.....	Hopewell G.M.C.	420	..	52	..	..	1 "
Country Harb.	Stormont	A. C. Blair.....	140	..	26	12	14	2 "
Eureka.....	Stormont.. ...	Tributers & others	155	..	110	18	..	6 "
Tudor.....	Waverley	Tudor G. M. Co. Tributers	404	..	278	12	33	6 "
Casham.....	Leipsigate....	Casham & Hines.	1,289	..	596	11	.	5 "
Gwen.....	Leipsigate	N. C. Owen *et al*.	184	..	166	14	..	1 "
Kempt.....	Kemptville	Walton & Britton.	68	..	37	12	.	3 "
Cogswell.....	Lake Catcha ..	F. W. Hannight .	104	.	110	10	..	2 "
Oxford	Lake Catcha	Oxford Mg. Co...	5	5	2	12	4	1 "
Hiseler.....	Gold River....	Geo. J. Hiseler ..	35	..	10	5	16	2 "
Baker.....	Gold River....	T. N. Baker.....	42	12	326	10	19	3 "
Brookfield....	Brookfield.....	Brookfield M. Co.	6,002	.	1,894	..	..	6 "
Napier.	Wine Harbor..	J. J. Trook *et al*..	221	..	47	19	17	3 "
Townsend....	Lawrencetown.	Estate of Adam Burns.....	48	10	54	12	..	6 "
Free Claim...	Renfrew.....	Bondholders.....	35	.	3	13	.	1 "
Golden Group.	Montague.... .	Golden Group Mining Co...	310	..	167	..	..	3 "
Salisbury.....	Montague.....	Salisbury G.M. Co	56	10	16	..	.	1 "
Cameron.....	Ecum Secum .	T. R. Earl	107	.	23	5	..	3 "
McKay	Malaga	H. S. McKay *et al*	414	.	662	..	..	6 "
Macdonald ...	Stormont.....	Fributers.....	15	..	8	11	..	1 "
Higgins	Salmon River..	A. Higgins *et al*..	1	10	3	..	..	1 "
McKay	Killag	Old Provincial G. M.C. *et al*	147		163	7	..	4 "
Yeadon	Mooseland.....	W. D. Yeadon...	4	..	10	..	..	1 "
Cream Pot....	Cranberry Head	Cream Pot M. Co.	20	.	4	7	..	1 "
		Total.	36,464	2	13,009	8	8	

The Conditions of Labor in the Klondike.

The influx of men into the Yukon this year, whether of 25,000 or fewer, has had two immediate results, it has extended the number of claims staked out and worked, especially on the benches and hills, and it has cheapened the price of labor of all kinds. Nearly every creek on both banks of the Yukon between Fort Selkirk and Dawson and even higher has been looked at, and on very many of them sinking will be freely done this winter. It is impossible to say what strikes will be made—the best, so far, have been made on the American side in the Forty-mile district. Labor has been cheapened in the Dawson area from $15 per day to $8, and even $5 per day. Many who came to hunt gold find that a hard matter, especially in a district already staked, and are glad to work for wages. In view of present conditions and prices of labor it is important to ask whether it is worth a man's while to come into the Yukon. If a man is of the right hardy sort and can afford to bring in with him at least a ton of food, etc., he may still do well in the Yukon either as a prospector or as a laborer for wages. The Klondike has been noted as 'poor man's diggings'; if that means that extraction of gold in Klondike wants no capital, it is false for it wants much. To prospect a claim is of itself a costly process. But if it means that a good man who possesses his own food and outfit can save plenty of money, it is correct. A *good laborer* with food supply secured is in a great position for saving dollars and would still be very well situated if wages fell to $5 per day. As for the prospector, he is always a gambler; give him too his food and there is ground for him to prospect still even in the Klondike area. Hardly any of the gulches have been touched yet, and he can undoubtedly get good terms from claim owners in gulches. But it must be remembered that he is running a risk on them; on the good creeks the system of lays is almost dead, owners naturally prefer to dispense with laymen and get their claims mined better for less money by wage-earners. Thus the chances of really good things are much fewer than before; in fact, Dawson is passing rapidly into the condition of a settled camp with prices lower all round. I do not think labor will be dear this winter; the royalty will close some mines and the supply is not going to run short. The men now cutting logs up the river will make for Dawson as winter comes on, and will wish to work in the mines for wages or on any terms. Except in the mines there will be no great amount of labor wanted. Cordwood cutting will occupy a few, but no great wages will be paid; therefore I should recommend none to come into the Yukon as laborers, except skilled miners for whom there will long be a demand at a higher rate of wages than others command. To the prospector I have nothing to say; provided he is of the right sort, there is unexplored land enough to tempt him out in many directions from Dawson

A. N. C. TREADGOLD.

An experiment of considerable importance to large consumers of coke has been in progress for some time at the Newport Ironworks of Sir B. Samuelson & Company, Limited, Middlesborough—the erection of coke ovens close to the blast furnaces instead of at the collieries—and a correspondent of the London *Colliery Guardian* says that so satisfactory has been the result that the firm is proceeding to double the number of ovens at the Newport Works, so that before long the whole of the 6,000 tons of coke which they used weekly in their furnaces will be manufactured within 1,000 ft. of the furnaces in which it is consumed. Some of the German ironmasters have adopted this system with advantage, and so far the above named firm is said to be the only one in England that has ventured to make this new departure; but it will not long occupy this position, for other Cleveland blast furnace proprietors who are also colliery owners are reported to be considering the matter, and others would be among the number if they could get the necessary land in proximity to their furnaces.

MR. W. J. McINTOSH, MANAGER
Modstock Gold Mining Co., Forest Hill, N.S.

EN PASSANT.

Mr. Henry Hess, the well known London publisher of the *Critic*, which reproduced the REVIEW's article exposing the scandalous promotion of the New Golden Twins, Limited, by the Klondyke and Columbia Gold Fields, Limited, has been served with a writ for libel, so that there is a likelihood of this disgraceful business being fully ventilated in the English courts.

In his statement of justification Mr. Hess points out "that the statements in the report purporting to have been signed by Johnson Brown (the half-breed Indian) are false and constitute material misrepresentations to the prospectus entitling shareholders who subscribed on the faith of this to rescind their contracts to take shares." The *Critic* will have no difficulty in proving its case.

We have often referred in these colums to the suicidal policy of many incipient mining enterprises to expending large sums on plant and surface improvements before the value of the property had been sufficiently tested to warrant such expenditures. A correspondent in the west calls our attention to doings of the Silver Queen Mining Company which may be worth enquiring into by eastern shareholders. He says:—

"While at Burton I saw a little of the operations of a mining company, whose method, if not a deliberate and well plotted attempt to inviegle a gullable eastern public, is one that the public can stand being warned against. The Silver Queen Mining Co. have a "mine" up Snow Creek, about twelve miles from Burton. It is situated on the side of a mountain 3,000 feet above the creek. They have a tunnel about 270 feet long and a shorter one, the one almost tapping the other.

There is very little ore to be seen on the dump, and still less to be found in the tunnels. For about twelve feet at the end of tunnel No. 1 it has been built up carefully with rather good looking rock. A new government trail is being built to the mine at a cost of $2,000. A compressor plant is being erected on Snow Creek 3,000 feet below the 'mine' to supply it with power and elaborate buildings, are to be immediately constructed, 'handsomely furnished, for that's what catches the easterners.'

They are trying to rush these improvements through. People round Burton say that the company has scarcely any funds in its treasury. The company may be working in good faith, they may not be preparing to unload their stock on the public, but to me it looks as if they were and at all events they are adopting a very bad course, when, instead of testing their property where work already done if it proves anything proves the prospect not to be a mine, they use their funds in expensive buildings and plants."

No better illustration of the ease with which money can be obtained for utterly preposterous schemes has recently been furnished than the now notorious "Electrolytic Marine Salts Co.," of Boston.

Organized and promoted by the Rev. Mr. Jernegan, a Maine parson, this company proposed to extract the gold existing in the waters of the ocean at a profit and actually made use of the shipment of bogus bars of gold to the New York assay office as a demonstration of the value of the process, and as a lever to raise the price of shares.

Just how much hard money was put into this enterprise we are unable to find out, but it appears to have been $400,000.00.

The "process" seems to have been a very simple one indeed. a "colleague" in a diver's suit walked on the bottom of the sea and deposited the gold in the "cells" of the reverend Jernegan's plant.

The men associated with this reverend rascal are reported to be hard headed men in their own businesses, but they did not consider it at all necessary to have expert advice or opinion before investing their money. The process was secret, the plant was secret, everything was secret, hence they put in their money—had an open, legitimate mining scheme or enterprise been taken to these men they would have refused it, and probably have said all sorts of hard things about mines and miners; but "for ways that are dark, and for tricks that are vain" we fancy some reverend gentlemen can give the poor miner "points."

We are glad to note that Nova Scotia mining interests are likely be substantially advanced through the operations of the Montreal-London Gold and Silver Development Co., Limited, on the Dufferin mine. From the report of Mr. Bernard Macdonald, reproduced elsewhere, the company's engineer, it would appear that the machinery plant now installed at the mine is the most extensive ever erected on a gold mine in that province.

Of the 60-stamp mill to be erected, thirty head have been contracted for with the Jenckes Machine Co., of Sherbrooke, and will be in operation before the snow flies. Steam will be used for motive power at first until the necessary arrangements for utilizing the splendid water power of the property can be perfected.

This advancement is likely to be followed by other legitimate enterprises directed to the low grade ores of magnitude in Nova Scotia, and it is to be confidently expected that the stigma attaching to the name of the Province by reason of former flotations of narrow, high grade veins will be removed with corresponnent benefit to the industry.

The Nova Scotia Steel Company has declared a four per cent. dividend on the year's operations. The outlook for current year is reported to be most satisfactory.

From the first Annual Report of the New Gold Fields of British Columbia we note a gross profit of £9,011 of which £4,334 is net. The total subscribed capital is £55,737, aud the company holds fully paid shares in various companies to the nominal value of £75,050, and will be entitled to a further £141,780 in cash and shares when certain transfers are completed.

The Calumet and Hecla owns mines, stamp mills, smelters, rail roads, docks, steamer, water works, sawmill, farms, forests, a ship canal and cities built on its own land. Standing on its property are nearly thirty churches in which the Gospel is preached in English, French, German, Italian, Swedish, Norwegian, Finnish, Slavonian and other languages. Each of these churches the Calumet and Hecla has furnished a free site for, as well as ground for a parsonage, and has helped to build by a cash donation which has invariably been the greatest in amount of any received for the purpose. Twenty thousand persons are dependent directly upon this corporation for their bread and butter, earned by the more than 4,000 workmen whose names are on the pay-rolls. The wages are the highest paid in the copper district. The sums paid for labor and the annual dividends are about equal. A report shows that there are 2,462 shareholders, who divide among them $4,000,000 annually—an average of $1,625 for each shareholder. There are several single shareholders who have millions invested in the stock of this one mine, while there are hundreds who have but a single share or two. Many of the employes of the mine have systematically invested their savings in the shares of the property for years, and, through the steady appreciation of the stock and the dividends returned, have grown independent. One man who began twenty-five years ago

as a surface laborer at the mine, just over from Germany and without a dollar other than earned with his hands, now owns over 500 shares, worth $250,000. Every dollar saved was invested, every dividend paid him was made to buy more stock. There are many old employes worth $10,000 to $50,000 each, made in the same way.

Nothing in mining should be available to stockholders except cash is the sage advice of the manager of one of the largest mining enterprises in the Western States. He says: "For twelve years I have insisted that the cost of all permanent improvements, buildings, tramways, machinery, supplies, etc., amounting in this time to more than $300,000, should at once be charged to expenses, and that the stockholders should be shown, as profits each year, only the cash remaining after all expenses have been paid. You may call this a cold-blooded proposition, but it is a safe one, and never deceives. Suppose that today I should show a surplus of $500,000, consisting of smelter, concentrator, machinery, tramways and all other tools and machinery (and these originally cost the amount claimed), but should show your mines entirely exhausted, how would you divide these assets? Sell them you could not. Cash is all you can divide between the stockholders. The curse of the mining industry is the fictitious value placed upon unknown quantities of ore of uncertain quality, and finely engraved stock certificates, entrapping the unwary and innocent, only to let them find out how quickly the supposed millions can vanish. Such schemes are based upon wind, and are conceived in diseased and disordered minds. Every dollar invested in a mine must come back, if at all, in the shape of dividends. Stop paying dividends, honestly and forever, and your capital stock is worthless—an empty hole in the ground is your entire assets."

An article by an Australian geologist, B. J. Skertchley, succinctly shows how scant is the distribution of tin ore. While the known gold fields of the world cover more than 1,500,000 square miles, the tin fields have an area of less than 12,500 square miles. There are seven tin districts in Europe, producing about 8,300 tons yearly, of which the Cornish mines yield about 8,000 tons Asia has two tin areas—Hunan, in China, estimated to produce 2,500 tons, and the Straits Settlements and adjacent principalities, yielding 58,000 tons yearly, the richest yield in the world. Africa has no known tin mine; North America no payable mine, though South Dakota and California have made some efforts in that direction; South America one limited tin area—Bolivia and Peru—yielding less than 4,000 tons a year, and Australasia, the youngest, furnishing about 6,000 tons a year.

A special system of air doors has been devised by a French mining engineer, with the object of lessening the destructive effects of a fire-damp explosion, by confining it to the point where it originated and preventing its propagation to other districts. It consists of two massive doors of iron or timber, very strongly mounted, and arranged a slight distance apart, which open in opposite directions, but are kept against the side of the working by springs or counterweights, which at the same time permit them to be so acted upon by the air current that they shall close against their frames when the current acquires sufficient intensity. Under these conditions, from whichever side the explosion may come, one of the doors will close against its frame, thus intercepting the passage and arresting the propagation of the destructive action. On condensation of the water vapour and cooling down of the flame, provoking a contraction of the atmosphere, this door will again open, and the second will in turn come against its frame, while also intercepting a portion of the recoil shock. In practice these doors have almost always been put out of shape, broken or torn off their hinges, but even in such cases they have sometimes accomplished their object.

Nickel steel is rapidly growing in favor at the hands of railroad engineers. The ability of nickel steel to withstand alternating stresses makes it appear desirable to try it in places where much damage results through defects from service strains not visible on the surface. Thus, the staybolt for locomotive boilers is something which cannot be too good, and it is stated that a western road is now experimenting with nickel steel for this purpose. Experiments made by this road on the material before service trials showed that the carbon was low, manganese high—being nearly 1 per cent.—and nickel 3.7 per cent. It broke at 86,930 lbs. per square inch, the elastic limit being 61,900 lbs.; the elongation was low, however, being only 19.2 per cent. Vibrating tests were made with this material, a load of 1,000 lbs. being kept on the bar, while its free end was made to vibrate at the rate of 500 strokes per minute of ⅛ inch amplitude. The average vibration of two specimens was 255,828, which is claimed to be three times as much as the best material heretofore available would stand. There are many points yet to be settled before nickel steel can be recommended for this purpose, but there seems to be every reason why trials should develop its utility for making the staybolt for locomotive boilers.

At some mines in the United States the grading of iron ore is carried out with extreme discrimination. The Minnesota Iron Company is now producing no less than seven grades of ore from its mines at Tower. This is perhaps the closest grading done by any large mining company, and as the ore is taken from pits forming one continuous line of mines it shows unusually close assorting. Previous to twenty years ago practically no care was taken in sorting ore, the work being done roughly by eye, the man on the stockpile guessing at what the ore contained. When the tide turned and the mine owners began dancing attendance on the purchasers, the latter dared to ask for what they wanted. Year by year the furnacemen have been able to get a little nearer the ideal ores demanded for various uses, and the chemist has come to the front in importance, not only at the mines but at the furnace as well. It is now possible, says a correspondent of the *Duluth Herald*, by a judicious blending to get almost any conceivable combination of iron, silica, phosphorus, and manganese. The result is seen in the vastly better grades of pig-iron now turned out of American furnaces. European iron-masters have also advanced in technical skill and precision during the past ten years; but it is a fact that American furnacemen now take the lead not only in tonnage per individual stack and for the entire country, but in skill and perfection of product as well.

The Maryland Coal Company have recently completed a new fan for their mines which is supposed to differ in some respects from all others, but if we are not mistaken there are some fans greatly resembling it constructed in Great Britain. The shell is shaped something like what two saucers would look like if the bottom of one were taken out, the itake being only on one side. The fan is 16 ft. in diameter, and is not a complete spiral, like the ordinary fan, its blades commencing 2 ft. from the centre of the shaft, wider at this point and gradually tapering down to a square end the width of the shell. The vanes are fastened to arms which are securely braced to an octagonal spider-web-like frame surrounding a shaft 4⅜ in. in diameter. The blades at the edge next to the shaft are curved slightly upwards, the curve inclining towards the outer end of the blade, this being expected to aid in the suction of air from an intake 6 ft. 5 in. in diameter, and also to add to the forcing power. It is intended that air shall be delivered at a high velocity. The intake is covered by a small building, and protected by wire netting to keep out flying leaves, etc. The air flue increases in size from the fan to the width of the mouth of the mine,

and is air-tight on the inside of the flue. Attached to the top of the flue is a flexible shutter, adjustable by rope and tackle, which can be drawn around under the bottom of the fan to any required distance, thus giving complete control of the draught. We are not supplied with any particulars as to the performance of this fan—the amount of air delivered within a given time, etc.; but perhaps no accurate tests have yet been made.

A new explosive, intermediate in power between nitro-glycerine and ordinary blasting powder, is described in a German contemporary. The powder consists of a mixture of the nitrates of sodium and potassium with sulphur bichromate of pottassium, and coal tar. The latter constituent renders the explosive impervious to damp, and holds the whole together. The proportions used are:—Sodium nitrate, 69 parts; potassium nitrate, 5 parts; sulphur, 10 parts; potassium bichromate, 1 part; coal tar, 15 parts. After mixing, the powder is compressed between warm plates, a proceeding free from danger since the temperature of ignition is at least 660 degrees Fahr. Taking ordinary powder as 1, the power of the new material is 4·9 to 7, nitro-glycerine being represented as 9.

The Hooley disclosures in London are fresh evidence that the evil practices justly ascribed to American mining men are of actual existence across the sea. The latest expose calls to mind the Londonderry mine, Coolgardie, West Australia, the original English purchasers of which cutely succeeded in unloading onto another English concern for $2,000,000. The new directors discovered they were swindled, but secured the publication of statement that "within sixty days five tons of gold would be won." Then they had a meeting, at which glowing reports were read, while the directors, sitting soberly around the board, had telegrams in their pockets that "the reef is barren of gold." The published accounts enabled them to unload, and, just after, the facts came out.

Last week, reports a B. C. contemporary, the Ashcroft stage brought $73,700 worth of gold from the Cariboo hydraulic mines, to Nelson, of which $53,500 was from the Cariboo Hydraulic mine, the result of the first run this season at that mine. The result was better by some thousands than was expected. The next wash-up, if the water holds out, will be very large. But for the great results the owners must wait until next year, when the Moorhead ditch will be completed and the immense reservoirs filled at Moorhead lake with two sets of giants working a mile apart on different parts of the great mine. Of the balance of the gold brought down one lot was $3,300, one $1,000 and one $1,900. These lots were from Horsefly and Barkerville, the results of the mill run on cement. At the Horsefly all is said to be very satisfactory and that the cemented gravel has yielded on an average more than twice as high as last year. This is only rumor, but it is now believed that the property is on a paying basis, and that work will be continued from now on. Mr. Ward brought down also $5,000 in dust, the result of three days' run in one part of the mine where they had to wash up on account of moving boxes.

Experiments have lately been made at several collieries with pipes varying in diameter from 20 to 40 mm. for determining the conditions necessary to secure efficient speaking tubes, and also for fixing the limits of distance through which verbal communications may be made, not only between two points, but also between several points simultaneously, and the following is an abstract of the conclusions arrived at by the "Zeitschrift fur Berg-Hutten und Salinen-Wesen:" The greatest distance to which a strong voice will carry distinctly through a straight tube, without branches, and in the absence of disturbing noise, is more than 450 metres, but it cannot greatly exceed 500 metres. There is a certain relation between the length of tube and its inside diameter, one of 30 mm. being suitable for a simple tube up to 200 metres long; but above this length the diameter must increase up to 52 mm. Tubes of much more than this diameter or less than 20 mm. are not to be recommended, and the larger the diameter the stronger must be the voice and the clearer the articulation, words rich in vowels being transmitted more readily, and long vowels being distinguished more easily than short. Zinc is the best metal for a speaking tube, owing to its slight elasticity; but for signals transmitted by knocks iron covered with zinc is preferable. A socket joint is best, because the tow used in collar joints must necessarily project into the tube, thus causing reverberation, and the inside of the tubes should be as smooth as possible, while changes of diameter should be gradual, and sharp curves should be avoided. Tubes for speaking should bear upon masonry for diminishing vibration, while if they have to serve for transmitting knocks they should be hung freely, and the latter method is best for signalling to a long distance, a whistle not carrying far.

In a study of deep coal mines in Prussia in the "Revue Universelle des Mines" M. E. Tomson describes the largest hoisting engine in use in that country. It is intended to hoist from a shaft 800 metres deep, and will raise a load of 4,400 kilogrammes, in addition to the weight of car, &c., at a speed of 10 metres a second. The engine is of the vertical compound type, and works at a boiler pressure of 180 lbs. There are two drums, each of which will carry 900 metres of cable, mounted on parallel shafts.

Following are the shipments of Canadian Crude, and refined oils reduced to crude equivalent, over the two railways for the month of July:—

GRAND TRUNK.

Crude.	Refined.	Equivalent.
11,040 bbls.	5,520 bbls.	24,849 bbls.

MICHIGAN CENTRAL.

1,465 bbls.	2,693 bbls.	8,198 bbls.
		33,037 bbls.

For colliery purposes wire ropes are now almost universally employed, although aloe and hemp ropes are also occasionally used. The aloe fibre is stronger and more elastic than the hemp, and there is a further advantage in the use of aloe ropes, viz., their increase of tensile strength in damp shafts, which, according to a continental contemporary, is the reason that even now aloe ropes are almost solely employed in Belgian collieries, even for the greatest depths.

The opinion held by many that hemp or aloe fibre ropes cannot be used for winding from deep shafts only refers to tarred ropes, and it is owing to the increased weight due to the tar that gives steel ropes the advantage over aloe or hemp ropes; yet so long as the ropes are not tarred they can be used for equally deep shafts as steel ropes, the length of free hanging rope at which it will break by virtue of its own weight being, approximately, for a

Plough steel rope	64,000 feet.
Crucible cast steel rope	40,800 feet.
Aloe rope	39,000 feet.
Tarred hemp	19,500 feet.

So that, using a factor of safety of six, and assuming the ropes have to support their own weight only, and are of uniform section throughout their whole length, an aloe rope could be used for a shaft of 6,500 feet deep, a crucible steel rope for one 6,800 feet deep, a tarred hemp rope for a 3,250 feet shaft, and a plough steel rope for a shaft having a depth of 10,670 feet. In manufacturing winding ropes it is now customary to

increase their strength by making one end thinner than the other, commencing at the thin end, and adding one or more wires every fifteen or twenty feet

The steel ropes employed have tensile strengths varying from 80 to 110 tons per square inch, the latter figure being for plough steel ropes. Their section is generally circular, although flat ropes have been largely used on the Continent, although from published statistics we find round ropes to be much more affective as compared with the flat ropes, the maximum work done by round ropes, before being replaced, reaching nearly eight times that done by flat ropes; and in one mining district during the period of fifteen years, dating from 1882 to 1896, 29 out of 1,525 crucible cast-steel ropes replaced broken suddenly while in use; 1,379 of the replaced ropes were round, and of these 19, or 1·38 per cent. broke in use; while the remaining 146 ropes were of flat section, 10, or 6·85 per cent., of which fractured whilst in use.

S. Diescher, in a paper read before the Society of Engineers of Western Pennsylvania, states that the best results, having regard to both strength and durability, have been obtained with ropes made of crucible steel wire having an ultimate tensile strength between 160,000 lb. and 170,000 lb. per square inch of section, with an elongation in length of 12 in. of about 4 per cent. Three of these ropes were in use on inclined planes for three, four, and five years respectively, the last one being still in service after 51,000 miles travel. The various strands of one rope were tested separately after it was worn out, and showed strengths ranging from 108,000 lb. down to 27,000 lb. per square inch.

CORRESPONDENCE.

The Mineral Wealth of Cassiar.

On either side of the Stikine river you will read the legend "unexplored" should you consult an honestly prepared map of Cassiar; it is only on the highly imaginative and quite unreliable plans published by transportation companies that you would find ranges, tributaries, glaciers and lakes set down with the presumption that is the handmaiden of of ignorance. The truth of the matter is that although miners have been working in the Dease Lake country for more than twenty years, the difficulties of transport, once off the main trail, have been such that they invariably failed to penetrate the maze of mountains separating the Stikine, Tarrzilla and Dease from the Pelly to the north, and from the Skeena and Peace rivers to the east and south. It is probable however that the next five or ten years will witness the opening up of these vast tracks, though the explorers will have to be men of a different stamp from those who formed the rank and file of the mad Stikine rush of 1898. Out of 7,000 men who left Wrangel during the months of March, April and May, of the present year, scarcely twenty-five per cent. knew mica from gold, nor quartz from calcite, and not one in every score had any experience in mining. They were merely the froth, the flotsam and jetsam of civilization—as useless on the Stikine as they had previously proved themselves in older regions.

Knowing this one ceases to wonder at the barren results, so far, of the said rush. It is hardly possible that so many promises of mineral deposits should all remain unfulfilled, and I believe Cassiar will yet be an important link in the grand chain of mining camps now being forged from Kootenay to Klondike.

From its mouth at Rothsay Point to the Little Canyon the Stikine flows for eighty miles through a trough in the Coast Range. The prevailing rocks are all granitic, and seem to have been thrown up since the Carboniferous, at least they burst through strata said to be of that age above the Canyon. Absolutely no prospecting has been attempted in this part of the Coast Range. The mountains are grim and forbidding in the extreme, glaciers, filling many of the valleys, and vast snowfields crowning the heights. The interval lands bordering the river are, however, covered with a luxuriant growth of vegetation, groves of cottonwood containing trees with a growth of 12 feet, extending for miles, with a uniformity of species only to be found in northern latitudes. Under these groves a dense underbrush of vine maples, devils' club and other shrubs makes travel extremely slow and arduous. Judging by what can be seen from the river by the aid of a good field glass there must be some excellent prospects in this very Coast Range, for strong veins of quartz and porphyry, and many igneous dikes are to be seen cutting the exposed faces of the cliffs bordering the river.

Singularly few tributaries enter the Stikine during the last hundred miles of its course to the sea. By far the most important is the Iskoot, and hardly anything is even known of it, save from Indian report. It heads about 60 miles south of Telegraph creek, in a plateau country 3,500 feet above the tide. No one, so far as I could learn, has ever succeeded in ascending the river, though half a dozen men managed to get to its headwaters from Telegraph creek this spring. They reported a country highly mineralized. In two days one prospector made several locations, his specimens showing free gold, though not in any great quantity. In time a camp will doubtless spring up at the head of tributary, but the miners will have many difficulties to contend with as the only practical route in seems to be over a pass 5,000 feet in height, open for but 10 or 11 weeks in each year.

Nothing could be learned of the country traversed by the Scud, another tributary falling into the Stikine just below the Little Canyon. It is supposed to head close to a tributary of the Iskoot, and seems to promise an easy passage into the valley of that stream, and moreover, at a point where no white man has yet penetrated.

The Clearwater joins the Stikine above the Kloochman Canyon. It is well named for its waters are deliciously limpid, contrasting with the silt-charged flood of the larger river. It evidently does not wash banks of glacial gravel or it would not be so clear, but possibly flows through a slate formation, and moreover through one that might well prove auriferous. Indeed it was reported that Indians had found free gold on this stream last May; a squaw, so the rumor went, having hammered several flakes out of a piece of float stab used as a hand-junk in the camp fire. Be that as it may, I certainly think the Clearwater worthy of careful study. I must not omit to record that there are hot springs on the left bank of the Stikine below the Little Canyon and facing the Great Glacier. This might be a good place to prospect as the favorable effects of hydro-thermal action are acknowledged.

It is, however, in its upper reaches that the Stikine invites the first attention of the capitalist. While not a poor man's country, and hence quite unsuitable for most of those who found their way there this spring, powerful companies could hardly fail to find remunerative investments. From below Glenora to a point above the Tooya, a distance of 36 miles in an air line and perhaps a third more following the windings of the river, there are many fine exposures of the ancient river bed, copper by a heavy flow (sometimes indeed by three distinct flows) of tertiary basalt, that has saved it from destruction during the glacial period. On these basalt floors are huge granite erratics deposited by ice since the flows were ejected and had cooled. Underneath these old gravels are slates on edge and almost vertical, evidently the ancient channel of the Stikine when it had a much greater fall but ran at a higher level that it does today in the section in question.

These old gravels are from 50 to 75 feet deep with a basalt cap varying from 50 to 150 feet thick. As usual they are water-soaked, springs issuing from the rim of the exposed slate bed-rock at frequent intervals. The exploitation of these old channels was utterly beyond the old hand-to-mouth Cassiar miners, and their presence was not even suspected by the frantic haste that over-ran them last spring, but

to mining engineers accustomed to drifting in the vaster Californian deposits of a similar nature these Stikine gravels would be a simple proposition.

Gold may be found in any panful of gravel taken hap-hazard from these gravels, It is generally leaf gold, but not always, and it is immediately below of these exposures that coarse gold has been found so far in the Stikine itself. Dr. Dawson has pointed all this out in his masterly report on the Stikine; all I can add is that several weeks spent hammer and pan in hand in that very region this year have convinced me that had he remained longer studying those old gravels with their protecting cap he might have put the case even more strongly than he did.

These observations almost exhaust the little I know of the probable mineral wealth of the Stikine, ror except beds of good lignite up the Tooya and Tahltan I know of no other occurrences of mineral. The Dease Lake country is, however, undeniably richer in the precious metals than the Stikine. Millions were taken from the creeks flowing into the lake and into Dease River, from the north, during the seventies, and the gold was very coarse; "like musket balls" one old sinner told me, and allowing for the usual personal equation of error and for the glorious imaginati.. of the real old-time prospector, that means pretty coarse gold. Cariboo waited many years for an audience with King Capital. Cassiar is yet kicking her heels in the anti-chamber; but her turn cannot surely be much longer put off.

McDaine, Thibet, Defoe and Dean creeks are none of them exhausted. The high gravel banks can certainly be handricked in many instances; ditches could be made to bring water to bench claims that would repay the outlay; and dredging ought to pay handsomely on more than one water course that I know of. When men can make $3.50 to $5.00 a day with 36-foot sluices, working alone, it needs no profound knowledge of mining to predict that the gold-dredger will soon be operating in northern Cassiar, notwithstanding that freight rates to the lake are as yet 13 cents a pound from Victoria or Vancouver.

Frozen ground does not exist now in the Dease Lake country, though it is said to have interfered with the first operations. There is plenty of timber for props and such, but very little over eight inches in diameter. The climate is a magnificent one. During the summer the days are long, clear, and hot. Very little rain falls except at the head of Dease Lake, and on the seaward flank of the coast range below the Little Canyon, so that camping out would be an uninterrupted delight were it not for the hosts of blood thirsty mosquitoes that make existence insecure during June and July. Last winter the lowest temperature recorded at Dease Lake was 30 degrees below zero, but some seasons it is very much colder than that, though the glass never, I believe, falls as low as it does on the Yukon.

CHAS. A. BRAMBLE.

VANCOUVER, B.C., 1st Aug., '98.

Hastings' Mispickel Ore Deposits.

SIR,—In your July issue in article on "The Gold Fields of Canada," reference is made to the mispickel deposits in this vicinity and the form of deposits are described as being that of "gash views,' if this is realiy so, your paper with its well known candor would of course say so, but I very much doubt your upholding a wrong impression, even if it is, as this idea of "goch viens" is, viz, nearly 30 years old. I speak of my own property only, as being that on which most work has been done on the eastern side of the county. I have had my property examined by a man that informed me that he was a geologist, and who at one time held the position of Geologist to the State of Minnesota, who had worked on coal veins in West Virginia, for United States Government, and on deposits of iron ore on Lake Superior, etc. He describes my property in the following language, viz :—

"Developments on your property makes a showing of larger deposits or veins of mispickel than any yet opened or known, and many other veins on your property have larger outcrops than any other surface indications elsewhere, these are separate from those having the developments, these latter give every indication of being able to sustain large output, three large veins are known, have every appearance of being true fissures difficult of tracing for any considerable distance, being eroded by glaciers and covered by debris."

In the same issue is an article on "Mining in Ontario," in which reference is made to "Ontario's large mispickel deposits," may I ask where are these large mispickel deposits, if not in this district.

My object in writing you is that if this district is worthy of a better reputation as a mining district than the one it bears, it may receive fair play.

Yours, etc.,

JOSEPH JAMES.

Actinolite, Ont., 2nd August, 1898.

A New Detaching Hook.

The following is a brief description of a new detaching hook for the prevention of over-winding, invented by Mr. T. Grundy, and recently tried with successful results at Victoria shaft, Thames, New Zealand :—Bearers were placed across the poppet-legs close under the pulley, and carried the circular cast-iron sleeve to bring the action of the hook into play. The trials made were in every way satisfactory, and the invention appears likely to be a very successful one. The hook consists of two outside steel cheeks, about 15 in. by 6 in. and ⅜ in. thick, rounded at the top and having projecting corners at the bottom. Within these are two other plates about 10 in. long and ½ in. thick, the four being bolted together by a 1¼ in. bolt, forming the pivot on which they work. The inner plates are locked by a locking-bar, held up in position by a spiral spring below, so that when ordinary winding is going on the rope cannot escape from the hook. This locking-bar projects from each side of the cheeks of the hook, and in over-winding are pressed down by the lower edge of the sleeve before mentioned. This releases the two inside plates, which are forced apart, leaving an opening at the top for the escape of the link of the winding rope, and throwing out two projectionr which catch on a circular ledge inside the sleeve and hold up the cage. At the same time a locking-pin falls into a groove in the upper part of a hook and prevents any movement of the plates back to their former position. This pin is an extra safeguard. The locking-bar is so made that a knock on one side will not displace it. It requires to be moved down on both sides at the same time, so that the hook cannot come into action by an accidental blow in any part of the shaft other than at the sleeve. The hook is released in a very simple manner. The link of the rope is placed into the hook, the locking-pin above is lifted by hand, the jaws of the hook forced together by a cramp, and the locking-bar below then flies into position by the action of the spring, and locks the hook round the link of the rope before the cage has time to get away. The advantages that appear evident in this hook are the reliability with which it worked during the trials, the absence of any copper which requires to be sheared off by force, the fact that the weight of the cage is held up on projections below the bolt on which the plates work, and especially the ease and rapidity with which the hook is released and is again in working order.

A special meeting of the Council and Library Committee of the Canadian Mining Institute will be held in the library of the Institute, Montreal, on Friday evening, 9th instant.

Copper and Pyrites in Newfoundland.

ROBERT H. JONES, F.S.A., London, Eng.

Copper is the chief mineral product of Newfoundland, where its known abundance and the richness of the mines which produce it have caused the island to be numbered among the great copper producing countries of the world. There is scarcely any part of the island in which this mineral cannot be found, although it occurs in the greatest profusion on the northern and eastern shores. The principal forms in which it is found are the yellow sulphuret, gray ore or tetrahedrite, copper glance (chalcocite), copper pyrites and the silicate. Erubescite, or the peacock ore, is occasionally found, but more rarely. As long ago as 1778, an ore of copper was worked at a place called Shoal Bay, and although the works were probably not of much importance, their old reputation still survives. Shoal Bay is an extremely wild place, and when I visited it, in 1893, an old man, who lived there, told me that it was still full of copper, but it certainly did not strike me as a copper locality.

Native copper frequently occurs and nearly always has some proportion of silver mixed with it, but the gold is mostly found in the sulphuret about Bett's Cove and the adjoining mines. Lumps of native copper are sometimes found with vitreous ore in parts of Placentia Bay. It is also found near Blue Mountain Tolt. I have frequently found good specimens at Port-au-Port, and on one occasion came on quite a bed of it, in very remarkable forms, mixed with pellets, discs, and spherically shaped lumps of pyrites and marcasite, ranging from the size of a pea to lumps as big as an orange, some of which were quite brilliant, but nearly all dull and oxidized. Here they lay about the strand, as thick as pebbles elsewhere, and could easily have been shovelled up into a boat. Some very remarkable specimens I carried away and now retain in my cabinet. These had all evidently been washed up by the sea under which the main deposit lay.

On many other parts of the west coast, the ores of copper can also be found, though a far richer field in which to look for them lies on the northern and eastern shores from Conception Bay to Cape Bauld in the far north, on every part of which copper can be met with. The main industry now lies in the region around Notre Dame Bay, Little Bay and Hall's Bay.

In 1880, Professor Stewart of New York visited this immediate neighborhood, and in a lecture subsequently delivered by him in St. John's, spoke of the copper to be found at Notre Dame "as a beautiful yellow sulphuret, free from arsenic or any undesirable ingredient, with a little iron and containing from eight per cent. of pure copper." He had never, he said, seen finer ore in the course of his experience. The character of the rocks in which it occurred was such as to give an absolute assurance of perpetuity in the working. These rocks were metamorphosed and laminated, and the extent of the mineral indications over extensive areas were such as to render exhaustion in the working a practical impossibility. Between Little Bay and Hall's Bay, he and his friends had traversed a region over and about which they had seen so much copper that they were fairly surfeited. Before visiting the country he had heard there were some copper mines to be seen, but when he got there he was astounded at what had been done in the short space of five years, during which copper ore had been extracted to the value of four million dollars, while about one million dollars had been spent on mining plant alone. Looking to the future, he had every reason to believe that Newfoundland was destined to become one of the greatest copper producing countries in the world, and that this industry alone would yet raise it to a very high place.

All the mines which have been opened about Notre Dame Bay have, without exception, proved to be very rich in minerals, and there is scarcely any part of its seaboard or of the numerous contiguous islands, which do not show very valuable indications. Respecting the discovery of the first mine, a story is related which savours strongly of that of the Boer and the first diamond found at Kimberley. In 1857, a Mr. Smith McKay, presumably a Scotch prospector, going into a fisherman's hut, in the little fishing village of Tilt Cove, saw a yellow stone, which the children had been playing with, lying on the mantle-piece, and this he learned had been picked up at the foot of the cliff. Naturally, the fisherman knew nothing of its value, but the canny Scot saw at once that it was a sample of the very ore he was looking for. After an inspection of the place, he started back to St. John's and secured a mining license to work it. Then, in conjunction with Mr. Bennett, who is now called the pioneer of mining enterprise in Newfoundland, he went back and commenced the first copper mine in Notre Dame Bay. This proved a great success and has since become very celebrated in the annals of copper mining in the colony. At the close of 1879 it had exported to the United States as much as 50,000 tons of copper ore, of the value of $1,572,154, with nickel worth $32,740.

Much of this was low grade ore, but it is especially worthy of note that it is mainly from this class of ore that the gold found with it is obtained and which, in one year, amounted to £10,000. This mine is now operated by the Cape Copper Company, and produced last year as much as 70,000 tons. A point worthy of note is, that in smelting the ore, quite an appreciable quantity of gold is found in the slag which remains in the bottom of the furnace, but unfortunately, both for itself and for us, Newfoundland has never sufficiently cared for its mineral resources to organize a mining bureau, from which authentic returns of its mineral produce could be obtained.

In 1875 another mine was opened at Bett's Cove, about a dozen miles farther off, which proved to be even a greater success than that last named. In the course of four years this mine yielded ore to the value of $2,982,836. Here, in one place, the workmen came upon a solid bed of copper 60 ft. thick. Strange as it may seem to any but a miner, these men have no liking for such prodigious masses of metal, because of the endless labor required to cut them into such pieces as can be easily handled. In many places the rocky matrix is full of small pieces, or even of shot copper, such as I found on the shore of Port-au-Port, which of course is infinitely easier to work. The Bett's Cove mine also has always been found remarkably rich in the precious metal, and some time ago smelting works were erected here on a small scale to preserve this, when the manager told Mr. Howley that he could always detect the presence of gold in the ore by the color of the flame when smelting was going on.

This rich mine has, however, met with a somewhat chequered career, sometimes brought about by low prices, or on account of the expense of exporting the green ore, but more frequently by reason of incompetent or injudicious management, as in the present case, where the climax of mistortune would seem to have been reached, when its managers, finding themselves hurried to complete shipments and to avoid heavy demurrage, resorted to the desperate expedient of cutting through the supporting pillars of solid metal, which brought about the result of the surface soil caving in and burying the workings. This, in addition to the resulting damage, has caused the forfeiture of the lease. Still, however, abundance of ore remains in the mine. In one shaft alone, which is still left intact, 4½ ft. of copper can be seen at the foot of it, and plenty more is to be got from the old workings by driving from the cove outside.

Other rich mines have also been opened, Little Bay, for instance, the richest of all, which has produced an average yield of 20,000 tons of ore per annum; and the mine on Rabbit's Arm is believed to be still richer, though, as yet, it has only been opened sufficiently to prove the fact.

Among that great group of islands which fronts Notre Dame Bay, there is one named Pilley's Island, which is specially noted for a remarkably fine quality of iron pyrites This mine has been in active operation for many years, without showing any signs of exhaustion ; and the quality of the mineral produced is shown by the fact that the ore yields as much as 52 per cent. of sulphur, after the extraction of which the blue billy, as the residuum or cinder refuse is called, forms a valuable by-product, used in the manufacture of steel, and commands a higher price than similar cinder elsewhere. The workings are very extensive and complete, and close adjoining is another large deposit of very similar ore.

In 1887, the export of iron pyrites from this mine amounted to no more than 410 tons. In 1894 it had increased to 38,214 tons, valued at $195,780 ; while in 1898, the amount exported to the United States, where it is used in the manufacture of sulphuric acid, etc., was 36,496 tons.

Every part of this eastern shore is wonderfully rich both in copper and pyrites, while the coast round about Green Bay, White Bay and Hare Bay is unusually rich in this class of ore ; but although pyrites especially seems to abound in all parts of this region, no mine yet opened can equal that of Pilley's Island in this special production. Up to 1879, the ores exported from all the mines reached nearly a million sterling. In 1891, the amount exported was $624,750 and the following year it reached $1,006,592.

After making a tour round the coasts, to consider the varied nature and position of the deposits, we are struck by the very curioua fact that whereas the form of the island somewhat approaches that of a rudely irregular triangle, of which the south-east and south may be considered the base and the north the apex, each side of this triangle has not only special geological features, but a totally distinct climate and generally different natural and mineralogical productions. The wide-spreading base, for instance, rugged, wild and sterile, is largely composed of the Huronian, Lower Silurian and Laurentian formations, but because it directly confronts the Grand Banks it is, more than any other part, subject to the obnoxious influence of the dense foggy mists generated on them and the constant humidity of the atmosphere is sufficiently indicated by its flora. When first essaying to climb one of the steep rocky hills, I was attracted by a broad patch of a blood red colour, to which I naturally directed my steps, when I found it was caused by a wide-spread growth of that little vegetable cannibal, the common Sundew, *drosera rotundifolia*, which was flourishing among the sphagnum, its long, thread-like roots moored amongst the latter's stalks ; and as the ground got more marshy, among the softly yielding moss as full of water as a sponge, were vast multitades of the curious side-saddle plant, *sarracenia purpuera*, one of Nature's marvellous machines for distilling water, the amphora shaped leaves of which are so commonly seen in all the great swamps of the northern United States.

In and about these sterile hills are considerable patches of pastoral land and many delightful prospects, but the Newfoundlander cares for none of these things ; he will build his house and set up his flake on any rocky eminence, no matter how hideously barren it may be, even if every drop of water has to be fetched from the mainland, provided only it be convenient to the fishery, which is the one paramount consideration for which all else must give way. On one occasion I came across a delightfully pleasant place, a veritable pastoral oasis amid a sterile desert of naked rocks, where I saw a novel method of removing haycocks from a field by the aid only of a loop of rope, the two ends of which were attached to a horse's collar.

Here the chief mineral deposits are argentiferous galena, lead, the sulphuret and carbonate of copper, antimony, graphite, molybdenum and manganese.

Then as we approach Cape Ray, the angle of the south-west and swing around to the western shore, we find ourselves in an altogether different climate, under the influence of the Gulf Stream. Here we are beyond the reach of fog, in a genial sunny land, where the air is balmy and delicious and the climate in every respect like that of England, except that it is not so liable to frequent and sudden changes. This is by far the best part of the island. The land is rich agricultural land capable of maintaining 200,000 people, but so shamefully neglected by the authorities that there is not a road in the place, and with the exception of a handful of fishermen or lobstermen who make use of their boats, all is waste and desert.

We are now in the carboniferous region, among which there is an enormons wealth of coal and iron, with numerous indications of petroleum. We have accordingly a long stretch of carboniferous limestone, conglomerate, and metalliferous calcspar, with forests of primeval timber. Then as we approach Port-au-Port, with its many curious coves and fantastically water-worn rocks, we see Bluff Head looming up in the distance in a purple haze. This is a great mass of serpentine overlaid with sandstone, and forms here the commencement of the Lauzun division of the Quebec group of rocks, the true metalliferous zone of North America, the chief components of which are serpentines, dolomites, diorites and chloritic slates, among which are found gold and nearly every other mineral that can be named.

From this point onward, after leaving Boune Bay, we approach the bleak region of the north, towards the apex of the triangle at Cape Bauld, and then run down the wild eastern shore, the climate of which is affected by the icy current from Baffin's Bay, running through the Labrador, and consequently is altogether changed, while the flora is so deteriorated that it is practically reduced to dwarf spruce and stunted birch, which caused a reverend missionary, who once visited this coast, to stigmatize the whole island as "a land of rocks and Christmas trees," though even he must have admitted that this bleak region was not without ample compensating advantages, in view of the rich abundance of seals obtained there among the ice of spring and the great wealth of the economic minerals got from every part of this eastern shore.

Practical Cyanidation of Tailings and Ores.

By ALFRED S. EDGECOMBE, Vancouver, B.C.

I do not propose, in these few notes, to give an academical treatise on the cyanide process, but a few remarks on the practical treatment of tailings and ores gained by some years' experience in Australia as manager of the largest plant erected there, also owner of smaller plants such as would be practicable to erect in Canada at the present time, where the development of mines producing free milling ore is not so advanced as in Australia.

Cyanide of potassium has, for very many years, been known as a solvent of gold, but until Rae, Simpson, Elkington—followed later by McArthur and Dr. Forrest—took advantage of its great affinity for the noble metal, it was not adapted to the treatment of large bodies of ore on a commercial basis, more especially in South Africa, Australia and other countries, and there is no doubt that in the former country it has proved the salvation of the mining industry. In parts of Canada it may yet play an important part, more especially where the ore is not of a basic character. The presence of zincblende, or oxides of zinc, in an ore, is fatal to the process, as when the gold is dissolved by the cyanide it is precipitated again on the zinc contents of the ore and lost when the vats are discharged. Sulphur, as contained in pyrites, or as forming free salts, decompose cyanide, but can be neutralized by the addition of an alkaline solution of caustic potash or lime, the latter being objectional owing to its deleterious effect upon the zinc shavings in the extractor. This entails a greater expense both in money, time and water required for treatment. The presence of a small percentage of

copper pyrites in an ore is detrimental, but not an unsurmountable objection as was at one time thought; a novel, but very successful, mode of treatment will be explained later on.

Treatment of Tailings from a Battery.—The ore is crushed by the ordinary California stamp mill and passed through a punched screen of 225 holes per super. inch; this results in tailings which will pass a No. 40 sieve in a dry condition, or is practically the same as being passed through a 1600 woven wire battery screen. From an amalgamating point of view the punched screen is preferable, as the "burr' arrests the passage of a great part of the coarse gold which accumulates in the battery boxes, amalgamated with the mercury placed there for that purpose. After passing the screens, the coarse gold which escaped the boxes is caught on the amalgamated copper plates, in the riffles and on blankets, most of the finer or flour, and the paint gold floats away and is pumped up by the tailings pump, but again settled in tanks placed for that purpose on the tailings heap; from there the light slimes pass away to the settling pits, the clear water returning to the dam for further battery purposes. Where there is a plentiful supply, the water and slimes may pass away to waste. The tailings from the above treatment contain but little slimes and these can be disposed of by a mode of leaching which will be described later on.

Another mode of crushing is by Ball mills. The ore is crushed dry and passed through a woven wire screen of 900 or 1200 mesh, and transferred direct to the ore vats, but this means of treatment is not to be recommended for several reasons, primarily, as it creates a large percentage of slimes in the ore when a fine screen is used. Too much stress cannot be laid on this phase of the process, as will readily be understood by practical men. Laboratory tests are all very well in their way, but for cast iron facts give me the experiences of those who have had difficulties to overcome in treatment, on a large scale. In one case the writer crushed this way, and after getting the solutions on the ore could not leach them, after trying all known methods apart from agitation and decantation, and that—by the way—is not leaching. Again, the saving of gold by ordinary battery amalgamation is deleted, and this is a most important point. The ball mills will also crush by wet method, but are not so advantageous as the old stamp mill. Rolls have the same disadvantage of creating slimes. The direct deposition of wet ores into vats has been tried, but they form a compact mass, thus resisting percolation, owing to the slimes they carry. From the tailings heap the ore is conveyed into the vats for treatment, and well tamped down, especially around the edges, as the solutions flow down the sides in an improperly charged vat.

Description of Plant.—The vats are built in circular form; the staves are 6 inches wide by 3 inches thick and 6 feet deep, grooved for the insertion of the bottom boards and a chime of 12 inches left. The diameter is 16 feet, and they hold a charge of 50 tons of free ore, with sufficient space for solution. They are constructed on piles and a framework so as to allow free access underneath. The staves are banded together by 1¼ inch round iron hoops made in three sections and screwed up tight by bolts and sockets specially designed for that purpose. They are fitted with filter beds made by nailing strips of wood along the bottom 1 inch apart, over which is placed cocoanut matting, and on this course bagging secured by a rope gasket around the edges On this are placed shovelling boards of 4in. by 1in. lumber, to prevent damage to the filter cloths. Some operators prefer the use of a filter made of coarse and fine gravel, others an asbestos cloth, but the writer has always found cocoanut matting very effectual and easily taken up to clean. The use of a good, efficient filter is a very important matter. The vats are inclined slightly to one side to allow the solution to drain to the pipes. A plug-hole is bored in the centre to draw away wash waters and alkaline solutions by a launder. Cast iron discharge doors, about 18 inches diameter, are inserted each side to shovel the residues out; these doors are luted to prevent leakage. The vats should be painted inside with parrafin paint to resist absorption of the gold solutions. The series of iron pipes, 3in. diameter, consist of water, alkaline and cyanide supply, and a discharge service. The ore vats are erected in one or two lines acoording to site and requirements. When the ore is being dumped into the vats a general sample is carefully taken for assay. The solutions are then run on and vary according to the ore under treatment, *i. e.*, an ore containing acids and slimes first receives a water wash to remove free salts and a portion of the slimes; next, an alkaline wash to neutralize the acid contents; then, after testing to see that the ore is "sweet" and in a suitable condition, the strong cyanide solution is run on at a strength of say 0.2 per cent., and is left to dissolve the gold for a space of 12 hours in free ore, or a higher percentage and longer time is necessary for a more basic substance, such as concentrates or a heavy pyritic ore. The drainage faucet is then opened and the cyanide and gold in solution allowed to run to the extractor boxes. A weak solution of cyanide is then run on, afterwards a final wash of clear water to remove and recover all the cyanide solution. After which the vat is drained and emptied by hand labor, or preferably by sluicing out with water where it can be obtained in sufficient quantity, thus effecting a saving of at least 25 cents per ton of ore. The residues (ore after treatment) are also carefully sampled for assay. It is a good plan to take samples of residues from different parts of the vat occasionally, such as the bottom, top and sides, so as to ascertain if the extraction has been equal; if it has not the vat has been improperly filled, probably not tamped sufficiently or evenly. Before leaving this portion of the subject I should like to mention that it is here great difficulty arises in treating an ore impregnated with slimes, which causes slowness of percolation, an unsatisfactory state of residue and much loss, both of cyanide and gold, as, although the latter is in solution, it cannot be extracted owing to the impossibility of leaching, and must be discharged with the residues. If the slimes are caked or in lumps, they must be extracted from the ore by screening, and pieces not larger than a nut allowed to enter the vat; if in a fine state distributed through the ore, it does not matter so greatly, but in any case they are detrimental to ease of working. The writer has found it a most excellent plan to adopt upward percolation, which may be attained by elevating the water supply about 12 feet above the level of the top of the ore vat and introducing the wash waters from below, allowing it to overflow the vat, carrying with it the lighter slimes and opening up the compact mass, so as to admit the cyanide solutions to percolate with facility. This method is just as speedy as downward percolation through a perfectly clean ore, and its advantage is obvious This method of leaching on a large scale had not come under the writer's notice prior to his working same, some two years ago, but the results obtained from a heavily slimed ore were excellent. The auro-cyanide solution, in leaving the vats, is conducted by its special pipes to the extractor boxes, which are constructed of pine, in shape of a trough, 12 feet long, 2 feet deep and 1½ feet wide, divided into twelve compartments filled with bright zinc shavings. These shavings are turned in a lathe from discs of pure zinc, and should be as fine as possible to present a large surface, with little weight and are turned freshly before use to prevent oxidation of the bright surface. The compartments are so arranged that the solution passes downwards and upwards in alternate compartments effecting an equal and gentle flow. The gold is precipitated on the zinc in the form of a blackish-brown slime, the top compartment receiving the greatest deposition, and the others correspondingly less to the last, where only a faint trace is noticeable. In order, therefore, to ensure the zincs are not overloaded, the contents of the lower compartments are transferred to the higher ones at intervals. The bottom of each compartment is fitted with a screen of smut wire which lifts out carrying the zincs with it. A trough is fixed on the

bottom outside edge of the extractor, into which, at clean-up, the precipitates becoming detached and deposited on the bottom, are sluiced. A separate extractor is used for the weak solution, the precipitates being not so fine. The solution, after passing the extractor, runs into the bottom sump vats, and from here pumped to the upper sump, where it is made up again to full strength, or used as weak wash, as required. The strength of the solution, after performing its task, is about .08 per cent., so that the consumption of cyanide on a free ore is about 1 lb. per ton of ore of 2240 lbs The solution vats are made precisely the same as the ore vats except, of course, they have no filter beds or discharge doors. The cyanide contains from 60 to 99 per cent. of pure cyanide of potassium, the balance consisting of carbonate and cyanate of potassium and carbide of iron. It is advisable to use the purest description, thus dispensing with additional tanks for dissolving and filtering, loss of time and labor, and gaining a more satisfactory result from the chemical, apart from the fact that the impurities cost transport charges, which is a direct loss. The manufacturers analyze all cyanide sold, charging only for the pure contents, so that it is, for reasons above stated, far cheaper to buy the pure article. Theoretically. .043 lbs. of cyanide should dissolve 1 oz. of gold, but from a test of some 100,000 tons of ore treated, it was found that .99 lbs. were required to obtain this result.

The Clean Up.—After a fortnight or month's run, as deemed necessary, the "cleaning up" takes place: this is proceeded with as follows:—A clear water wash is passed through the extracter boxes to eliminate all the cyanide solution therein, then the zinc shavings are carefully lifted out from their compartments and conveyed in dishes to an iron sieve placed over a large tub on which is running a stream of clear water from a faucet. The zincs are then shaken and washed between the hands, after the fashion of washing clothes. This is all that is necessary to collect the precipitates which pass through the sieve into the tub of water below, and allowed to settle there. The zincs, which remain unbroken or in fairly good condition, are replaced in the extractors ready for the next run; the broken zincs, which consist of small particles up to several inches long, are kept separate to be dissolved in a tank containing dilute sulphuric acid. The consumption of zinc is caused, in a great degree, by caustic soda solution used to neutralize an acid ore. The precipitates are then collected, dried on an iron plate over a furnace, and then roasted in an iron muffle at a red heat, this volatalizes nearly all the zinc which may have passed in combination with the precipitates.

If the ore contained an appreciable amount of mercury lost from battery operations, it may now be recovered by looting on a door to the muffle, through which is passed an iron pipe terminating in water, thus converting the muffle into a retort until the mercury is distilled. The door is then removed to allow free access of air for oxidizing purposes. After roasting, the precipitates are fluxed with bicarbonate of soda, borax and silica, taken to the bullion room and melted in black-lead crucibles, size No. 30. A high heat is requisite to obtain a fluid slag. The resulting bars of bullion, varying in size according to the richness of the precipitates, from 30 ozs. to 200 ozs.; these are then run together into 500 oz. bars, clipped in two places, top and bottom, assayed and sold. It is essential that the bullion room be kept distinct from the laboratory, otherwise the results of delicate assays required for the residue ore, will be vitiated by the inclusion of slight particles of precipitate float in the air. The system of precipitation on zinc is the weak point of cyanidation, as here a loss of quite half a pennyweight of gold per ton of ore is encountered with ores assaying between 6 and 7 dwts. The Siemens & Halske process of precipitating by electrolitic action, is being worked in South Africa very successfully. The extractor boxes are constructed as above described, except that there are numerous divisions of sheet iron, which act as the anoid, and sheets of lead foil suspended and connected therewith, as the cathoid upon which is precipitated the gold. These sheets, at the clean-up, are simply removed and cupelled. It is claimed that a much higher percentage is obtained. In treating copper pyritic ore, where the solutions contain gold, silver and copper, the solutions are run through the extractor boxes where nearly the whole of the copper is precipitated; the solution is then made up to its original strength and passed through the extractors again, when the gold and silver contents are deposited.

Following are statistics of a run of about 90,000 tons of ore from a California stamp battery erected in Queensland, Australia :—

Weight treated per day	79.7 tons.
Percentage of acid in ore	0.24 per cent.
Water to remove acid and slimes, per ton of ore.	174 galls.
Average leaching rate per hour	0.93 inches.
Cyanide consumed per oz. of bullion	0.99 lbs.
Zinc " " "	0.26 "
Strength of cyanide solution	0.2 per cent.
Percentage on tailings	0.08 "

	Gold, dwts.	Silver, dwts.
Assay before treatment, per ton	6.45	30.45
" after " "	1.49	16.41
Extraction, per ton	4.96	14.04
Recovery, "	4.51	14.31
" per cent	68.3	46.9
Average fineness of bullion	.2243	.7275

Cost of treatment per ton, 7s 6d ($1.80).
Profit per ton.....12s 6d ($3.12).

Notes on Coal and Coke.*

By C. A. MEISSNER, Londonderry, N.S.

At a meeting of the Mining Society in this section (Pictou County) it will probably be interesting to give a few notes on coke and coal, especially with reference to the comparative benefits of washing the latter. My references are in the line of coke and coal for blast furnace use.

The Nova Scotia coals as a rule, are very well suited for blast furnace purposes, except that the ash is too high. To overcome this, washing is about the only remedy, and I think this has been pretty well demonstrated by this time, by the Luhrig washing plant at Ferrona, and the Robinson washing plant at Westville. As to comparative efficiency of these two plants I am not prepared to give any figures, though it would be a matter of very great interest to be able to make a comparison as to quantity of output per day and quality of coke, also data as to waste, and cost of washing. The difference in cost of erection of the two plants is very great, and in view of that the above data would be of very great interest.

Structurally, our coke here is probably not quite as good as the cokes in Pennsylvania, particularly the Connelsville and West Virginia; but the later results of washing all indicate that there is no difficulty in getting the ash to range from nine to fourteen per cent.

As to the increase in value brought about by washing, the following data gathered by Mr. Zirkler and myself at the time when our furnace was still running may be of interest; of course some of the figures have changed since then, prices of coal are different and the quality of the coke is very much better; ash is now much lower than it was then, as the data refers to the earlier stages of washing at the Drummond Colliery; but they will do as a matter of comparison.

A very interesting set of data on this subject however is given in an article written by Mr. R. E. Chambers, of Ferrona, some years ago entitled "A method of ascertaining the value of Iron Ore, Limestone and Coke for Blast Furnace Use." At the time my data were col-

*Paper read before the Mining Society of Nova Scotia, July, 1898.

lected the average analyses of these coals, washed and unwashed was about as follows:—

Comparative Cost and Value of Drummond Coal, Washed and Unwashed.

WASHED COAL.—Cost $1.49 per ton.	UNWASHED COAL.—Cost $1.17 per ton.
12 p.c. ash.	19 p.c. ash.
20.5 vol. matter.	19.0 vol. matter.
66.0 fixed carbon.	60.0 fixed carbon.
1.5 sulphur.	2.0 sulphur.
100.0 p.c.	100.0 p.c.

These figures are based on dry coal (212° F.); the washed coal would of course carry more moisture for which allowance in price would have to be made. The amount of moisture would have to be determined by analysis, or a certain figure could, by mutual agreement be taken as standard.

According to above analysis the theoretical yield of washed coal would be about 79 p.c. and the composition of the resulting coke would be about 83.50 p.c. carbon, 15.20 p.c. ash, 1.30 p.c. sulphur.

The unwashed coal would yield theoretically about 80 p.c. of coke and composition of this coke would be about 75 p.c. carbon, 23.5 p.c. ash, 1.5 p.c. sulphur.

If the price of washed coal is $1.49 per ton, the price of 0.79 ton of coke made per ton of coal, would be the same, and the price per ton of coke would be $\frac{1.49}{.79}$=1.886, only considering cost of coal.

The price of unwashed coal is $1.17 per ton, giving 0.80 tons of coke, and the ton of coke therefore at $\$\frac{1.17}{.80}$=$1.462.

As to the real value of the coke, the washed coke with 15.20 p.c. of ash, will require about 0.15 ton of limestone per ton, to flux this ash, and the resulting 0.19 ton of slag will take 0.076 of carbon to melt it.

Therefore from every ton of coke used we get:—

0.835c.—0.076c.=0.759c. T or 75.90 p.c. of available carbon at a price of

$1.886 (on account of coal)
$0.150 " " limestone)
$2.036

and the price of one ton available carbon out of washed coke=

$$\frac{\$2.036}{\$0.759 \text{ p.c. c.}} = \$2.682$$

23.50 p.c. ash in unwashed coke will require 0.395 T. of limestone per ton of coke to be fluxed and take 0.158 of carbon to melt the resulting 0.395 T. of slag, leaving an available carbon of 0.75c.—0.158c.=0.592c. T. or 59.20 p.c. at a price of $1.462 on acct. of coal

0.235 " limestone
$1.697

and the price per ton of available carbon out of unwashed coke is

$$\frac{\$1.697}{0.592 \text{ p.c.}} = \$2.866$$

These figures are only theoretical and in real practice we could not get such yields as 79 and 80 p.c. in our bee-hive ovens, but both coals would be affected in the same way and the figures of $2.682 per ton available carbon from washed coal, and $2.866 per ton available carbon from unwashed coal show about the right proportion of prices.

Another interesting little set of data that were made by us at the time the furnace was running, was on the question of raw coal in the furnace, which I give herewith:—

Our Drummond coke then contained on an average about 18 p.c. ash, while the Drummond lump coal showed about 19 p.c. ash; sulphur was practically the same in both. Volatile matter and moisture in the coal was 25 p.c., and the proportion of fixed carbon, neglecting sulpur, was: 83 p.c. in Drummond coke; 56 p.c. in Drummond coal.

One hundred tons of coke require about 15 tons of limestone to flux the ash; the resulting slag of 20.3 tons requires about 8.2 tons of carbon to melt it; the carbon thus remaining available for the furnace process is: 100 original coke less or (17 ash and 8.2 carbon=25.2) 100—25.2=74.8 available carbon in coke.

The cost is 100 tons of coke.....$350.00
15 tons of limestone... 15.00
$365.00

or per ton available carbon=$\frac{365.00}{74.8}$ = $4.88

One hundred tons of coal contain about 56 tons of available carbon; it takes 19 tons of limestone to flux the ash; the resulting slag of 23.3 tons requires 9.3 tons of carbon to melt and the carbon remaining available for the furnace process=56—9.3=46.7 available carbon in coal.

The cost is 100 tons of coal=$205.00
19 tons of limestone=$19.00—Total $224.00

or per ton of available carbon $\frac{224.00}{46.7}$ = $4.80

Now as we were then using the coal, we were replacing 100 tons of coke by 100 tons of coal while we could have afforded to use 160 tons of coal without additional expense because it required 160 tons of coal at 46 p.c. available carbon to be equal to 100 tons of coke at 74 p.c. available carbon, or to put it in another way:

74.8 tons available carbon out of 100 tons of coke are equal to
74.8 tons available carbon out of 160 tons coal, and the price is
74.8 x 4.88=$365.00 for coke carbon, and
74.8 x 4.80=$359.00 for coal carbon.

While apparently this would indicate quite an advantage in the use of raw coal, I think this advantage is entirely dependent on the quality of the coal; with a hard splinty coal such as they use in Scotland the advantange is very decided; with our soft coal here, however, I do not see that we gain anything particular by the use of them, except that at times when we are short of coke, the use of a proportion of coal tided us over without injury; I do not think it would have been safe to have continued any large quantity very long. In fact, at the time I judged that the only real value lay in the improvement of the gas, and I think that for this purpose it is well to always have coal ready for use in the furnace whenever the gas gets poor, and I have often wondered why it is not used more by furnacemen at times when the shortage of gas makes whatever troubles are occurring, much more serious. I think our soft coals really burn when thus put in the furnace long before they reach the melting zone, so that the greater portion does not do the work that the hard coke is expected to do in the furnace.

FIRE AT THE WORKS OF THE JENCKES MACHINE CO.—Later reports show that the damage to the works of the Jenckes Machine Co., at Sherbrooke, Que., by fire on the night of the 13th inst. was very much exaggerated. The fire was confined to the machine shop building, and the other departments, foundry, boiler shop, etc., were in operation as usual on the following Monday. A few days later a portion of the machine shop was started up, and the whole is expected to be in running order by the 23rd of August. The patterns, drawings and office records were preserved practically intact, and all orders for work will be accepted as usual. The principal item requiring replacement is the roof of the machine shop, which, however, is well under way. The whole of the work is being pushed with much energy and the numerous orders in hand will suffer comparatively slight delay.

Cyanide Experiments Upon Dry Ores of Southern Slocan District.

W. S. JOHNSON, B.A.; B.A.Sc., Slocan City, B.C.

INTRODUCTORY.

Now that the cyanide treatment of ores has become a recognized metallurgical process for the profitable extraction of silver and gold from various classes of ore not only on this continent but in Australia and Africa, where in the latter country it has added so much to the production of gold and prosperity of the country, it occurred to me that possibly the cyanide treatment might be applicable to the dry ores of this district, and the present paper is the result of some experiments that have been carried on during the past winter. It is not the intention of the writer to enter into the discussions of the theoretical side of the question, but to record results attained from a close attention to a series of experiments lasting over a period of four months; which to me seems more relevant to the furtherance of the practical success of any particular method of extraction than the hypothetical discussions indulged in by many writers in our mining journals, who probably have never carried out any experiments, but as soon as a paper is written giving results obtained from actual experiments, are ever ready to pull it to pieces.

During the prosecution of this work literature on the subject by Alfred James, Prof. Christy, Dr. Scheidel and A. Van Furman was consulted; and I wish to express my indebtedness to these gentlemen for the assistance their researches have given me.

The mode of procedure as outlined below is somewhat upon the same line as that given by H. Van Furman in Transactions of A.I.M.E., Sept., 1896. Wherever a departure was made, the advantage of such departure was first proved before employed.

CHARACTER OF ORE BODIES.

The ore bodies of the southern Slocan district may be divided into three classes:

I. Galena.

II. Dry ore bodies containing silver sulphide (Ag_2 S.) and gold with more or less iron pyrites (Fe S_2) in silicious gangue.

III. Silicious ore bodies containing gold.

I. Galena ore bodies are probably of the same origin as those around Sandon, and as they are smelting ores are foreign to this article and a more detailed description is unnecessary.

II. Dry ore bodies containing silver sulphide (Ag_2 S.) and gold associated with more or less iron pyrites (Fe_2 S.), zinc blende (Zn F_2), S., etc.

This class is a very important one and extends over quite a large area, beginning at 10-Mile Creek on east side of Slocan Lake and extending in a southerly direction to Lemon Creek: or that portion of country enclosed by 10-Mile and Lemon Creeks, which take their origin from a common source, and comprises an area of approximately 200 square miles.

This class may again be sub-divided into two sub-classes for cyaniding purposes—

(*a*) Silicious ores in which silver value is predominant.

(*b*) Silicious ores in which gold values predominate or of about equal value.

As the former sub-class is a smelting ore rather than one fitted for cyanide purposes, I will confine myself to sub-class (*b*).

(*b*) This class of ore is chiefly found along 1st and 2nd North Forks of Lemon Creek and vicinity, and as the main characteristics of this class are similar, a description of one will apply to all; but it must not be understood that the same treatment will answer for all, as each ore body may have physical and chemical composition differing from that of one near by, although apparently of the same composition, so as to necessitate a difference in its treatment.

As an illusfration of sub-class (*b*), I will take the Chapleau mineral claim, situated on the 1st North Fork, about 3 miles from its junction with Lemon Creek. This is a silicious ore, with silver sulphide, or argentite (Ag_2 S) (both in a fine state disseminated through the quartz and also in crystals) as well as gold; about 20 per cent. of the latter is free milling.

Shipping returns from three carload lots gave respectively $132.00, $141.00, and $85.00. Value ratios of silver and gold are as 1 :4.

III. This class of ores, dry silicious ores containing gold, mostly with a little silver alloyed.

This class of ore bodies lies to the south of Lemon Creek and extends across the summit into Ainsworth and Nelson divisions; represented by Golden Wedge, Black Prince, Alpine, etc. This class better suited for cyanide treatment than the above, being more granular, contains less basic constituents and little argentite.

The ores experimented with were from sub-class (*b* II.) and III.

METHOD OF PROCEDURE.

As the reliability of experiments of this kind depend to a great extent upon the methods adopted as well as upon the ability of the operator, it seems to me that an outline of the method of procedure is in place.

Ores of values of $40.00 and over, when not free milling, are better fitted for the smelting process than any other metallurgical process, other things being equal; and for this reason it has been my care to limit myself to a value of about $40.00 per ton.

Crushing and Assaying of Sample.—Of the various ores experimented with, a sample of 10 lbs. was taken, when found by an approximate assay to be about $40.00 per ton. This was crushed to pass through screens of 10, 20, 30 and 40 meshes to the inch. This was thoroughly mixed and quartered down until about 250 grammes remained (little over ½ lb.) This 250 grammes taken and crushed until it passed through a screen of 100 meshes to the inch. This pulp assayed by taking 4½ T. assays and running them through separately, also weighing and parting each separately for gold and silver, the average of the four assays being taken as the value of the ore.

Analysis.—Also from this pulp was made a complete analysis to determine the different constituents.

Free Milling Test.—100 grams of the 10, 20 or 30 mesh were taken and the quantity of *free* gold was determined.

Acidity.—For ascertaining the acidity of an ore for cyanide treatment it is important to know the quantity of acid that can be washed out by water and the acidity due to more stable acid salts, and to find out this two quantities of 50 grammes each were taken; one was washed with water and the washed ore was then treated with a known quantity of deci-normal Na O H, stirred and allowed to stand for 20 minutes. Na O H solution filtered off into a beaker, ore washed and washings also filtered into a beaker. The excess of Na O H was determined with deci-normal sulphuric acid; this, from known quantity of Na O H first taken, gives the amount of caustic soda (Na O H) required to neutralize acidity of ore due to acid salts not soluble in water.

The other 50 grammes treated with a known quantity of deci-normal caustic soda sol, without previous washing of ore by water, and excess of caustic soda (Na O H) determined in the same way as above This subtracted from known quantity taken will give quantity of caustic soda (Na O H) required to neutralize the total acidity of ore.

So now data for determining acidity of ore due to soluble acid salts and insoluble acid salts is gotten.

Example.—Let x = quantity of Na O H required to neutralize insoluble acid salts.

y = quantity of Na O H required to neutralize both soluble and insoluble acid salts.

Then $y - x$ = quantity required to neutralize soluble acidity of ore.

Having now found the quantity of Na O H required for *acidity* of ore, the equivalent of Na O H in lime can easily be calculated by equation.

Na O H : quantity of Na O H : C a O : required amount lime.

Example.—Suppose 15 lbs Na O H required to neutralize acidity of a ton of ore, what quantity of lime (C a O) would we have to substitute for this?

Na O H : 15 : : C a O : required lime.

$$\begin{array}{l} 23 \\ 16 \\ 1 \\ \hline 40 \end{array} : 15 : : \frac{40}{56} \quad \text{required lime.}$$

$\therefore 40 \times \text{required lime} = 15 \times 56$

$$\text{required lime} = \frac{15 \quad 56}{40} = 21 \text{ lbs. lime.}$$

and for sodium peroxide ($Na_2 O_2$) a similar equation can be worked out.

Some authors* state that if, when ore is treated with water and no acid reaction is given with litmus paper, it may be taken for granted that no acid is present.

If litmus paper is freshly prepared this may do; but it is very unreliable, as I had a case where 25 lbs. of lime per ton was required, still this ore did not show any acid reaction with litmus paper.

Having taken all the required preliminary precautions, treatment of the ores with cyanide of potassium can be attempted, and for this purpose, I found, for laboratory work, that ½ gallon Winchester bottles, with the upper portion cut off, answered very well, and correspond with the size of vat in practical treatment. The *modus operandi* was as follows:—

Four bottles were placed side by side, 200 grammes of ore weighed

into each and requisite amount of Na O H or its equivalent in lime (C a O) added, 200 c c of K C N Sol added to each of a known strength, say to begin with 0.1000% K C N; at end of 24 hours 5 c c of No 1 taken and its strength ascertained by standard silver nitrate ($Ag\ No_3$). Then 29.2 c c of clear solution drawn off with a pipette and placed in a lead tray and evaporated to dryness. This tray then rolled up and marked No. 1 and put aside. At end of 48 hours 5 c c of No. 2 drawn off, its strength ascertained and noted, and 29.2 c c of its solution evaporated to dryness upon asbestos cardboard, rolled up and marked No. 2 and put away with No. 1.

Also strength of No. 1 again ascertained and 29.2 c c of its solution evaporated to dryness and its lead put aside marked No. 1*a*. When a correction is made for lesser amount of solution, this serves as an excellent check upon No. 2.

At end of 72 hours No. 3 tested in the same manner, No. 2 serving as the check; and finally, at the end of 96 hours, No. 4 treated in the same manner.

* E. B. Wilson, E.M.: Cyanide Process.

After No. 4 has been treated, wash out K C N from ore by decantation through a filter, dry ore and mix thoroughly, and take an assay ton, and find the value of gold and silver left in the pulp. This, when added to silver and gold found in evaporation of 29.2 c c No. 4 solution, should make up the total value originally in the ore.

Whilst making the assay of No. 4 pulp, the resulting lead buttons, arising from evaporation of different solutions, are cupelled and silver and gold ascertained.

By drawing of clear super-irritant liquid scorification of lead is not required.

The contents of the bottles were stirred every 5 or 6 hours during the leaching.

As 200 grammes of ore were taken and 200 c c of solution, 29.2 c c of solution is equivalent to 1 assay ton, *i. e.*, the gold and silver found from evaporation of 1 assay ton of solution will equal the amount of gold and silver extracted from 1 assay ton of ore, or the number of ounces per ton extracted.

As there is always considerable acid fumes in a laboratory, I found it necessary to run through a blank experiment, i. e., placed 200 c c of K C N sol. of same strength as used with the ores, in a bottle along side of those containing ores, and at end of operation measured the quantity and ascertained its strength. It was necessary to measure the quantity in order to find amount of solution lost by evaporation and the correction made.

A blank experiment was made in a room free from acid fumes, and at end of four days the strength of solution had not appreciably altered, so it was assumed that decrease of strength of solution of blank experiment run through with ores was due wholly to acid fumes in laboratory, which decomposed the K C N, forming H C N, as $2\ K C N + H_2 S O_4 = K_2 S O_4 + 2\ H C N$.

Slimes.—As formation of slimes of various ores during crushing interfere with lixiviation of ore with cyanide, No. 2 bottle was washed seven times and decanted through a filter, these slimes dried and weighed, from this amount of slimes per ton can be calculated.

The above method I found to work very satisfactorily, and think that evaporation of solution in lead tray will give better results than various modes of filtration.

Precipitation of gold and silver from solutions by F E S and zinc chloride is very unreliable, as some gold comes down with silver when solution treated with F E S and zinc chloride only gave me traces of gold when solutions have contained over an oz. per ton. Zinc oxychloride precipitates nearly all of the gold, and should be substituted for zinc chloride.

Prof. Christy's method of precipitating gold from solution by acidifying K C N solution with $H_2 S O_4$ and then adding a cuprous salt solution; a very neat method, but still when the solution contains under an oz. of gold per ton, I prefer the evaporation of an assay ton (29.2 c.c.) as in precipitation of small amounts of gold from solutions there is likely to be an error introduced by manipulation, filtering, etc. The above method is rather that of the Agitation Process than Percolation; the latter is generally used in practice. The only difference is that in the Percolation method more time is required to get the same percentage of extraction.

The results obtained below were obtained by using the method above described.

Having given a general statement of the "modus operandi" employed during the experiments, I will now give the results in a tabulated form. It will not be possible to give the results of all experiments, as it would take up too much space and time. However, enough will be given to elucidate the work.

There are four tables in all—No. I, No. II, No. III, No. IV.

Experiments I and II are upon the same ore; III and IV upon different classes.

An analysis of the ore used in tables I and II

Gave	SiO_2	91.66 per cent.
	Fe_2O_3	2.13 "
	FeS_2	5.34 "
		99.13

Silver, 38.04 ozs. per ton.
Gold, 1.10 " "

(a) and (b). Were neutralized with lime alone.

(c) and (d). With lime almost to point of neutralization, and finished by adding sodium peroxide in excess.

The reason for finishing the neutralization

TABLE I.

No. of Experiment.	Duration of Experiment.	Preliminary Treatment.	Strength of K cy Solution.	Mesh.	Assay of Ore before treatment.		Assay of ore after treatment.		Percentage of Extraction.		K cy consumed per ton of ore.	Time required per ton of ore for neutr'liz'n	Cost of chemicals per ton ore.
					Silv.	Gold	Silv.	Gold	Silv.	Gold			
	hours				ozs.	ozs.			p. c.	p. c.	lbs.	lbs.	
(a)		Lime	0.097	20	38.04	1.10				29			
	24		0.043				33.10	0.78	13	34	1.5	25	
	48		0.031				32.10	0.72	15				
	72		0.021				32.40	0.75					
(b)		Lime	0.235	20	38.04	1.10							
	24						37.00	0.70	3	36	6.6	25	
	48						32.14	0.36	16	67			
	72		0.051				25.40	0.30	33	72			
(c)		Lime	0.272	20	38.04	1.10							
	48		0.160				32.20	0.56	16	49	4.5	25	
	72		0.051				25.72	0.36	32	67			
(d)		Lime	0.404	20	38.04	1.10							
	96		0.171				22.00	0.36	42	67	4.06	25	

TABLE II.

(e)		Lime	0.161	30	38.04	1.10							
	48		0.130				25.00	0.28	34	74	1.9	25	$1.05
	96		0.121				17.56	0.18	54	83			
(f)		Lime	0.323	30	38.04	1.10							
	24		0.282				32.00	0.76	66	30			
	72		0.220				18.16	0.21	47	80	4.00	25	1.88
	96		0.191				12.10	0.09	68	91			

The reason for finishing the neutralization with sodium peroxide (Na_2O_2) was to prevent an excess of lime (C a O) in the ore, which excess would consume potassium cyanide (K C N), forming calcium cyanide ($Ca\ Cy_2$), an inert compound; whereas, if sodium peroxide were in excess, the additional sodium peroxide there was required for neutralization of acid in ore would form sodium hydrate, and at the same time evolves oxygen which assists in solution of gold.

As $Na_2O_2 + H_2O = 2\ Na\ O\ H + o$

(Ellsner's Sq're) $4\ K\ cy + 2\ Au + o + H\ 2\ O = 2\ Au\ K\ cy_2 + 2\ K\ H\ O$

but from the percentage of extraction obtained in (c) and (d) in comparison with quantity of K cy consumed it is likely that too much of an excess of sodium peroxide was used, the rapid evolution of oxygen decomposing the K cy and the nascent cyanogen not being taken up by the gold quickly enough, paracyanogen (Cy_2) was formed, causing useless consumption of K cy, as the paracyanogen (Cy_2) has little solvent effect upon gold.

Table II.—By inspection of Table II. it will be seen that percentage of extraction has reached the maximum.

This ore is the same as used in I., but was crushed to 30 meshes, and only a slight excess of sodium peroxide used.

This treatment gave better results than any other tried by the writer, and am of the opinion that the consumption of K cy by careful work can still be further decreased. It will be noticed that strength of solution, experiment (e), was 0.161 per cent., and silver and gold extractions were 54 per cent. and 83 per cent. respectively, with consumption of 2 lbs. K cy per ton; and whilst (f) with K cy solution 0.323 gave extraction of 68 and 91 per cent. with consumption of 4 lbs. K C N, it is evident that the most efficient strength lies between 0.161 and .353 per cent.

Other experiments were tried upon this ore with solutions of greater strengths, 0.5, 0.7 and 1.0 per cent., but the additional percentages extracted would not compensate for the additional quantity of K cy consumed, which amounted in 1 per cent. solutions to almost 10 lbs. per ton.

Table III.—The ore from which results in Table III. compiled is a better ore for cyanide treatment than above, being a somewhat granular quartz with crystals of iron pyrites disseminated.

Iron pyrites amounted to 2.3 per cent. of total.

The consumption of cyanide per ton should be even lower than is shown in the table, as acidity shown by litmus paper was practically nothing, but afterwards I found by further work that there was a little acidity, and as this was not neutralized in above experiment, the consumptiom of K cy is a little high.

TABLE III.

No. of Experiment.	Duration of Experiment.	Preliminary Treatment.	Strength of Solution.	Mesh.	Assay of ore before treatment.		Assay of ore after treatment.		Percentage of Extraction.		K cy consumed per ton of ore.	Time required per ton to neutralize acidity of ore.	Cost of chemicals per ton of ore.
					Silv.	Gold	Silv.	Gold	Silv.	Gold			
	hours				ozs.	ozs.	ozs.	ozs.	p. c.	p. c.			
(g)		None	0.202	20	3.12	0.16							
	24		0.178				1.82	0.06	42	62	1.2	None.	$0.65
	48		0.168				0.76	trace	78	94			
(h)		None	0.383	20	3.12	0.16							
	24		0.323				1.44	0.03	54	81	3.0	None.	$1.55
	48		0.306				0.21	trace	92	98			

TABLE IV.

(i)		Lime	0.262	40	14.36	0.76							
	24		0.222				13.18	0.74	8	Very small.	4.2	24	
	48		0.171				13.15	0.73	8	"			
	72		0.153				13.15	0.71	8	6			
(j)		Lime	0.363	40	14.36	0.76							
	24		.303				12.32	0.66	14	13	7.00	24	
	48		.262				12.32	0.52	14	31			
	72		.202				11.64	0.40	18	47			

High extraction of silver no doubt due to the fact that silver here is alloyed with gold and not as Ag_2S as in former tables.

Table IV.—Again by inspection of Table IV which is an ore of pure iron pyrites of low grade, it will be noticed that percentage of extraction is very low, when compared with the quantity of K cy consumed. The results of experiments as shewn in (j) are best obained yet, but hope to get a more suitable strength as I am still experimenting with this class.

Recovery of Gold from K cy Solutions.

Have not done any work on this line in the lot; but will give a brief description of the one in general use.

The method most widely adopted is to allow the solutions, hold the double cyanides of gold and silver (K au Cy_2 and K cy Cy_2) to run through a series of boxes charged with zinc shavings, gold and

silver are precipitated from solutions in metallic form and some zinc goes into solution, precious metals and slimes fall to the bottom of box and are at stated periods refined. Whilst K cy solutions passes to a sump from whence it is pumped back to a tank, again made up to right strength and usual average.

Another method elaborated by Prof. Christy for precipitation of gold from solutions, is by adding cuprous salts to acidified solutions, the gold being precipitated as cuprous auro-cyanide (Cu Au Cy_2).

As this method necessitates the destruction of all the free cyanide it is only applicable to weak solutions where the destruction of K cy is of no importance.

From laboratory experiments the author* says the total quantity of gold is perpetual, which is not possible with the zinc method.

The method of procedure is as follows:—

Solution with potassium auro-cyanide is acidified with H_2 S 04, then would be added the proper amount of copper sulphate and common salt, the whole solution stirred and allowed to stand 12 hours, then filtered. The residue is called cuprous auro-cyanide. This residue then refined.

This method of recovery of gold and silver might possibly be applicable where strong solutions were used as follows:—

In ordinary practice a weak cyanide solution is first applied, then a stronger one.

Where these are a series of vats the strong solution from No. 1 might be used as weak solutions for 2, 3 and 4 and to alternate the solution containing a maximum of K au cy_2 and a minimum of K cy; this solution could be treated by the "cuprous method," the destruction of the little K cy remaining in the solution being of little moment.

This is a promising field for further investigations and should be looked into by those intending erecting cyanide plants.

Probable Cost of Treatment.

This is a very important question and as a paper of this kind would fail in attaining its object unless an estimate of cost of treatment were appended, I feel it my duty to give one with the data I have on hand.

Owing to a great many factors that enter into a consideration of this kind, we will understand that such an "estimate" is only an approximation to accuracy.

To form an accurate estimate of costs, data in above tables should be supplemented by work on a larger scale at some place fitted for the purpose, also quantity of ore for treatment in vein, accessibility of ore deposits, price of chemical, freight, labor, etc., determined.

Assuming the laboratory results as fairly accurate (as indeed they should closely duplicate larger tests when made at a mill), the cost of chemicals can easily be gotten at, and for rest of data one can use data that has been given by competent men upon similar ores in other places.

The estimate given here is from data derived from tables II and III, and data from Dr. Schudel's "Cyanide Process."

Referring to (f), Table II, as being the more satisfactory of the two as regards percentage of extraction, it will be seen that consumption of K C N is 4 lbs. per ton.

New York quotations upon carload lots of 98 per cent. K c y, is 28 cents per lb.

Freight, duty and cartage to mill brings price to	$ .42 per lb.
Consumption of zinc averages 8 ozs. per ton =	.05
Assuming cost of lime at mill at $10 per ton, this amounts to .006 cts. per lb. Now, cost of chemicals per ton for such an ore as (f) are:.....4 lbs. K.c y at 0.42 =	$1.68
8 ozs. zinc..	.05
25 lbs. lime.....	.16
	$1.88
The cost of labor and crushing per ton on a similar ore at Revenue.....	2.00
Madison Co., Mon., is $2.00 royalty, $1.00.....	1.00
Total cost per ton =.....	$4.88

or say $5.00 per ton.

Now, referring to (g), Table III, as being the better suited strength for economical extraction of maximum value.

Cost of treatment of this ore per ton—

Chemicals =	1.2 lbs. K c y=.....	.50
	Zinc.....	.05
		.55
Labor and crushing.....		1.50
Royalty.....		1.00
Total		$3.05

or exclusive of royalty, $2.05 per ton.

Comparison of Cyanide with Smelting.

Now let us compare the costs of treating ores of class (f) with smelting costs as obtain here at present from a miner's point of view. Take the case of a mine upon 1st or 2nd North Forks of Lemon:

Cost per ton at present is about $15.00 for getting to the railroad, and freight and smelting charges, $14.00.

Take the cost of ore (f), Table II—

Here total value of silver per ton, 38.14 at 56 cts. per oz=....	$21.28
Gold per ton, 1.10 at $20.00 per oz=.....	22.00
Total ore.....	$43.28

The smelters pay for 95 per cent. N. Y. quotations of silver and $19.00 per oz. of gold, so you are paid upon above ore per ton—

1.10 oz. gold at $19.00.....	$20.90
95 p. c. of 28.04 × .56c.....	20.21
	$41.11
Less $15 for packing to railroad, and $14 for freight and smelter.....	29.00
Net value per ton to shipper = ...	$12.11

or ore valued at $43.24, nets the shipper $13.61 per ton.

Now, same ore by cyanide treatment See (f), Table III.

Silver, 68 p. c. of $21.28.....	$14.47
Gold, 21 p. c. of 22.00..	20.20
	$34.67

or $34.67 extracted from ore.

In this case mill would be in the vicinity of mine; transportation would be reduced two-thirds, or about $5 per ton, so cost of treatment and transportation to shipper would amount

Transportation.....	$5.00
Cost of treatment.....	5.00
	$10.00

So $34.67
Less 10.00

$24.67 = net returns per ton to shipper, or
$24.67 — $12.11 = $12.56 in favor of cyanide treatment.

*Prof. Christy, Trans. of A. I. M. E., Sept. '96.

From the fact that there are so many fair prospects of same general character along 1st and 2nd North Forks of Lemon Creek and neighborhood, and that now it does not pay to ship ore under $40.00 per ton, so all ore under this value is thrown aside, and the ratio of ore under $40.00 to that over $40.00 is as 5 : 1, so that one can readily realize what a boon it would be to the district if some such cheap method of treatment of such ores were established.

Before this can be successfully accomplished careful investigation by laboratory work, supplemented by experiments upon a larger scale, at places fitted for that purpose, must be carried out, as well as finding out the extent and character of ore bodies. It may happen that an ore may be fitted for cyanide treatment until the line of "vadose circulation" is found, and after that some other process may be required; hence it is necessary to prove the ore bodies to some depth.

When upon this subject, I hope it may not be taken amiss, by saying to capitalists (who have had little experience in such methods as cyanide, chlorination, etc.) intending investing their money in such processes, to employ competent men, as there is no existing metallurgical method that requires such close attention to the chemical side of the question, in order to make the method a financial success, as the difference between success and failure, or at any rate indifferent results may be due to very little.

Even practical men in charge of a cyanide mill in one place, could not be expected to inaugurate one upon apparently the same class of ore in another place. Once the mill has been placed upon a good footing, then an intelligent man may manage it; and to place a man in charge of the work in its initial stages, who has neither had the technical training nor practical experience, would be *suicidal.*

Also, when capitalist is satisfied as to quantity of ore visible, and laboratory tests show it suitable for cyanide treatment, a considerable quantity should be shipped (and if possible their chemist or engineer accompanying it) to a mining school where appliances are designed for the treatment of all classes of ore.

Sending it to a mill designed for one class of ore and treatment worked out for it, pre-supposes of the ore sent, identical physical and chemical composition to that class of ore the mill was designed for. The results would be of doubtful value, as the treatment and mill must be designed for the ore, not the ore for the mill.

In conclusion, I wish to express my indebtedness to J. C. Gwillim, B.A., Sc., for data as to extent and character of oae depth.

Notes on Lardeau and Cariboo Creek Mining Divisions, West Kootenay, B. C.

By HARRY BUSH, Vancouver, B. C.

Three miles from Pingston Creek on the western side of Arrow Lake, a valuable mineral belt was discovered some time since consisting of a huge outcrop heavily mineralized, traceable without a break for twelve miles, and showing a width from 20 to 100 feet. This body of ore is pyrrhotite carrying values in gold, silver, copper and lead equal from $10 to $20 per ton. The ore resembles that in the Le Roi and other Rossland mines. For two or three miles on the trend the outcrop shows out in places through the moss, but after the timber is passed the ledge has been exposed by the effects of nature. The whole width of the vein matter is composed of pyrrhotite quartz and solid galena in seams carrying values in gold, silver and copper with heavy percentages of lead equal to 60 per cent. A shaft being sunk is now in solid ore and the ore in the bottom is indicative of still further improvements in smelting values. Transportation will be easy to deep water by ærial tram which can be constructed at a moderate cost. Timber and water are plentiful, and the facilities are excellent for all purposes. The ore can be won and shipped from the very surface, and all work being done is in pay ore. Little dead work need be anticipated with the exception of making tram for transit. When this work has been completed ore can be shipped from the mine at a cost not exceeding 10 cents per ton. An enormous quantity of ore can be won at little cost and shipped continuously. The C. P. R. are building wharfs so that vessels of the Rossland type can come and go at all times. There is a future before this section of Arrow Lake of which the C. P. R. already, with their usual energy and tact, have taken the full advantages. The bright mining prospects and the cheap facilities available will precipitate matters and Pingston Creek Camp will jump to the front at an early date as a large ore shipper. A good trail has been made to Pingston Lake, and mining activity is apparent in every direction.

In another direction, ten miles from Arrow Head, is Thompson's Landing, reached by the C. P. R. boats, this being the quickest route to Trout Lake City. This is one of the latest but at the same time one of the most promising camps in British Columbia. But little of this district has been prospected, yet sufficient exploration has been accomplished to prove the existence of very rich leads of gold, silver, copper and lead. From Thompson's Landing to Trout Lake City a good wagon road has been built, a distance of twelve miles. The country traversed is one very favorable to the existence of mineral deposits, being a splendid slate formation, solid and in place. Although nothing so far has been discovered of any intrinsic value between Thompson's Landing and Trout Lake, on arriving at the latter place one is surprised at the rapid advance made in building a substantial town. There are several good hotels and others are approaching completion. The town has every appearance of doing a big business generally. From Tout Lake City the Horne-Payne Syndicate have built a wagon road through the Town of Ferguson, a distance of four miles, and thence on to the well-known Silver Cup Company's property, or in all eight miles with good bridges where necessary.

Ferguson is a town with several hotels, stores and private residences. This town has also sprung up within the last few months. The Horne-Payne Company have erected a saw-mill, offices and other buildings. Development work is being pushed and ore is being shipped continuously from the Silver Cup Mine. The vein matter is largely impregnated with grey copper, carrying high value in silver. Although money has been expended lavishly the results are not so encouraging as they might have been under more effective management. Claims have been bonded by the Company in the immediate vicinity, and many of these have, after unnecessary and unworkmanlike expenditure, been abandoned only to be taken up again and worked to advantage. The Horne-Payne Company have extended their operations all through British Columbia with dire results, all this having a bad effect. Gross incapacity in direction of affairs, total want of mining knowledge and the employment of superintendents without experience and worse still, the purchase of mining areas without merits at big figures, and the set determination to wilfully throw money away without even the slightest possibility of any return, is the only success that those directing this unfortunate concern can boast of. Monuments of failure where success was impossible are distributed in various districts, notably the Illicillewaet, all contributed by the Horne-Payne Syndicate and to the like concerns all mining districts are subject to bad odor. English companies should use more diligence in their choice of management and then losses would be less. The above Company has evidently been inaugurated to dispense with the Company's capital as quickly as possible, and with the least tangible results, and this only

needs inspection by any mining authority to verify the statement. When this syndicate has exhausted all its resources in bad investments, and still worse mining development, the districts where the expenditure had taken place will suffer untold criticism without desert. Canada were better without English companies, if power be vested in incompetent and extravagant managers.

Four miles out of Ferguson a trail begins where the wagon road ends. This leads to the ten mile up Gaynor Creek. At a further distance of four miles some fine showings occur A ledge showing galena high in silver and lead is traceable throughout several claims. Very little work has been done on any of these, but assessment shows the ledges are very promising. Further on two miles a discovery has been made by the Lade Bros. consisting of a mixture of iron and quartz. Two tons of this was shipped as a test and resulted in the phenomenal return of $1100 to the ton in gold. The work done so far applies only to the two tons taken out. The gold occurs in several stringers, notwithstanding gold is visible all through the stone. Without further development the value of the property cannot be determined, as this is evidently only a pocket, and the ledge is anything but defined and has no indication of permanency. Several other locations have been made on this line, but as yet no encouragement has rewarded the locators and the ledge cannot be found From the ten mile in another direction a trail has been made for nineteen miles to the Abbott Group, viz: Hecklar, Abbott, King William, Union and Kamloops. These claims are owned by Messrs. Marpole and Abbott of the C. P. R. and others. A trail was built to enable supplies being got in, but this track is impracticable for transportation. So far very little prospecting has been done within this nineteen miles; however, a good road can and should be made to the foot of Trout Lake up Hailey Creek where a gradual rise can be ensured for a distance of twelve miles, which would complete the road to the head of Hailey Creek at the foot of the Abbott Hill. This could be constructed at a cost not exceeding $15,000, and would open up much unexplored but valuable country. Another feasible route could be made traversing Hall Creek to the Duncan River, a distance of four miles, thence down the Duncan where steamer transportation can be secured at the Big Jam.

The Abbott Mine has a very fine showing. At an elevation of 6,500 feet a tunnel has been driven 328 feet to intersect the ledge at a depth of 400 feet. The main ledge has been exposed higher up, and in width is from 12 to 15 feet trending N. W. and S. E. with four feet of clean galena carrying carbonates and grey copper. The remainder of the ledge matter is concentrating. Results give over $100 in silver and 75 per cent. lead. This ledge is traceable through the Hecklar, Abbott, King William and Union; the vein occurs in a contact of lime and slate. The general formation of the country is a fine, soft brown slate. A belt of limestone, a mile in width, intrudes through the slate and is continuous right along the country for miles. This intrusion is the very foundation of the country. On the King William in a direct line with the Abbott, the ledge outcrops 30 feet high and is 20 feet wide—the ledge being a fine laminated quartz carrying grey copper and galena. The country being bare of undergrowth and timber the outcrop is so distinct that it can be seen for miles with the naked eye running as true and straight as a die. Four hundred feet lower down on the King William an outcrop of quartz three feet wide is exposed and cut by a creek. About one foot of this is solid galena, carrying high values. A tunnel has been driven cutting the drain at 30 feet. This is a true fissure, cutting the slate at right angles, N. E. and S. W. When this junctions with the main lode the possibilities are great. On the Abbott claim, four hundred feet higher up, another parallel vein is exposed in the lime belt, which is regular and well defined right through the country. The vein is 10 feet wide, half of which is solid galena. One hundred feet higher another ledge is exposed from six inches to a foot in width of galena impregnated with grey ore. These ledges are all strong, passing through the four claims of the Abbott into the Wagner group, viz.: Lucile, Francis, Jewel, Emma Fraction, Queen Mary, Princess Marie, Lardeau Fraction, Lardeau, McCartney Fraction, Duncan and Ella. All these claims are on the same line. A tunnel has been driven on the Francis and Jewel, cutting the ledge at 40 feet. On the Queen Mary and Princess Marie open cuts expose the continuation of the ledge, carrying identical values. On the Lardeau the solid galena is exposed on the surface and traceable right through from the Hecklar into the Duncan. In all there are four claims on the main ledge. The outcrop of the Duncan is composed of iron, rose quartz, and seams of solid galena standing out of the ground 50 feet and being 50 feet wide. A tunnel has been driven 100 feet, and a crosscut towards the dip has been completed 45 feet, cutting the same continuous body of ore 60 feet from the mouth of the tunnel. A good working winze has been sunk following down the vein at an angle of 55 degrees. At this depth a crosscut has been driven 10 feet toward the hanging wall A fine body of ore has been met with carrying the same mineral of solid galena and grey copper. Another property running parallel with the Duncan and known as the Merry, has a very fine showing of galena, going 70 per cent. in lead and 180 ounces in silver. This occurs in the lime belt, is four feet wide and continuous through the claim into another location known as the Bannockburn, also carrying identical values in a lode exposed on the surface. For permanency and vast bodies of valuable ore, the Lardeau will be a very large shipper as soon as railway transportation is open, and as it is now almost fixed that the construction of the railway is to commence very shortly and that it will be built within a few miles of the Abbott hill, the future of this vast mineral producing district is assured.

The Slocan country, lyiny between Arrowhead and Kootenay lakes, has forged ahead absoluteiy on the merits of its rich silver deposits, the output and development demonstrating that this is one of the richest silver and lead producing regions in the world. Considerable development is proceeding and there are over thirty shipping mines, which number is steadily increasing.

A very rich district is West Kootenay, and bids fair to become one of the large producers of British Columbia. It is known as Cariboo Creek, situate between Nakusp and Robson, with easy access to the C. P. R. Company's splendid line of steamers running between Arrowhead and Trail daily, and calling at Burton City, the outlet and inlet of all mines in the district. The new discoveries are attracting much attention, and it is a wonder that this promising locality has not long since come into the prominence its merits deserve. The most important city in this district will be Mineral City, seven miles in the interior from Burton, by which it is now connected with a first class wagon road constructed by the provincial government It is an ideal town site, lying in a beautiful valley, and is in close proximity to all the principal mines. A good hotel has been built, and arrangements are being made for a tri-weekly mail service to this point from Burton City.

The advantages of Cariboo Creek appear to have been overlooked by experts and speculators. The entire country is of solid formation, the ledges wide, carrying high values both in silver, copper and gold, with heavy percentages of lead. There are no indications of pinching in the ledges, no difficulties occur in tracing them wherever discovered, and from the very surface results are phenomenal. The formation is well defined and unbroken. There are many properties now working and others will shortly follow. Amongst those

showing up well are the Columbia, Cariboo, Black Bess, Ocean Wave, Trio, Silver Queen, Hailstorm, Gibraltar, Promostora, Eureka, Winnipeg and many others.

The Columbia Cariboo is about seven miles from Burton City. A wagon road is nearly completed all the way and the rest of the distance is over a good trail. This property consists of three claims. A well defined lead of rose quartz is traceable a distance of over 3,000 feet, carrying galena and carbonates and running high in gold from the surface. A shaft has been sunk a considerable depth on the ledge, the width of eight feet of solid quartz being maintained, but at depth the gold values improve considerably. Open cuts have been made along the outcrop, proving the vein regular and defined, with a width of eight feet of payable ore. This ledge is a very fine fissure and a very strong one at that, crossing the country stratification at right angles. A tunnel now being driven will intersect the ledge at considerable depth. When this is accomplished, drifting on the ledge, both east and west, will be commenced and connection made with the shaft. Shipments will then be made to the C. P. R. smelter at Trail. The vein matter is a desirable fluxing matter much needed by the Trail smelter, and the quartz will be treated upon special and easy terms, as it will mix well with the Rossland ores and is at present much needed. This property is one of the very best in West Kootenay. The wealth, value and permanency giving from $12 to $40 per ton from the very surface, in so large a body of ore will enable the company to win large quantities of ore at a nominal cost. When the tunnel connects with the shaft, every ton taken out will be pay rock. The stratification of the country rock is lime and shale, and traverses north and south, whilst the ledge which cuts it runs due east and west, a magnificent sign of duration and richness.

On the Black Bess very little work has been done so far, although the vein matter shows in considerable bodies in various parts of the claim. The vein is composed of iron, and steel galena, the assays showing high results in gold and silver.

The Trio consists of three claims, and a quartz ledge has been uncovered traversing through two claims, showing a width of four feet, carrying galena and gold assaying from $10 to $60. A good number of men are pushing work by sinking and tunneling, and ore will be shipped to the smelter at an early date. The vein is strong and shows permanency.

The Silver Queen, better known as the Maxwell Group, consists of six claims. Tunneling and sinking are being energetically pushed. On the surface the main lode shows a width of 14 feet, consisting of iron impregnated with steel galena, assaying from $50 to $400, principally in silver, but carrying from $10 to $12 in gold. Development shows a complete change, and as depth is attained the iron runs out and the vein matter carries considerable calcite. This ore can be smelted at a very low rate and is a desirable commodity for the smelter to mix with other ores. Drifting shows the ledge to average eight feet, of which three are solid ore. The ledge is well defined between two permanent walls, with every appearance of continuance. Another parallel vein has been discovered three feet wide, assaying from $30 to $260 in silver and gold. Drifting and sinking shows this to be strong and well defined.

Several other discoveries have been made which tend to show that several parallel ledges traverse the property, all of high grade ore, a considerable quantity of which is now ready for shipping.

The Hailstorm is situated on the summit of a mountain at an elevation of 8,000 feet. It has a very fine body of quartz exposed, showing galena and giving good results in gold. The vein outcrops for 400 feet. A shaft is down nearly 100 feet, which gives improved grade ore, the width of the body being six feet.

The Gibraltar is in proximity to the Hailstorm, and shows similar prospects.

The Promistora, which is now shipping ore going over $50 per ton net, principally gold, has a very fine showing, and as opening up progresses, indications warrant extensive working and heavy shipments of ore.

The Great Western, four miles from Mineral City, adjoining the Milly Mac, has a fine showing of quartz 12 feet wide and continuous through this claim. This quartz is similar to the Columbia Cariboo and contains much galena. The average assays return $60 per ton, half of which is in gold.

The Milly Mac is a group of 12 claims. The ore carries carbonates, chlorides and native silver. The main lode is quartz of great width, and development proves that gold is largely prevalent in the general assay value.

An important discovery has been made on the divide between Slocan Lake and Cariboo Creek, the vein being 10 feet wide with three feet of clean ore going $100 to the ton, and four feet of good concentrating ore. There is no question of doubt that the great Slocan silver lodes, with their varying values, all pass through the Cariboo Creek, yet carrying all the values of the Slocan with a large increase of gold.

The Cariboo Creek district is one of the richest in British Columbia, and the trial shipments now being made are actually exceeding the values I have placed upon the various properties. Considerable interest is being taken in this district by the Rossland and Slocan camps, and the uniform rich grade big ledges with the additional gold values, are causing some enquiries from influential syndicates outside of British Columbia. In no other district has the meagre exploration disclosed such vast possibilities. Lately the Silver Queen made another shipment to the Nelson smelter, with a result of $290 net per ton. Necessary arrangements are being made by the Columbia Cariboo Company to push work as energetically as possible in order to make shipments of ore by the end of July. These shipments are likely to be extensive. The C. P. R. are assisting in every direction to further the interest of this district which they look upon as being one of the most remunerative outlooks.

The Management of Blast Furnaces.

By E. S. Cook, Pottstown, Pa.

Introduction.

In discussing this subject the object sought may be best attained by giving an account of my own experiences rather than by treating it in a general way.

My first intimate acquaintance with the blast furnace dates from 1871. At that time it was generally believed that no one was competent to manage the practical end of blast furnace work unless he was "born in a tuyere arch." This expression was meant to imply that the mysteries could only be solved and handled by a man starting as a laborer and working up through the various positions pertaining to the stock-house and cast-house—first helper, keeper, and finally founder—involving an experience of five to ten years or more. The founders were men separated by the process of natural selection from their fellow workmen, possessing more than ordinary natural intelligence and good judgment, quick to meet emergencies, of some mechanical skill and close observers of blast furnace phenomena.

The managing partner, or business manager, as a rule, possessed little or no practical knowledge of making iron. He bought the material, ofttimes at the dictation of the founder, in whom resided the power to condemn or approve.

The total product of the active furnaces during the year 1872 was about 2,500,000 tons. The product for 1897 nearly reached 10,000,000 (9,652,780) tons, while the total capacity of all the furnaces now erected is estimated at 14,000,000 to 15,000,000 tons.

This wonderful increase is due, in great part, to the application of scientific methods to the management of blast furnaces, the New Method replacing the "rule of thumb" practice, or the system of guess work in which the furnace itself was the laboratory.

The discovery of Sir Henry Bessemer, and the introduction of the Bessemer steel rail, has revolutionized the traffic and transportation of the commercial and industrial world. Pig iron, however, is the basis of the steel manufacture. With pig iron costing from $25 to $30 per ton to make, it is evident that steel rails could not have been made and sold for less than one cent per pound. Better management of blast furnaces reduced the cost of manufacture, lower priced pig metal made cheaper rails possible, cheaper rails reduced transportation charges. These causes acted and re-acted upon one another so that the world is now furnished with pig iron and steel in their various forms, at lower rates than were even conceived as being within the range of possibility.

This in turn has led to an increased use. Notwithstanding, however, the vast consumption, productive capacity is in excess of current demands.

A few enthusiastic young men happened, by chance or otherwise, to obtain control of the practical working of several furnaces. They formed the neuclus of the new order of blast furnace management, and demonstrated that energy, close application to details, and untiring industry, together with a broader intelligence, capable of applying the teachings of chemistry, could profitably replace the old order, where guess work formed the foundation, assisted by shrewd observation and long experience.

The new method reduced the risks, but the improved results were only obtained by hard work and many disappointments and trials. We had to learn by bitter experiences how to properly apply the analyses furnished by the laboratory, the manager, in most cases, being his own chemist.

Notwithstanding intense commercial competition, it is worth noting that the more intelligent and liberal minded managers exchange thoughts and experiences with the utmost freedom, so that these friendly meetings and friendly competitions to excel were largely instrumental in adding to the efficiency of each individual manager. Previous to 1873 metallurgical literature was sadly deficient so far as it related to the blast furnace It was suggestive rather than instructive, and valuable to this extent. With the growth of the American Institute of Mining Engineers and the British Iron and Steel Institute, and following the Centennial Exhibition in 1876, the literature of the blast furnace rapidly increased. It now forms a valuable aid to all interested in the development of the business.

Intelligent management, with its improved results, brought with it a demand for better appliances, better equipped furnaces, different constructions, etc., so that the blast furnace engineer, practically unknown before, now became a feature. He gathered up the experiences of the various managers, became a medium of exchange, formulated, combined, suggested and devised many useful appliances, so that he assumed a position of no little importance.

It is rather a curious incident, however, that men trained as mechanical engineers did not become the most successful managers; a different bent or training of mind seemed essential.

The Blast Furnace.

I will not refer to the theory of the chemistry of blast furnace operations other than to remark that if it were a melting operation only, such as takes place in a cupola, it would be comparatively simple.

It becomes complex because of the chemical reactions, upon which depend the removal of the oxygen from the ores, and the mechanical difficulties that beset the descent of the materials, and the ascent of the gases of combustion through the column of descending solids.

It was not long after I became the manager of a furnace that I discovered it was one thing to criticise the actions of the founder after the event and quite another thing to have the sole responsibility and to forsee the result of a certain course of action.

Hindsight is the gift of the many, but correct foresight in blast furnace work, as in any other department of activity, is confined to the few. While great progress has been made by the present generation of blast furnace managers, there yet remains much to be accomplished. Not unfrequently I am forced to confess how little I really know about the operations of a furnace and what little control I have over the process. In fact, after a practical experience of twenty-three years, I realize more than ever before how much there is to be learned in order to perfectly control the operations of a blast furnace. Sometimes the furnace seemingly runs itself, moving along with the regularity of clock work, which becomes almost monotonous, and then is followed by irregularities more or less serious, causing the manager a nervous strain and physical exhaustion, with a feeling of mortification at his apparent helplessness and of disgust that he knows so little.

A furnace seems to have an individuality.

Two furnaces, side by side, fed with the same material and under the same management, may work entirely differently and demand different treatment to obtain good results, showing, in fact, the unaccountable differences that frequently characterize different members of the same family. There is a close resemblance between the profession of a furnace manager and that of a physician.

A furnace is always spoken of as possessing sex. Objects to which we become attached are idealized and we fondly refer to them as if they were of the same sex as the mothers, wives, or girls we love.

Indications of the internal hidden working are the volume and pressure of blasts, the tuyeres, the slag, the escaping gases, the rate and manner of the settling of the stock on top, and the grade, composition and tonnage of iron produced. A cold top and a hot bottom are just as essential to a healthy furnace as a cool head and warm feet to the individual.

Fluxing.

Chemistry has simplified and rendered comparatively easy the fluxing of the earthy constituents of the various ores employed, plus the ashes of the fuel. In previous years this was the chief cause of trouble. Guesses were made as to the proper flux to be employed. Mistakes were followed by serious irregularities, such as high fuel consumption, worthless iron, and frequent scaffolds and occasionally the chilling of the furnace, involving heavy losses.

Fortunately there is considerable range, so far as safety to the furnace is concerned, in the composition of slag.

When a choice of material is possible the skill of the manager is displayed in making a combination of ores that will give the results desired with the least expenditure of fuel.

The most fusible slags theoretically are not the most economical practically, and in fact cannot be successfully employed in anthracite and coke furnaces.

Silicious slags, easily fusible, attack the brick work of the lining and of the bosh. They become pasty above the line of fusion, frequently inducing scaffolds or arches, to say nothing of the evil effects upon the quality and grade of iron caused by the absorption of sulphur.

In proportioning the flux, care must be taken to provide for the removal of the sulphur of the fuel, as well as the sulphur contained in the ores. It is also conditioned upon the composition of the iron to be made. If the volume of slag is large per ton of iron a somewhat silicious slag can be depended upon to remove the sulphur, while if the volume of slag is small we are obliged to depend upon high temperature and basic slag to prevent the union of sulphur with the iron. The effect of sulphur upon the metal is to lower the grade and render it unsuitable for many purposes. Occasionally our slags contain three per cent. of sulphur when in small volume, falling to two per cent. when the volume of slag is increased, the grade and quality of the metal remaining the same.

Pig iron contains more or less silicon.

Upon the assumption that the same ores are used in making foundry iron of two per cent. silicon, considerably less limestone flux would be required than in making a mill iron of only one per cent. silicon.

This is frequently overlooked. The character and quality of the iron made is influenced very materially by the fluxing.

There is less margin for variation in this respect than the mere working of the furnace alone.

The composition of the slag does not indicate either the grade or the analysis of the iron made. With slag of practically the same composition I have made No. 1 x foundry iron by fracture containing three per cent. silicon with large crystallization, and iron of close grain with less than one per cent. silicon.

The percentage of flux employed will be considerably less with the former iron. This is due to the fact that the iron carries off many pounds of silicon, that in the latter must be taken care of by the slag in the shape of silica.

As a rule slags high in alumina (exceeding 15 per cent.) are undesirable. Silica may vary from 27 per cent. to 37 per cent., depending upon the analyses of the ores and fuel, the volume of slag, and the grade and quality of iron desired.

Changes occur in the composition of slags, due to mechanical causes, requiring constant watchfulness and supervision as well as the variations in the ores, limestone and fuel.

Theoretical fluxing is one thing, but practical fluxing to obtain the most economical results, both as to product, quality of iron, fuel consumption, etc., is quite another thing.

It gives room for the display of no little individuality so far as the management is concerned, and considerable difference, when judged by the final test of all, viz., the balance sheet.

By experience we learn to distinguish slags by their physical appearance. Chemical analysis is too slow and not conclusive, for while indicating a safe slag, so far as the operation is concerned, it does not show the refinements that will suggest themselves to the experienced manager.

The most successful founders of the old school were good judges of slags, quickly observing slight changes and acting promptly, guided by these indications. The most successful managers of the new school acquired this expert knowledge by actual contact with the daily operations of the furnace.

It is in this particular, along with others of perhaps equal importance, only to be gained by an apprenticeship, long or short, depending upon the individual, that chemists, attempting to run a furnace on theory made lamentable failures.

Fuel and Ores.

Up to 1882 anthracite coal was the exclusive furnace fuel east of the Allegheny mountains, coke being used to the west.

The mechanical difficulties of blast furnace management are much greater with anthracite fuel and the magnetic ores, common to the East, than with coke and the easier working Lake ores.

Indeed, the anthracite district has been a most valuable school, furnishing in the past some of the ablest and most successful managers for Western furnaces.

Some years ago, Mr. Chas. Foote, now Vice-President of the Illinois Steel Co., wrote me that the use of Connellsville coke and Lake Superior ore in the blast furnace was heaven on earth to the manager accustomed to anthracite coal and the magnetic ores of New York and New Jersey. He had previously managed the Crown Point furnaces on Lake Champlain, and wrote feelingly, urging me to go West. I did not go West, though strongly tempted, but in the lapse of years cheaper transportation, etc., have brought Lake Superior ore and coke to eastern Pennsylvania, so that we are finding more comfort in living than we did some years ago.

Anthracite coal is dense and solid, consuming on the surface only, while coke is porous and light, the combustion permeating the whole structure. Much more coke can be burnt in the same space in the same time, thus increasing the product of the furnace.

Coke offers less resistance to the blast, permitting the use of a larger volume of air per minute with the same engine and boilers, and is generally higher in carbon and lower in ash and sulphur. Coal will carry and melt as many pounds of ore as coke.

The fuel consumption per ton of iron for long periods is less with coke for the reason that the furnace can be handled with greater ease and with less danger of mechanical disturbances.

By reason of the more uniform working, the product of the furnace is larger, and the fuel consumed has a larger devisor.

Coal is apt to splinter and crepitate upon exposure to heat, and this tendency is one of the reasons why an anthracite furnace is difficult to control. The dirt thus formed in the furnace not only reduces the amount of combustible fuel reaching the tuyeres, but accumulates along the walls, giving rise to serious mechanical difficulties. Coal dirt, though nearly all carbon, will not burn in the furnace. It is carried off by the slag, sometimes in comparatively large quantities. As the slag flows down the runner from the tapping-hole or cinder notch, into the car provided to receive it, the dirt will separate. The slag, being heavier, drops at a different angle, so that the dirt can be collected on a shovel.

When examined, the small particles show the same bright fracture and oft-times the same bright surface as when mined, thus passing through the fiery furnace unscathed.

It would be an unspeakable blessing if all the coal dirt formed in the furnace was only thus carried off. Unfortunately this is not the case. Sometimes the obstruction caused by its accumulation so seriously impedes the passage of the blast that we are obliged to stop the engine, remove the tuyeres and ravel out the dirt through the tuyere openings, together with other stock, in order to secure passage for the blast and gases.

Ores.

Ores of the same oxidation, belonging to the same class chemically, and of essentially the same analysis and physical structure, vary greatly as to their working qualities and their practical value. One may part with its oxygen freely; another may hold it very tenaciousl.

Why this is so I do not know, but it is a fact that influences the consumption of fuel per ton of iron more than the uninitiated would imagine. By burden is meant the pounds of ore that one pound of fuel will carry, that is, deoxidize and melt, converting it into pig iron. The burden is effected by this quality existing in ores, the difference between the burden at 1.5 lbs. of ore and 1.75 lbs., the grade of iron remaining the same, is oft-times the difference between running at a commercial loss or a corresponding profit.

The burden is also affected by the richness of the ore mixture; for instance, notwithstanding the larger volume of slag, and, of course, the larger amount of flux usually used with a 50 per cent. ore, the furnace will carry a larger burden of a 50 per cent. ore mixture, than if it was 60 per cent. This is due to the chemical duty to be performed in the way of deoxidation. With a burden of 1.50 lbs., ore yielding 50 per cent., the iron per pound of fuel is 0.75, while with a 60 per cent. ore it is 0.90 lbs. iron per one pound of fuel. A correspondingly larger amount of oxygen is to be removed by the gases in the later case.

Other things remaining the same, while the burden possible with a 60 per cent. mixture is smaller than with a 50 per cent. mixture, the fuel per ton of iron made will be less with the 60 per cent. mixture.

Magnetic ores are usually very dense, and more or less difficult to handle, parting with oxygen slowly.

If ores are too finely divided physically they are a source of trouble. The gases, meeting more resistance in their ascent from the tuyeres, will seek the easiest way of escape. Channels of travel are apt to be formed, or, to speak technically, "the furnace becomes channelled." The effect is that portions of the furnace do not receive their share of the gas, and ore reaches the crucible holding oxygen in combination. This is destructive to the temperature of the crucible and represents a loss of fuel and waste of iron, to say nothing of the irregularities that will develop at and about the boshes, if the unequal distribution is not corrected.

It will thus be seen that good judgment, skill and experience of the manager in selecting and combining ores to accomplish a certain end plays a very important part, and figures largely in the final result, measured in dollars and cents.

Furnaces are not usually run for pleasure, nor for demonstrating any particular engineering device or the working out of any chemical theory, however attractive, but they are run for the sake of profit. Frequently—only too frequently—we are disappointed and sadly disappointed in results, but the man that combines technical knowledge with practical experience and an acquaintance with business conditions and requirements, with a due appreciation of their importance, is the man that will show the best final results, and is the manager that is sought after. In the blast furnace business a little knowledge is very dangerous. The man who, in his own estimation, knows it all, has no inducement to learn.

Limestone.

The flux usually employed is either limestone, calcite or magnesium limestone, dolomite. Whether one or the other should be used depends upon circumstances, commercial and technical.

Either will answer so far as mere running is concerned.

At the same cost per ton of stone, the use of calcite or dolomite will depend in great measure upon the composition of the ore mixture and the kind of iron to be made.

Pig Iron.

The various qualities of pig iron derive their names from the uses to which they are put, or from their composition.

Bessemer iron is pig iron of suitable composition to make Bessemer steel.

Basic iron is pig iron suited for the basic open hearth steel manufacture.

Basic Bessemer for the Basic Bessemer converter.

Foundry iron for use in foundry to be remelted and cast into various forms.

Mill iron for use in puddling furnace to be converted into wrought iron.

Low phosphorus for use in acid open hearth steel manufacture and steel castings.

Spiegel, Ferro Manganese and Ferro Silicon are irons of particular composition, for special purposes, and require special ores and treatment in the blast furnace.

Blast.

Furnaces are now operated by volume of air blown per minute as distinguished from the old practice of running by pressure of blast. Pressure is now regarded in the light of one of the valuable indications of internal working or conditions.

Calculated over long periods as measured by piston displacement and exclusive of wastage, between five and six tons of air are required to produce one ton of iron, and from 60 to 65 cubic feet of air to burn one pound of fuel, depending upon the tightness of pipes and fixtures and of the air piston of blowing engine. Atmospheric moisture plays an important part. It is never absent. It enters the tuyeres as vapor of water, calling for an increased amount of fuel to restore the heat absorbed by converting this vapor into its constituent parts, oxygen and hydrogen. Whether the air contains five grains moisture per cubic foot or ten grains, either must be provided for by extra fuel or higher heat of blast, if the temperature of crucible is to be maintained. On an average for any one year, probably 125 pounds of water per ton of iron will be forced into the tuyeres in the shape of vapor, while during the humid summer months it may amount to 200 pounds and over.

This is the reason why more fuel per ton of iron is required during the summer as compared with the winter months.

As a rule less cubic feet of air is required per minute to consume same amount of fuel during the fall, winter and spring months than during the warm months of the year.

Blast Furnace Manageeent.

The modern blast furnace is not an invention, nor a discovery, but a growth. It represents the combined results of numerous experiences, and in itself is the epitome of many a hard won fight. Sleepless energy and untiring devotion, perseverance in overcoming obstacles apparently unsurmountable, and the forgetting of self, has worked out many unsolved problems. Blast furnace management is fearful drudgery for a man not in love with his work.

No department of iron or steel manufacture calls for closer application and attention to details It is absolutely continuous. With these qualities lacking, no amount of technical knowledge will win success. The most successful managers have been those that were so absorbed in their work that they never stopped to enquire whether they were being suitably paid.

The results obtained have shown that capital usually seeks out the best talent.

Time does not permit to more than merely mention a few of the improvements. The hearth with open foreheart hand tympe gave place to the German patented, closed front. The principle, however, was worked out in American practice, we finally adopting a modified form of the Lurman device. Fire-brick stoves, an English invention, have practically replaced the cast-iron pipe stoves for heating the blast. Enthusiastic agents, eager to swell their commissions, made extrava-

gant claims for super-heated blast, in fact representing that brick stoves were really a panacea for all blast furnace ills.

They have proven a valuable adjunct, but many failures and serious troubles, scaffolds, etc., followed their introduction in many instances. Numerous minor but important improvements have been made in tuyeres and tuyere fixtures, etc., permitting the replacing of tuyeres in 5 to 10 instead of 30 to 40 minutes.

We have replaced tuyeres with only stoppages of 2 to 3 minutes. This may be considered incredible by many furnace managers.

We now use mechanical appliances for stopping the iron-tapping hole, an invention of Samuel W. Vaughan, manager of the Cambria Iron Co's furnaces, thus saving many long stoppages. When a furnace is making iron at the rate of 8 to 10 tons per hour or more, the importance of every minute saved in stoppages can be appreciated.

One of the most frequent and troublesome of the mechanical difficulties is the formation of "scaffolds" in the furnace.

A scaffold is an accumulation on the walls of the furnace, offering an obstruction to the regular and even descent of the material and diverting the uniform distribution of the gases.

Scaffold material is an agglomeration of coal or coke, limestone and ore, partially fused into a solid mass and fastened to the walls. Sometimes scaffolds form a short distance above the tuyeres and gradually grow, extending far up into the shaft of the furnace. At others they commence at the top of the boshes, beyond the reach of the tuyeres, extending upwards and towards the centre of the furnace. Not unfrequently the area of the furnace is so completely occupied by this solid mass that only a small opeoing, a few feet in diameter, is left free from top to bottom.

Of course the operations of the furnace are brought to an inglorious close, but usually only after a hard and laborious fight—a very expeusive contest.

On other occasions the obstructions cause irregular working, inferior iron and high fuel consumption, with excessive costs, but may not be sufficiently serious to put the furnace out of blast. As a rule, however, it does not pay to fight a serious melted scaffold in the hopes of restoring the furnace to good working condition. It may appeal to the professional pride of a manager to continue the fight, but as a commercial proposition it is usually cheaper to stop, shovel out and try again. Scaffolds are not as frequent as formerly, but they are still a serious menace and in one form or another are a constant source of danger and anxiety.

It is estimated that fully 70 per cent. of the heat of the crucible is brought into it by the solid materials which, in their descent through the furnace, come in contact with the highly heated gas currents.

The effect of any serious interruption to the regular descent of this stock can be thus appreciated. The working or acting area of the furnace being thus reduced by the scaffold accumulation, the flow of gases is confined to a restricted channel. The time of contact with the ores is lessened so that they reach the crucible unprepared for melting, which further lowers the temperature of the crucible. The blast meets with greater resistance, and at times the whole power of the engine fails to drive the air through the furnace. The flow of gas failing, the hot-blast stoves are thus deprived of their source of heat, and the temperature of the blast falls. The boilers are fired with coal to maintain steam to operate pumps and keep the engine moving. Finally a passage may be opened and gas again flows through the stoves as the blast finally works its way through the obstruction.

With the lowering of the temperature of the crucible the tuyeres are closed with a semi-fluid mass of iron and slag, communication between the tuyeres and cinder notch or slag opening and the iron tapping hole is obstructed by the partial chilling of the contents of the crucible. Days, and sometimes weeks, elapse before any iron of merchantable shape and quality is run into the pig beds.

My first experience of a genuine scaffold of the worst kind was a few months after I was entrusted with the responsibility of the management. During an absence of a few days my foreman filled into the furnace a lot of dirty limestone. The limestone shipments had been delayed by wet weather. The centre of the stock pile was reached, which proved to be very dirty from long-continued dumping and the daily removal of clean stone from the edge of the pile. For two weeks I never saw a bed. The struggle lasted a month or more. Finally the furnance was restored to normal working condition, much to my gratification, but a great expense and loss to the company. I was thus early impressed with the importance of exercising the most careful watchfulness as to the preparation of the material filled into the furnace—ores, fuel and limestone.

It was a valuable though a costly lesson, and I have since tried to make good use of it. It pays to use every precaution to prepare the stock before filling, rather than throw additional work on the furnace and run the risks of serious disturbance of its operations.

By experience we learn the various symptoms characteristic of disorders or variations from normal conditions, iust as physicians determine disease.

The correct diagnosis is more or less difficult and obscure, as different causes produce the same results. It is just as easy for the furnace manager to draw wrong conclusions and administer the wrong remedy as for the doctor, though he may have the more or less intelligent assistance of his patient.

In the meantime the patient in both cases suffers the penalty of ignorance, however excusable that ignorance may be on the part of the attending expert.

Serious difficulties command the attention of even the average workmen. They mean hard work all around. In many instances less than one-half of the labor necessary to overcome troubles would have prevented them altogether if the warnings had been observed—in other words, if the symptoms had been detected by close application and attention to details. I have always endeavored to impress this fact upon my foremen, by precept and example.

When the furnace is running along smoothly then is the time for the manager to be watchful, to give attention to minute matters, and thus endeavor to keep her running regularly.

The average man, under such conditions, is apt to become careless and neglectful. He fails to observe indications of importance, not purposely, but simply from lack of intelligent observation.

Seeing, he sees not, that is, he does not perceive; the mind is dormant. Constant watchfulness and preparation for difficulties that may never come, is no more an evidence of undue nervousness than a laudable ambition to improve one's condition is to be confounded with restless discontent, so disastrous to all effort.

The formation of scaffolds is due to many causes, and sometimes they apparently come from no *traceable* cause, simply from "pure cussedness."

Scaffolds may result from the furnace being too hot, as well as too cold; from errors of fluxing or variations in materials, (theory may be all right but practice all wrong); from improper filling of stock, either from badly proportioned bell, neglect in the stock house or on the part of the top filler; from long continued use of excessively basic slag, lime scaffolds may be formed, or from use of slags too silicious.

Unexpected stoppages, due to accidents, allowing no time for preparation, may or may not be followed by scaffolds more or less serious.

The gangue of certain ores, fusing to a sticky mass at comparatively low temperature or the use of an easily clinkering coal, may be responsible. A hard and tough white ash coal is required for blast furnaces.

Volume of air blown, area of tuyeres and heat of blast, under certain conditions, are frequently important factors.

Time will not permit any reference to remedies employed to dislodge and remove scaffolds, other than to remark that they are sometimes heroic, involving the liberal use of dynamite or practically blowing out or lowering stock below the scaffold, thus loosening it by melting away the foundation and then refilling.

Methods will vary with circumstances and the judgment of manager.

Other disturbances to uniform settling of the stock are known as "arching," "hanging" and "jumping." These invariably produce bad results. If continued, they add to the cost of the iron and at same time cause the production of lower grades and inferior quality. They are not necessarily dangerous.

If not corrected, however, the conditions producing them may lead to a permanent melted scaffold. They may be considered as warnings of something worse to follow.

Accumulations may form on the bosh walls of considerable thickness that in no way interferes with the uniform working of the furnace. If these accumulations are evenly and regularly distributed they serve to protect the brick work from fusing and from the destructive chemical action of the slag and gases.

This coating at times forms ar artificial bosh, more durable than the original brickwork, in fact a graphitic lining.

Furnace "kish" corresponds closely in composition with native graphite, from which plumbago crucibles are manufactured.

Artificial graphite contains more iron than the native, as the following analysis will show:

	Fe. %	SiO_2 %	C. %
Native graphite	1.6 to 4.6	2.4 to 8.6	78 to 85
Artificial or furnace graphite.....	17.3	2.20	70.74

When two to three tons of fuel were consumed per ton of iron, or when comparatively large furnaces made but small products, the artificial or furnace-made bosh lining served to lengthen the duration of the blast. Modern practice, however, does not rely upon this formation to protect the bosh walls, finding it inconsistent with fuel economy and large products.

Modern Construction.

With more intelligent management the common construction previous to 1880 was found insufficient. The changes were gradual, experimental, groping in the dark, as it were.

Each change was made to overcome some special difficulty, as the necessity presented. Probably this side of the subject can be best illustrated by giving a short sketch of the operations of the Warwick furnace. This furnace was first started in 1875.

From 1875 to the summer of 1877 it was in charge of experienced founders, of good reputation, but one scaffold followed another, varied by chilling, about every six months, so that the company was brought to the verge of bankruptcy. The causes were various, but chiefly to the lack of knowledge of the material used.

The ores used and mined by the company were of different composition from those usually employed in the Schuylkill Valley at that time. The largest product of iron for any one week was 190 tons, which represented the average best work of furnaces of the same size in the vicinity. The weekly average, however, of any one blast barely exceeded 50 tons per week for the reasons mentioned.

November, 1877, the furnace was placed in my charge. No changes in construction were made except the substitution of a 7-foot bell in the place of a 5-foot bell. In blowing in, the furnace started excessively hot, causing me much anxiety, but it proved a blessing in disguise, as was demonstrated a couple of years later.

A graphite coating was formed on boshes, or a scaffold evenly distributed, preserving the brick work without interfering with the working of the furnace. The bosh walls, following the construction of that period, were about 3½ feet thick.

In the course of a few weeks the furnace reached a weekly make of 300 tons and over, an unheard-of product at that time for an anthracite furnace of its size.

It created more local excitement and interest than a make of 1,300 tons does now. When congratulated I replied that I was sorry, I was afraid that a standard had been made that could not be reached again. We ran 105 weeks without special incident, when the inwall gave way, terminating the blast.

The average weekly product was 357 tons.

The furnace was relined, maintaining the same construction, and blown in March, 1880. My troubles now commenced, 1880 being an eventful year. It was a life and death struggle, not only for me, but the new method of management was on trial also.

I had earned the jealous hatred of the Old School, and my troubles were a source of no little satisfaction to many.

Furnace was blown on March 28, 1880, care being taken not to allow the furnace to start so hot, or grey as it is termed, as the previous blast. A good start was made, the product averaging 368 tons per week, but we only ran six weeks. A new furnace disease was developed; symptons were not wanting, but their significance was not appreciated until some months later. No serious irregularities were experienced, until upon a certain night following an unusually large cast, the stock settled a few feet from the top, a common occurence. Following each cast a stoppage was then necessary to close the iron tapping hole. On starting engine it was found that the resistance to blast entering tuyeres was so great that the engine was barely able to run. Gas failed, steam became short, necessitating heavy firing. The tuyeres became a dull red, showing partially fused iron and slag.

Melting practically ceased. Communication between tuyeres-cinder notch and iron notch was cut off. With 14 pounds pressure at the tuyeres, scarcely any flame was perceptible at the open iron or cinder hole. Some of the tuyeres became solid; others melted slowly. The liquid, not being able to sink into crucible, formed a column of sufficient weight to over-balance the air pressure in tuyere pipe and flowed back and filled the pipe with a mixture of slag and iron.

After struggling day and night for several turns I was forced to admit that the furnace was chilled. We proceeded at once to empty the furnace. In cleaning out it was noticed that from the tuyeres upwards for a distance of ten feet or more the contents were a mass of finely divided dirt, analyzing 47 per cent. coal, 46 per cent. ore, 7 per cent. limestone. Above this mass of dirt the stock was in good condition. Below the tuyeres the crucible was filled with dirt, offering no difficulty to remove.

There was no iron to contend with.

When furnace was finally emptied, measurements were taken, showing the inwall above boshes to be in good condition and of about the same dimensions as when blown in, but the bosh walls were completely melted, only a light shell on the outer course remaining, about 9 inches thick instead of 42 inches.

It was assumed that the brick used was of poor quality, but this explanation, while the best that could be given at the time, was not satisfactory to me, nor probably to any one else.

There was no evidence of a melted scaffold such as previously described, and "dirt scaffolds or dirt troubles" had not then received a name. During this short blast we made mill iron, and my critics asserted that I was running for sake of a record without regard to the durability of the furnace, and that no furnace could stand such treatment.

Repairs were made, a new bosh with different make of brick being constructed. The furnace was again blown in August 27, 1880.

This time I aimed to make foundry iron to meet the criticisms mentioned. It was generally understood that foundry iron formed graphitic protection to the bricks, and to this extent prolonged their service. This was undoubtedly true when combined with large fuel consumption and small product, but fortunately or unfortunately for me our product of foundry iron averaged 382 tons per week, a larger weekly product than had yet been reached.

In nine short weeks we had a repetition of the previous blast almost exactly. In the midst of the best working and largest yield, with scarcely any warning, the furnace was again chilled.

Precisely the same conditions were found to exist as before, only more so. The loss of brick work extended higher up the boshes, the mass of dirt being proportionately greater.

To say that I was discouraged does not begin to portray my feelings, but I was determined to kill or cure. In cutting away the brick work below the mantle, in order to make an opening to remove the stock, I noticed that as soon as the workmen penetrated and air was drawn in through a small hole, cinder commenced to trickle down. As the opening was enlarged, the stock was shown to be white hot and in good condition. It then occurred to me that the whole trouble was due to the dirt, and if the dirt had been removed through the tuyeres by ravelling out we would have been saved much hot and hard work and the furnace might have continued in blast. At the time, however, it was too late.

When furnace was emptied, the boshes were found to be completely destroyed, but the inwall was in good condition.

While discouraged I was not hopeless.

I was now satisfied that all my efforts would prove of no avail unless some means could be provided to preserve the boshes.

The walls being thick, as they melted, the area above tuyeres greatly enlarged. The cavities thus formed filled with "dirt" or finely divided ore and coal.

The volume of air blown was not sufficient to fill and keep active the enlarged area. The chilling was due to this mass of dirt being dislodged and settling into the crucible, thus preventing all contact between the air and fuel, the temperature being just sufficient to form a pasty, semi-fiuid mass.

My idea was to hold the bosh-walls intact and maintain their shape and dimensions. Mr. P. L. Weimer, of Lebanon, one of the most progressive and intelligent furnace constructors of his time, became deeply interested, and, as a result, the first instance of a water-cooled bosh, in this section at least, was constructed.

This was accomplished by employing a series of vertical pipes encircling the entire bosh, and in height about 15 feet above the tuyeres. They were placed against the old shell of brickwork and only a lining of nine inches of brick was used in front of them.

Many were the criticisms as to the absurdity of attempting to run a furnace encircled with a flowing stream of water.

The furnace thus constructed was blown in December 15, 1880, continuing in operation 245 weeks, showing a larger product for the blast than had ever been made by an anthracite furnace, average weekly product, including many stoppoges and delays, being 416 tons, and the total make about 102,000 tons.

Thin bosh walls had been previonsly used in Germany, but had not attracted much attention in this country.

This blast, terminating September 1, 1885, was not without many incidents of interest and much hard work, giving opportunity to study the "dirt trouble" or "dirt scaffold," and to become familliar with the symptoms and guard against serious consequences.

By maintaining the size of bosh, the "dirt" was prevented from accumulating in such quantities as to endanger the safety of the furnace. It would take too much time to go into further detail, but suffice to say that the folly of thick bosh walls was demonstrated, thus leading to the present construction of thin walls protected with rows of bronze bosh plates, which method was elaborated in the West.

"Dirt troubles" were recognized as one of the conditions co-incident with the new practice of comparatively large product and compartively low fuel consumption, but more particularly confined to the use anthracite coal. They, however, are not unknown to the coke furnaces.

By close watching we are now able to control them, but so far have not succeeded in preventing the formation of the dirt.

The blast commencing December, 1885, was of 180 weeks' duration, averaging 598 tons per week. New and larger iron stoves were added to the equipment during the repairs, enabling a larger volume of air to be blown than previously.

This, together with the use of one quarter coke addition enabled us to increase our product. We had our "ups and downs," the average results, however, being fairly satisfactory. The bosh coils were used to maintain the shape and size of the boshes, 18 inches of brick being placed in front of them.

The blast October, 1889, to July, 1892, lasted 144 weeks, averaging 744 tons per week. A new stack had been constructed, 70 feet high, instead of 53 feet, and bosh walls, 18 inches thick, protected with water coils and strengthened with a bosh jacket. We had several serious "dirt troubles." With each improvement in construction, designed to overcome the troubles, the product of the furnace was increased so that relatively we were in the same position in this respect as before. However, while we could not prevent the accumulations, we learned to handle them to better advantage.

Several times during this blast we were obliged to use oil blowpipes to melt out chilled tuyeres and open the iron tapping hole, closed with chilled iron, remove the tuyere and ravel out the stock which consisted chiefly of fine dirt.

For several days little or no merchantable iron was made, but finally in each instance the furnace was restored to normal working condition.

During the blast from October 1, 1892, to September, 1896, 206 weeks, we made a product of about 204,000 tons iron, using half coke and half coal as fuel.

In the first six months we had several serious experiences from "dirt," due in great part to over-confidence in the high heats of blast from our new brick stoves and the larger use of coke. It was assumed that the high heats of blast possible with brick stoves, as compared with cast iron pipe stoves, would enable us to contend with "dirt accumulations" without taking the usual precautions. Greater confidence was also felt in the bosh construction, we having substituted bronze bosh plates for the water coils. Only four inches of brick work was in front or the bosh plates, so that the bosh could only enlarge eight inches in diameter, thus leaving less room for the lodgment of dirt During the first six months we learned that this confidence was misplaced. Our old enemy was as much in evidence as on previous occasions.

Our weekly product of iron reached 1,000 to 1,100 tons.

The dirt accumulation formed higher up, lodging at the top of the boshes, above the bosh plates in the widest part of the furnace.

Neglecting, in a measure, our usual precautions, and taking chances or risks, we suffered in consequence. The average furnace employee is naturally conservative, opposing on principle every innovation, and charging every trouble to any new device or construction that may have been adopted. He forgets the past and is constantly citing the "good old times," as better educated and better informed people are in the habit of doing.

The new bosh plates were condemned as being responsible for the irregular working, and this belief caused a hopeless discouragement to take possession of my principal men, unfitting them for effective work, notwithstanding all the records I was able to show to the contrary. They could not or would not be convinced.

On one occasion an opportunity occurred to prove conclusively that bosh plates were innocent of all blame.

Following an unusual large cast of iron, as on previous occasions, the dirt accumulation loosened and moved down to tuyeres so that the furnace would not take any blast.

Instead of attempting to force blast into the furnace and thus closing the tuyeres with semi-fused iron and slag, the engine was stopped and several tuyeres removed before the dirt was fused into a sticky mass. Bars and hoes were used to remove the stock.

In a short time we were almost overwhelmed with a flow of red hot dirt flowing like so much red hot pewter sand.

This was removed and the ravelling continued until the lower part of furnace was completely emptied, but there was no movement of the stock on top of furnace Dynamite cartridges were used above and below to cause settling but with no effect.

The men were cautioned to keep away from tuyere openings, for fear of accident in case the stock should drop suddenly and drive out a volume of burning gas. No movement occurring, my foreman and myself cautiously approached a tuyere opening and, reaching forward, looked up into the shaft of furnace. The boshes were found to be perfectly clean and in beautiful shape, the bosh plates were seen to have nothing whatever to do with the trouble, as an arch had formed fully fifteen feet above the top row of plates.

The skew back of this arch was later located more exactly by drilling holes through the brickwork.

Had this arch given way while we were at the tuyeres openings, we would have been cremated.

The tuyeres were replaced and the engines started.

Gas issued from the top of furnace. The blast pressure was low. This gradually increased, becoming quite high, and the flow of gas almost ceased again. Conditions assumed a serious aspect, for unless this arch broke away the blast was ended.

Gradually the pressure lightened, showing that the blast was making its way through the arch, and finally, with a terrible roaring noise, the stock settled or jumped, making a pyrotechnic display that would have been interesting under more favorable auspices

Red-hot coke, in large quantities, was driven out of the top of the furnace (the bell fortunately being open) down through the gas flues and up through the stove checker work and chimnies, for many feet into the air. This occurred about midnight.

The scene for a minute or two, with the mass of fire and gas, was calculated to cause dismay, if we had had time to think.

Fortunately no one was injured.

The furnace resumed working and commenced to melt regularly.

In the course of a few days, after more or less trouble with a high bottom and chilled taping hole, necessitating the use of the oil blow pipe, the furnace was in normal working condition.

After this we did not take any more chances. All were convinced that the bosh plates were not the cause of the irregular working, and with renewed courage we went to work to combat our old enemy with the confidence born of many victories.

If we could not prevent the dirt accumulating, by carefully watching the symptoms, we could prevent serious consequences following.

So far the present blast, commencing December, 1896, has been free from any serious troubles of the kind, but only for the reason that we are constantly on the watch and do not permit the slightest symptoms of disorder to pass unnoticed.

We are now making 1,200 to 1,400 tons iron per week—the total product for 1897 being 63,137 tons—as compared with 17,148 tons for 1878.

Careful, experienced and intelligent nursing is just as important in the modern furnace as in the modern hospital.

On an Improved Appliance for Drawing Timber in Mines.

By Mr. D. H. F. Mathews, H.M.I.M.

Prop drawing in mines has always been considered one of the most dangerous operations that the miners have to carry out in collieries: and any apparatus which is more safe and more powerful than the old gablock, or dog and chain, and which will assist in reducing the accidents in mines, and probably lessen the timber cost of a colliery, should be readily welcomed.

I find by Mr. Hall's reports of the Liverpool district for the last five years there have been twenty-eight fatal accidents from prop drawing, and it appears that only one of those accidents occurred when the gablock and chain was being used at the time It happens frequently that the gablock and chain is provided for the prop drawer, but he does not always use it, because it causes him a little more trouble and loss of time: and judging the roof to be strong enough to stand, he strikes the prop out with his hammer, when the roof may fall upon him any moment, causing severe injuries, and sometimes unfortunately proving fatal.

The improved appliance, known as the Sylvester Pulling Jack, is the best and safest apparatus the writer is acquainted with for withdrawing props in mines

It has been in use in North Staffordshire for some time, but has only lately been introduced into a few mines in this district, and is giving great satisfaction. The machine is of very simple construction, being founded on the principle of the gablock or dog and chain. I had the pleasure of seeing it tested first in the Bickershaw 7 ft. Mine, at Messrs. Ackers, Whitley & Co.'s Collieries, Leigh, and I was very much struck with the safe manner in which props were withdrawn from old wastes or goaves with its use.

The machine consists of a steel bar 3 feet long, 1½ inches deep, and ⅝ inch in thickness; having specially shaped notches about one inch apart, ¼ inch deep along one edge. A short chain is attached to the bar for fastening it to a firm prop. The notches of this bar form the fulcrum for a 3 feet lever, which is made with a forked end, through which pass two ¾ inch bolts, the bolts being placed a little more than 1 inch apart. The bolt which turns in the notches allows the lever to describe an arc sufficient to bring the sliding block to the next notch. The other bolt connects the lever by means of a link to the block, which slides along the notched bar.

This sliding block serves two important purposes, firstly, it is fitted with a catch bolt which falls at right angles into the notches of the bar holding the block, while the lever reaches forward into the next notch; and secondly, the rear part of the block being formed into a jaw-shaped recess, it allows any link of the chain used for attaching it to the prop to be withdrawn, to be connected and securely held. This

prevents, to a considerable extent, the loss of distance along the notched bar when taking hold of a fresh portion of chain, as the length of chain may be easily regulated.

A leverage of 30 to 1 is obtained by Sylvester's Pulling Jack, although only a 3 feet lever is used, which is a great improvement on the old gablock, which on an average is only 7 to 1.

The machine may appear at the first glance to be slow in action by its only moving 1 inch per stroke of the lever, but when we consider that probably one-third or more of the distance advanced by the old gablock is lost again through the springing back of the prop in consequence of having to take hold of a fresh length of chain after each movement, the improved machine has really the advantage in regard to speed as well as being much more powerful.

The appliance is attached to a firm prop, which may be several feet away from the prop in the waste which requires to be withdrawn, it depends on the length of chain used, the average distance being four to five yards, but I have seen the machine fixed nine yards away from the props to be withdrawn, and two men were able to get out seven 7-feet props in the one fixing of the machine in thirty-five minutes, and each of those props would cost one shilling each to the colliery proprietors before they were sent down the mine. This will prove that if the machine costs thirty shillings it will soon repay itself in the value of timber to be re-used again, as well as securing greater safety for the men employed in that class of work. The machine has also been found useful in taking old bars out, when they require changing in haulage roads. The machine can be attached to the haulage rope, or to one of the secure props, some distance away from the bar to be withdrawn, which will be found much safer than the old method usually adopted. Sometimes labour and loss of time is caused when trams or tubs are locked together through their breaking away in jigs or endless-rope brows. The pulling-jack in these cases may be hitched to the rails, rope, or chain, and has been found to be of great service. The weight of the machine is only 28 lbs, including the three feet length of chain and hook attached to the notched bar, and can be easily carried by one person. The writer is of the opinion that when this machine is more generally used, and a special rule adopted at collieries that no timber must be withdrawn from the wastes or goaves, or working face, or roadways, except by authorized qualified prop-drawers, and then only by means of a gablock and chain, or patent pulling jacks, that accidents occurring from prop drawing in mines will be considerably reduced. I am glad to be able to state that one company in this district has recently adopted rules to that effect, where they have sixteen of Sylvester's machines in use, and they do not allow timber to be knocked out on any account by their prop-drawers. The inventor of the machine is a workman in North Staffordshire; and the writer has written this paper with the hope that it will assist to bring to the front an apparatus which will be the means of saving life and limb in mines, and has great pleasure in introducing it to the members of the Society.

The PRESIDENT said that he thought they were indebted to Mr. Matthews for calling their attention to what appeared to be a valuable machine for the saving of life and limb and as he made out there was great economy in the use of it.

Mr. HUTCHINSON said that they had introduced the machine at the Bamfurlong Collieries. He had put it into the hands of men who had been drawing timber at least 14 or 15 years, and who were used to the gablock and chain and the ordinary method of drawing props, and they said they could draw 12 to 13 props with the "Pulling Jack" where they could draw six or seven before. Not only that, they said that many props which they would have had to leave in the goaf and which they dared not go in to loosen under the old system, could now be got out by this appliance. He had no need to doubt those statements, and its use meant a great saving to them because every prop cost over 1s. He had ordered several more machines, and in another month they would have 15 or 16 machines in use at their collieries. From the experience he had had he was sure, both in point of safety, and saving to the colliery proprietor, it was the best method of prop drawing

Mr. TICKLE said that the Abram Coal Company, through the instrumentality of Mr Alfred Johnson, was the first to use this apparatus in the Wigan district. He had watched it and had been with the men when the machine had been tried. They had used it in the Wigan 4 feet, Wigan 5 feet, and 6 feet, and Orrell 5 feet, and under every possible condition and had found it to answer very satisfactorily. Objection might be taken to its weight, but it was not very great, and the question became very small when they considered the greater safety of the men when using the apparatus. The difference in weight is 16 pounds, and he contended that was very little when life was at stake. He got a report from one of their timber drawers in the Orrell 5 feet mine. In 7½ hours they took out 200 props and bars, and not one of them cost less than 1s. 3d. each. He considered that was very satisfactory for the time it took to get out the timber. The men took to using the machines better than they did to the old gablock and chain, because they knew they could gain so much more with less trouble and with greater safety to themselves. Experienced timber drawers, having a thorough knowledge of the machine, could so arrange their work that they need be no nearer than ten or twelve feet from the prop which had to be drawn. No hammer is required in the operation, a great point to be considered in timber drawing. He had no trouble at all in getting the men to use the machine, and he had great pleasure in supporting Mr. Mathew's views. They had 21 machines in use, and in fact, they had withdrawn all their old gablocks and chains. They had provided the timber drawer in each district with one of the machines. The Pulling Jack can be applied to many other useful purposes underground, especially in main haulage roads, breakdowns, &c, or for tightening ropes, lifting heavy timbers into position. The machine is very simple, easily handled, and not liable to get out of order. It is bound to come to the front in practical mining work.

Mr WINSTANLEY proposed a hearty vote of thanks to Mr. Mathews for reading his interesting notes on this machine. He said that he took particular pleasure in doing so, because they had in that particular appliance one of the very few inventions which had been brought out by a man actually engaged upon the work with which the appliance was connected. They had in connection with the mining industry hundreds of inventions brought out by people who never went down a pit in their lives, and of course it went without saying that those appliances were never successful. He happened to know the circumstances under which this machine was brought out, and it was the result of Mr. Sylvester's careful observation and practical experience. Wherever it had been used it had been found very useful in connection with all manner of heavy colliery work, as well as in drawing timber.

Mr. UNSWORTH, in seconding the motion, said that he had taken considerable interest in the paper, because it was for the want of an apparatus of that sort that he lost the very first workman who was killed under him The man was drawing props and he left one in the waste, and he rushed in and knocked it out, which brought the roof down and buried him. He thought at every colliery where they had a hauling apparatus of any kind whatever, the instrument would be very useful in straightening up the road after an accident by withdrawing the tubs and putting them in position where manual force would be of no use whatever.

The PRESIDENT said that no doubt the machine put into use would mean a saving of life and limb as well as economy.

The motion was passed.

Mr. MATHEWS said that he had brought the subject up from a safety point of view, as when the Compensation Act came into operation it would probably be considered more important as giving greater security whilst performing that class of work in mines.

A vote of thanks to the President closed the meeting.

The Stamp Milling of Gold Ore.

(Discussion Chemical and Metallurgical Society of South Africa.)

The CHAIRMAN re-opened the discussion on Mr. E H. Johnson's paper on "The Stamp Milling of Gold Ore in its relation to Cyaniding." Some apology was dne to Mr. Johnson, he considered, for having postponed the discussion so long.

Mr. F. WHITE: This discussion has been postponed for so long that I am afraid a good many of us have forgotten what took place at the last meeting. An interesting point in connection with stamp milling is: Do the heavy stamps now generally employed give a proportionate increase in quantity of ore crushed as compared with lighter stamps, the amount of water used per ton of ore crushed being the same; also, whether the percentage of slimes produced is the same as with lighter stamps. I am inclined to think that the percentage of slimes is generally over-estimated. In an account of the work done at the Windsor Mine, published in the *South African Mining Journal*, I noticed that the slimes are but 16 per cent. of the total weight of ore milled, and the value but one dwt., which is clearly too low a figure to be profitably treated by any slimes process at present known. Now, I should like to ask those who advocate the necessity and advantage of a separate slimes treatment, should the battery manager at this mine endeavour to make richer slimes, and more of them, so as to find work for a slimes plant, or should he try to still further reduce the amount? The Robinson and Ferreira Companies find that the weight of ore milled has been over-estimated by, in the one case six, in the other five per cent. As it is to be presumed that the weight of sands treated in the cyanide vats is accurate, this difference of five per cent. or so will probably have to come off the slimes, reducing the generally accepted percentage to 15 or 20 per cent instead of 20 or 25 per cent It is possible, therefore, that the contents of some dams supposed to contain a large quantity of accumulated slimes are over-estimated to the extent of 25 per cent. It is possible that such an error as this was the cause of the great discrepancy between the actual and theoretical extraction to which Mr. J. R. Williams called our attention when reading his paper on "The Treatment of Battery Slimes," in July last. He then said: "The system adopted is to take the difference between mill and tailings' tonnage, and call the difference slimes." He clearly inferred that the tonnage of slimes had been over-estimated. Applying the experience of the Companies to which I have referred, it looks as if the tonnage milled at the mine Mr. Williams alluded to had also been over-estimated. The application of these remarks to Mr. Johnson's paper shows, I think, that when we are discussing whether stamps make too much or too little slimes, we should be sure that the figures on which our arguments are based are fairly correct, and not "estimates," as is too often the case. I would like to support Mr. F. Alexander's remarks in reference to the thickness of wires of which screens are made. When mention is made of number of meshes per inch in screening used it is very necessary to state what is that size of wire, whether fine, standard, or coarse I am indebted to Messrs. Raleigh and Rockey for calculations which show that in screening of 700 meshes per square inch, fine wires give 11 per cent increase in discharge area over standard wire, and 16 per cent. over coarse wire. Although fine screens may not last so long as the others, it is very probable that the extra discharge obtained and decrease in slimes formed, will more than compensate for the extra labour required in changing screens with more frequency. I have found that the proportion of water-borne material, or slimes, produced in crushing Rand ores is approximately 40 per cent. of the quantity which will pass a sieve of 90 mesh per lineal inch. Our President, in referring to his experience in treating slimes, stated that after a certain limit in classification is reached, filtration is stopped. I would like to suggest, as an explanation, that the percentage of interstitial spaces or the free way for the passage of liquid between grains of sand when these are properly classified is the same, though in one case the grains may be one-thousandth of an inch in diameter, and in the other only one-tenth, but the resistence due to capillary attraction or fraction may become so intense in the mass composed of the smaller grains that the passage of liquid due to gravity is stopped entirely. This I think will explain why filtration stops in practical slime work, although theoretically it should not, and also why a mass of slimes retains so much more moisture than an equal weight of ordinary tailings. It may not be generally known, but if a box, say, equal to one cubic foot, is filled with lead bullets of, say, ½-inch diameter, the weight of lead contained in the box will be exactly the same as if it were filled with the finest shot. The reason for this is that the area of a circle bears the same proportion to that of its enclosing square, whether the size be inches or thousands of an inch.

Mr. A. VON GERNET: I think the point mentioned by Mr. White is a very important one. The quantity or tonnage of slimes that is produced by the battery is a highly important matter for purposes of comparison with the tonnage of tailings treated. There are about fourteen or fifteen slimes plants on these fields at present at work, and some of them have been running a considerable time, whilst others have only recently started. I have lately written to all companies using slimes plants, asking them to give full information on different points, such as the size and kind of mesh used in the battery, the tonnage of tailings produced, the tonnage of slimes produced, the actual results obtained in the different operations, and other points. It is a long list of questions, but we hope in a few weeks by the courtesy of mine managers to get all the data that we have asked for, and we shall then submit the results in due course to the members of this Society. I believe that many points which are at present totally unexplained may be satisfactorily explained by the information we shall get in this way. Before slimes were treated it was a very easy matter to say—"The difference between ore crushed and tailings treated is slimes, which are in the dams," but that time is over now. The information which we hope to get will doubtless be reliable information, and I think it will raise many and interesting discussions on this matter.

MR. J. R. WILLIAMS: I may state in addition to what Mr. von Gernet has remarked that one large group of mines has already ordered a considerable number of automatic weighing machines. We intend in future to weigh all the ore that goes into the mill, and the same with the tailings discharged. When we get these figures before us, we hope to account in both mill and cyanide works for the total tonnage of ore mined, except perhaps abont 2 per cent. of slimes that do not settle. With one or two companies the system of measurement of mill tonnage was adopted, and we came within 2 per cent. of the tonnage on 24,000 tons. On carefully checking the cyanide tonnage however we found some discrepancies, because one company was in the habit of taking 20 cubic feet to a ton, but the time came when we found we wanted 22 and 23 cubic feet to make a ton, notwithstanding the ore had been crushed through the same mesh. On the Rand Mines I believe we have always used the very light screening because we get a higher efficiency from it, and although the cost of renewal is greater, it is on the whole a cheaper system. There is one point in Mr. White's paper I should like to consider for a moment. Whilst admitting that his argument about the lead bullets in a box is all right, yet if he were to mix his coarse and fine bullets in the box he would get in many more. I do not think the size of the particles has much to do with the leaching, neither has capillary attraction. Take a sample of slimes which will not leach in the ordinary way, and use the method first suggested by Mr. Sulman of first adding soap and then hardening the water with lime. You then get a slime which is absolutely leachable, and from which you get a high extraction. So I do not think size of particles has

much to do with the question, as the question is more a chemical one than a mechanical one.

Mr. H. W. MILLER: Mr. Johnson has raised a point which may be interesting to the mechanical section of our members, and that is the temperature of the water used for milling. This is sometimes abnormally high from passing through the condenser. Six or seven years ago we discovered a curious coincidence, that the quantity of water required for the stamp mill was also the same quantity of water wanted for condensing. In later years the mill engines have been so overloaded with electrical and other machinery that the temperature of water passing through the condenser has been naturally raised. There is great diversity of opinion amongst millmen as to whether hot water, or water that is tepid, or cold water is the best for purposes of amalgamation. I have asked the opinion of many managers, but it is very varied. I think the question of reducing the temperature of the water to a suitable point for milling can be overcome, although a larger quantity of water may be required, by a auxiliary circuit pump, and by allowing the larger quantity of the water to go through the condensers, and then returning the excess of water to a dam or reservoir behind the mill. I venture to assert that the expense of running such a pump for the separate circulation of condenser water would be counteracted by the economy of using the condenser and getting the vacuum on the low pressure cylinder.

Mr. J. R. WILLIAMS: I see there is one able mill manager here to-night, Mr. McDowell, and I think we would like to have his views on the subject. Does not he find more difficulty from the varying temperature of the water than from the use of either hot or cold water? I am inclined to think that the temperature of the water has very little influence on milling, but if the water suddenly gets hotter or suddenly gets colder, the amalgam will become more or less floured.

Mr. J. J. MACDOWELL: My experience is that it is desirable to get an even temperature. It does not matter much whether the water is hot or cold, but sudden changes of temperature seriously affect the amalgam. At the Rose Deep we used water at 100° F. and as low as 76° F., and I got very good amalgamation from both, but if the temperature was allowed to vary from one to the other I could not Even temperature is what is wanted; that is my experience. Personally I prefer water at a temperature of 90° F. to 93° F.

Mr. W. A CALDECOTT: Mr. Johnson's contention that it is inadvisable to use hot water in the mill seems to me reasonable, both on the ground that hot water tends to promote the decomposition of the pyrites in the mortar-boxes, with the formation of products adverse to subsequent cyanide treatment, and also because many experienced millmen on the Rand consider its use for amalgamation in this temperate climate unnecessary and even injurious The real point is that since one of the greatest obstacles to successful cyanide treatment is ferrous iron in various forms, anything, such as the use of hot water, which tends to promote its formation, is to be avoided; personally, I should certainly prefer to cyanide material which had been crushed with cold rather than with hot water. It may be noted that Prof. le Neve Foster, whilst at the gold mine in the Val Antigoria, near the Domodossala in Italy, during 1869-70, found that 3·1 per cent. more gold was extracted by amalgamation during winter, when the temperature averaged 39·4° F., than during summer, when the average temperature was 52° F.

Mr. Johnson's mention of the influence that the method of crushing in the mill has upon subsequent cyanide treatment may be considerably developed. For instance, the sudden reduction of height of discharge is equivalent to greater average diameter of sand particles, with consequently more inaccessible gold, or higher residues. Another result is sudden increase of tonnage milled, which involves irregular time of filling of collecting vats, a condition of affairs which does not conduce to successful running of a cyanide works. Unfortunately the mill, and what happens therein, is in too many cases a sealed book to the cyanide manager, who is thereby debarred, not ouly from ascertaining the cause of the otherwise mysterious variation in residues, but also from any influence in preventing the recurrence of bad results. It is becoming daily more evident that all the reduction works or gold recovery plant of a company should be run as one whole, with mutual co-operation between those responsible for the various branches, and the present disregard shown in many cases, by one portion of the metallurgical staff for the convenience or interests of the other, is decidedly detrimental both to the interests of the shareholders and to the credit of the general manager of the company. The time when the mill, with its amalgamated plates and vanners, was practically the sole means of recovering the gold, is now a thing of the past, and the instinctive feeling of the millman that every ounce of gold he did not catch was gone for ever, must now be modified to suit present conditions.

Mr. Williams' remark that the nature of the ore entering the mill greatly influences the cyanide extraction, is obviously true; not only the fineness of the gold and its distribution throughout the matrix would affect the results, but ore which had been broken some time and exposed either in the stopes or at grass would naturally weather and become acid with the formation of reducers, rendering it more difficult to treat and increasing the cyanide decomposition. The condition in which iron exists in pyrites and its effect on subsequent cyanide treatment have recently been discussed at length by Recknagel in a most interesting paper (*Eng. and Min. Journal*, 13th Nov., 1897). He points out that, although yellow iron pyrites and marcasite have the same chemical composition, FeS_2, yet the iron in the latter is in the ferrous state, and that where this exists difficulty is found in cyaniding the ore.

Mr. W. VERSFIELD: With reference to the state in which iron exists in pyritic ore, the following extract from a recent letter from Dr. Hahn, of the South African College, may be of interest:—

"Every year we make a very large number of iron and sulphur determinations of pyritic ore. We rarely get a sample in which the result agrees exactly with the formula FeS_2. There *are* such examples of pyritic ore, but in the majority of our determinations we find the result agreeing with something lower than two of sulphur. In all these cases I should say we have a mixture of FeS_2 and Fe_6S_7, or of FeS_2 and FeS; in fact you may consider Fe_6S_7 itself a mixture of FeS_2 and FeS. I am perfectly convinced that a good deal of cyanide is consumed by FeS, because, according to our experience, which extends over at least fifteen different samples, of which over 200 determinations have been made, we rarely met with pure FeS_2, the amount of sulphur being as a rule below this amount."

In a later letter Dr. Hahn states that he could not say where all the samples came from, but some that were found to contain less S than in FeS_2 were from the Geldenhuis Mine.

By permission of the Chairman, the following remarks by Mr. J. A. Wilkes were read by the Secretary:—

If the last discussion (Jan. 24th) proved anything, it proved the necessity of each mine conducting independent experiments. Leaving out the few plants which have been erected during the last 12 months, what arrangements exist for such experiments?

To find out the exact point where coarse crushing ceases to do more good than harm, it is first necessary to partition off the ore bin behind 10 stamps, so that the weight of ore fed into that 10 stamps can be tallied

This 10 stamp must be used as an experimental mill. The ore bin behind the 10 stamp standing next to it must also be partitioned off, so that number 10 stamps can be run under the same conditions as the experimental mill (that is as regards new shoes and dies, drop, weight of discharge, etc.) For it is, of course, impossible to compare an

experimental mill crushing with new shoes and dies with the rest of the mill using perhaps 20 per cent. of light shoes and dies.

The amount of ore fed into each of these 10 stamps would be weighed and the amount of amalgam from the plates kept separate. Their tailings would not only be regularly assayed, but (after each experimental change of condition) sized and each size assayed. In order to obtain easily a reliable assay of the value of ore treated in each mill, regular samples would be taken from the lip of the mortar boxes (and, therefore, amalgamation in the boxes would be stopped if it was used).

Then, of course, a tank and spitz-lutte in the cyanide works would be kept separate for the experimental mill.

Given these slight alterations (with perhaps the wages of an extra man in the mill), data could be obtained leisurely and surely, which would very soon lead to improvements in the present milling and cyanide practice on a lot of mines. In six months or at least a year the extra bother and expense of experimenting would be over and our mill and cyanide men would possess that most valuable of all knowledge, *i.e.*, comparative experience.

Unquestionably every plant should be designed or altered in such a way that a part of it can be easily isolated and used for experiments without causing any inconvenience or delay in the general way of working

For want of such an arrangement I have seen (within the last three months) two first-class Main Reef companies, who were trying coarser crushing, go back to the finer screening again, simply because coarser crushing increased the value of the cyanide residues. Not the slightest attempt was made to size or in any way analyse the coarser tailings and residues to find out how the loss occurred. No alteration made in the cyanide treatment to meet the coarser crushing in the mill; they did not even attempt the obvious remedy of additional spitz-lutten, but hurried back to the dear old finer screening, which they knew so well, and there they are to-day, satisfied I suppose that coarser crushing is a mistake.

The truth is, a manager does not feel justified in making experiments with a huge mill and cyanide plant, and it is certainly a mistake to turn a large mill into an experimental plant when, by a few alterations, equally reliable data can be obtained from 10 stamps without in any way affecting the sacred output.

I have often heard experimenting men called expensive men; but can they possibly be more expensive than the rule-of-thumb plodder, who runs his plant from 5 per cent. to 15 per cent. below its real efficiency because perhaps that's the way they used to work when they were assistants on other companies.

Another influence against experiments in coarser crushing is the fact that in many cases the necessary additions to the original cyanide plant would be inconvenient and upset present arrangements, and as the results cannot be guaranteed, it is found convenient to rattle on this year the same as last year.

No one knows so well as the manager of an old cyanide plant (which is only just large enough to treat the *average* amount crushed by the mill), how provokingly irregular is the tonnage crushed by the average mill per day and per week. The losses from this cause alone in some of our older cyanide works must be very considerable, as it necessitates either irregular treatment or running the tailings to waste.

There is no necessity for this irregularity. It can be prevented by

(a) Roughly regulating the number of new shoes and dies placed in the boxes at one time.

(b) By putting in false dies as the old ones wear down

(c) By seeing that the night shift men do not turn on more feed in a box to save the trouble of shifting tappets.

(d) By keeping the level of the discharge somewhere near the same height above the level of the dies.

(e) By placing suitable weights on the stems as the shoes wear down.

Of these expedients the last is the most effective and at the same time the most neglected in Rand mills. It has been tried in several mills, but always abandoned, and no wonder, for the additional weights used were old tappets, which were, of course, too long for short stems and would not go over broken stems. They were awkward to get on and off, and mill men soon found that whatever their advantage to the company, they meant a lot of extra work and bother for them and no extra pay, so the weights went.

If some little thought and experience had been exercised over the design of these weights, making them a convenient shape and weight, if they had been designed to go over any stem and fitted with an attached stud or wedge (instead of a loose key), there is no reason why our mills should any longer deluge the cyanide works with tailings one week and starve it the next. I maintain that, although this and other expedients have been tried and abandoned, their exact value and effect has never been known, and never can be known, until two batteries are partitioned and worked side by side, as I suggested.

These weights would mean extra work for millmen, but if they also mean ·25 of a ton more crushed per stamp per day, that is 25 tons more crushed per day in a 100-stamp mill.

If the profit of the company would be £1 per ton crushed, and an extra man in the mill to attend to these weights, would earn the cost of his month's wages in one day.

But though the experimenting cyanide man may be tolerated, the experimenting mill man is looked upon with distrust everywhere Was not the best method of running a mill absolutely determined once and for ever by Hiram J. Wunce-was-out-west, in the year 1849? How then can such as we hope to improve on methods venerable with antiquity, and handed down from generation and generation?

If cyanide men on the Rand think they are going to convert batteries into mere crushing machines for their tanks and lower mill men to the level of Cornish "stamp-watchers" without a struggle, they are very much mistaken.

But I wish to ask Rand mill men a few questions. I hope they will not be considered foolish questions. They refer principally to the rank and file, and not to the splendid new deep level mills lately erected.

Question No. 1.—Why do Rand mill men continue to use slight stems? By slight stems I mean stems of from 3½" to 4" dia., instead of stems as stout or stouter than those introduced three years ago in the deep level mills. Stems of 3½" dia. are easily bent, and in a mill using them, it is safe to say, not one stem (over a month old) will be found straight. Directly a stem is even slightly bent, friction is increased, the hole in the guides wear out of round, the heads then are inclined to knock against each other and against the side of the box. One slightly bent stem in a battery of five will make the millman loosen the guides, to prevent it jambing, and by loosening the guides the holes wear out of true to such an extent, that the guides cannot be re-fitted when worn "chuck-a-block," so the life of the guide-block is shortened 50%. All this is avoided and extra weight given to the stamp by using stout stems. The majority of the mills are thumping away with light stems, because, I suppose, light stems happened to be sent out with the mill when it was erected.

Question No. 2.—Why do practically all Rand mill men use a screen-frame which blocks up with wood in every mortar-box about 3 lineal inches of discharge, where there ought to be screening?

At present the vertical ends of a screen-frame (as made on the Rand) overlap the *length* of discharge-opening (as cast in the mortar-box) by about one inch at each end; and not content with this, they place a wooden stay in the middle of the frame which effectually blocks

up another inch of possible discharge. So that in every mortar box there is crushed ore splashing against 3 in. of wood, where there ought to be screening.

The difference is apparently insignificant. But it is not difficult to prove it is anything but insignificant. For instance :—

Total possible discharge in *our* mortar-box...	49in.
Length of available discharge with present screen-frames.....	46in.
In each mortar-box—diff.....	4in.

So that 3 in. of available discharge is stopped by the wooden screen frames at present in use

There are 20 mortar-boxes in a 100-stamp mill ÷, 20 + 3in. = 60in. of available discharge blocked up by unnecessary wood.

Ten lineal inches of screening in an average mill discharges 4·5 tons per day, so that these 60 in. (if not blocked up) would discharge 27 tons per day (and remember the splash is greatest near the screen ends).

If the profit per ton crushed was £1, that would mean £27 a day or £9,450 profit in a year of 350 working days, and this would be gained at no extra working expense, by this simple alteration.

It may be said that a screen frame would not be strong enough if the ends were reduced to 1 in. and the centre stray removed. But the ends can be strengthened by sheet iron and the centre wooden stray replaced by a ¼ in. shouldered bolt, which would stand free of the screening. But if the screen frames wear out faster, £9,540 would quite cover the extra expense, I imagine.

Question No. 3.—Why do mill men *on the Rand* use chuck-blocks ?

I hope it will not be considered unfair to suppose that each mill is at present using the screening which gives the best results.

Suppose a mill man finds 800 screening to be the right size for the ore he is treating. That is to say he finds that when he has reduced his ore fine enough to pass an 800 screen, the best results can be obtained (taking, of course, the whole metallurgical plant into consideration), you would naturally suppose his one object would be to get the ore through the screen directly it was fine enough to pass it, and to that end he would have the screen where it would receive the greatest splash.

Not a bit of it. Although he knows the bother and loss at present caused by slimes, although he knows the amount of amalgam caught in the box is insignificant (nowadays with pyritic ore) and that the same amalgam can be caught as well on the outside plate with less loss of time. Although he knows he can't crush as much with chuck-blocks, he persistently perches his screen on the top of a 6 or 9 in. chuck-block and thus thousands of grains which have been crushed fine enough to pass through his screen splash instead uselessly against this chuck-block and fall back under the stamps, to be ground to slime, *i.e.*, the *present* curse of cyanide works.

If the object of mill men here was to produce slimes, what could they use better than chuck-blocks? I know only of one thing in a mill which can prodoce more slimes than a 6 in. chuck-block. It is a 12 in. chuck-block. Why, with an 18 in. chuck-block you could use a mortar-box as a spitz-lutte.

Question No. 4 and last.—Why has an important mill like the new Simmer and Jack gone back ten years for a design for battery tables? I was surprised on looking in the mill the other day to find they were working tables similar in every respect to those condemned on the Rand six years ago.

Nine years ago lip-plates were the correct thing on the Rand. They died hard ; it took three years to kill them. But after lots of controversy, it was decided that if you wanted extra amalgamation surface outside, you had far better put it on the end of your table than obtain it by lip-plates. It was found impossible to keep the top of the table in good condition under lip-plates, and that the turnover which the pulp did more harm than good, and that a drop in the middle of the table (*a la* Simmer and Jack) delayed the scraping and dressing of the table, and therefore, also the efficiency of the mill. Indeed, a separate paper could be written on "The abuse of lip-plates," but this paper is too long already.

THE CHAIRMAN : We can hardly hope to reply to all the questions raised by Mr. Wilkes at the present meeting, but at one of our next meetings doubtless a discussion will be raised on his criticisms. His views, it seems to me, are expressed in a somewhat humorous style.

Mr. E. H. JOHNSON : In replying to the various criticisms on my paper "The Stamp Milling af Gold Ores in its relation to Cyaniding," I feel I owe an apology to the members for being the cause of such a considerable encroachment upon the valuable time of the Society. I feel this the more, since, either from want of lucidity on my part, or from some other cause, the criticisms have wandered greatly away from the point of issue. Mr. Franklin White, for instance, seemed to consider it a species of "side show" to dry crushing, and interesting as his figures are in regard to the amount of non-leachable product from various meshes of screen, they bear only on screen products, and not on chuck-block products, which is the point I wish to obtain elucidation on.

Mr. Alexander seems to have grasped my meaning, and I should like to thank him for having relieved me of a doubt that troubled me not a little, viz : that I have expressed myself very vaguely. Mr. Williams inferred that I was advocating coarser crushing. My statement that the "ideal physical condition of tailings for treatment is perfect accessibility of every particle with the crushing carried sufficiently far to expose the gold to the solvent and the minimum reduced beyond that point," I think refutes any advocacy of coarse crushing. There has been a confusion of issues. The points between which I wish to differentiate were the effects of chuck-block grading of pulverization as compared with screen grading, and in this connection I was taking the extremely high discharges which are still used in some of the Rand mills.

The effect of a high discharge, in which category I place the 9 in. one mentioned, approximates the milling effect to one of levigation rather than crushing, and it is this levigation effect that has the deleterious results to which I wished to draw attention.

In cases where a finer product is required, the lower chuck-block and finer screen would produce better product for cyaniding, and a probably higher mill efficiency. The erosion of fine amalgam from a high chuck-block is greater than is generally supposed, as shown by the quantity caught on vanner plates in mills where vanners are used, and the mercury in the gold slimes from the zinc process where vanners have not preceded tailings collection. I have had the mercury as high as 3 per cent. of the gold slimes under such conditions.

Mr. Williams also stated that the variation of a chuck-block from 3 in. to 9 in. was to balance the wear of dies. I would like to ask one of the millmen present if this wide variation really takes place from the wear of the dies. My experience in a mill where a 9 in. chuck-block was used was that the variation was between 8 in. and 10 in., consequent upon wear of dies.

This brings me to another point in Mr. Williams' criticism in which he states that no matter how much slimes are mixed with the tailings, if the tank is filled properly a leachable product can be obtained. I feel tempted to take him literally, and ask him why he uses a slime plant since he can treat the whole product in one operation? What I presume he means, though he does not say so, is judicious elimination of slimes during filling the collecting tank. The conditions I was quoting were filling into long rectangular pits with end overflow, the grade between the mill and the pits not admitting of the use of a spitzkasten

for slimes separation. An argument which appeals to me even more than Mr. Williams' criticism was the fact that when the chuck-block was eventually lowered to an average of 4 in., 10 per cent. more tailings were obtained and 12 per cent. better extraction by cyanide with a slightly improved catch by amalgamation. The latter I attribute to less amalgam escaping from erosion.

With regard to the question of hot water. The facts elicited from the millmen show that there is by no means uniformity of opinion on this point. A good deal of this apparent difference arises probably from the different conceptions of what constitutes hot water. What I had in mind at the time was the water taken directly from the condenser into the mill, and not that which is delivered into an intermediate reservoir and keeps the temperature somewhere in the region of 90°C. Taken directly from the condenser, the water is certainly subject to considerable variation of temperature, which seems to be generally admitted to be injurious. Yet it is a very common practice. With regard to its influence on cyanide work, my contention was that it would tend to *accelerate* decomposition in the presence of decomposing agents. Not that it is in itself a decomposing agent, as Mr. McNaughton inferred. There is evidence that reaction takes places between finely divided iron and pyrites during crushing, according to the formula $FeS_2 + Fe = 2$ FeS. This reaction was detected by Mr. Caldecott in grinding dry two portions of the same sample of pyrites—one in an iron mortar and the other in an agate mortar, and determining presence of FeS in the former. The ferrous sulphide formed is itself soluble in cyanide solutions, and in the presence of air and moisture forms sulphate. I have invariably found ferrous hydrate present in the heated mill water, but to what extent this is obtained in the cold I have not had the opportunity of determining. As regards the influence of heated water on subsequent slimes treatment, Mr. Williams' experience seems to have been quite at variance with that of the Rand Central and also that of the Bonanza, I believe. His argument appears to be based on similar evidence to that of the man who produced fifteen witnesses who had not seen him steal the pig against the two who had; ergo he had not stolen the pig. The balance of evidence during the discussion on this point seems to have been that heated water was not favourable to amalgamation, and it is certainly no particular advantage to cyanide work. Then why use it? An intermediate cooling reservoir is not difficult to arrange.

In the last issue of our Journal there appears a most interesting extract from the *Engineering and Mining Journal*, relating to certain experiments made at the Homestake Company by Mr. Grier, on the relative effects of different temperatures of water on amalgamation. His experience seems to have been decidedly in favour of a low degree of temperature that would be difficult to obtain on the Rand. It is unnecessary for me to refer further to this, as I have no doubt you have all read it. It certainly deserves most careful perusal.

There is only one other reference I should like to make to Mr. Williams' criticism, and that is somewhat irrelevent to the subject. I allude to his comparison between the mill men and cyanide men as a class. Mr. Williams is probably right, but as comparisons are always odious, to quote an old saw, and as there was nothing in my paper to induce the remark, I must certainly repudiate any desire to cause friction which such a remark might lead to. My sole object in bringing forward the subject was to promote an understanding between mill and cyanide workers of the community of interest which existed in their work, and also to remove a little the impression that this Society was solely devoted to one branch of the metallurgy of gold.

The CHAIRMAN: The long and interesting discussion that has been the result of the reading of Mr. Johnson's paper is the best evidence of its great value, and our thanks are due to Mr. Johnson for having brought forward such an interesting subject.

Meeting of the Mining Society of Nova Scotia in Pictou County.

The July meeting of the Society was held at New Glasgow and Westville on 27th and 28th ultimo.

The members left Halifax on the afternoon of Tuesday, 26th ultimo, arriving at New Glasgow at 10 o'clock.

On Wednesday, in the forenoon, the party were driven out to the works of the N. S. Steel Co., and under the guidance of Mr. Graham Fraser, Mr. Harvey Graham and Mr. Thos. Cantley, an interesting two hours was spent in inspecting their plant. From the Steel works the party were driven to the summit of Fraser's Hill, and enjoyed the beautiful view of the surrounding country which is to be seen from that spot.

In the afternoon a visit was paid to the surface works of the old Foord pit, where Mr. Poole and Mr. Rutherford, of the Acadia Coal Co., met the party and conducted them over the various points of interest in that locality. Proceeding from there to Mr. Poole's residence the party were hospitably entertained by Mrs. Poole, returning to New Glasgow at 6 o'clock.

In the evening a meeting was held at Hotel Vendome at 8 o'clock. There were present: Mr. Charles Fergie, President; Vice-Presidents Libbey, Meissner and Hayward; Past Presidents H. S. Poole and R. H. Brown, Messrs. Robb, Graham Fraser, E. M. MacDonald, Crockett, M. R. Morrow F. H. Mason, J. W. Clendenin, Hugh Fletcher, W. G. Matheson, Harvey Graham, J. G. Rutherford, and H. M. Wylde, Sec.-Treas.

The minutes of the last meeting were read and confirmed.

On motion of Secretary Wylde, seconded by Mr. Morrow, Mr. G. S. Troop was elected a member.

THE SECRETARY, in the absence of Mr. Wilson, Chairman of the Committee, appointed at last meeting to obtain evidence from miners regarding amendments to the Mines Act, stated that circular letters had been issued, but very few replies had been received, and it was decided that if possible printed copies of the Mines Act, as amended by the Commission appointed by Government, be obtained and issued to members.

Mr. C. A. MEISSNER read a paper, "A Few Notes on Coke and Coal" (reproduced elsewhere in this issue).

Mr. POOLE gave a very interesting description of the Pictou coal field, illustrating his remarks with maps.

A vote of thanks was tendered to Mr. Meissner and Mr. Poole for their papers, and also to the N. S. Steel Co. and to Mr. Poole for the kind manner they had entertained the members during their visit.

The meeting then adjourned.

On Thursday, 28th July, the party drove to Westville, and proceeded to the Drummond Colliery, where the Vice-President and Manager, Mr. Chas. Fergie, met them. Pit clothes and safety lamps were issued, and boarding the cars a visit was paid to the workings underground. On regaining the surface Mr. Fergie, after shewing the party over his surface works, escorted them to his residence, where they were cordially welcomed by Mrs. Fergie. A sumptuous luncheon was then served, after which, with three cheers for Mr. and Mrs. Fergie, the party drove to the station to catch the train for Halifax, arriving there at 9 o'clock, having had a very successful meeting.

Canadian Mining Institute.

A joint meeting of the Council and Library Committee of the Canadian Mining Institute was held in the Library of the Institute on Friday evening 12th instant, Mr. George R. Smith, M.L.A., General Manager of Bell's Asbestos Co., Ltd., presiding in the absence of the President.

The SECRETARY, having read the minutes of previous meetings, the following were elected

NEW MEMBERS.

Brelich, Henry, M.E., Nelson, B. C.
Douglas, Dr. James, New York.
Green, George, Montreal.
Kehoe, Henry, Mining Engineer, Canadian Pacific Exploration Co., Ltd., Rossland.
Milbourne, C. K., Dominion Development and Agency Co., Ltd., Nelson, B. C.
McRae, John Ferguson, Rossland, B. C.

ELECTION OF A COUNCILLOR.

The SECRETARY having reported the resignation of Mr. H. S. Poole as a member of Council for Nova Scotia, Mr. Hiram Donkin, C. E., General Manager of the Dominion Coal Co., Ltd., was unanimously elected to fill the vacancy.

NELSON MEETING POSTPONED.

The SECRETARY reported that in accordance with the instructions of last Council meeting he had been corresponding with members in British Columbia with the object of ascertaining their views as to the desirability of

holding a meeting in that Province during September or October. While many favorable responses had been received the concensus of opinion pointed to the desirability of postponing the meeting until next year. The following letter from Mr. S. S. Fowler, a member of the Council, explained the situation:—

"As to the general prospects of the meeting, it would seem to me now not advisable, particularly because the members in the district are extremely busy, and several of them, I understand, are preparing papers to be read be- a proposed meeting of the B. C. Association, and their resources would be considerably taxed by writing another paper for the Institute this season. You will understand, of course, that the subjects available and of interest are limited at present, but are increasing in number, and I think that the opportunities for papers next year will be far better than they are or will be during this year. Moreover, visits to industrial establishments are, of course, as you know, a very entertaining part of any meeting, and are always looked forward to by those in attendance. Next year the Crows Nest Pass Railway will be completed, thus making accessibility to the points in south-east Kootenay and the coal mines themselves quite easy. In this district the Trail smelter will be in operation, and we will have probably a 40 stamp mill completed this year, beside some novel features in concentration of lead ores, which, I think, would be very interesting to the members. All these points may be easily taken advantage of next year, whilst it is extremely doubtful if they will be in shape during this year.

"Together with the lack of any very keen interest, or possibly some doubt as to the success of a meeting which might be held this year, and under circumstances which I have just referred to, it seems best to me to postpone the proposed meeting until some time during 1889. This meeting next year could be easily decided upon as to the exact date, at your next meeting, and the members would have far better opportunity of preparing themselves, both as to papers and attendance, than can be possibly arranged for during the few months which would intervene between now and a meeting held this year."

On motion it was unanimously decided to postpone the British Columbia meeting until the fall of 1899.

THE LIBRARY.

MR. STEVENSON BROWN reported progress on behalf of the Library Committee.

About 500 volumes and periodicals were now on hand and suitable cases for their accommodation had been secured. A large number of maps of mining districts had been mounted and would be hung on rollers, while the list of exchanges for the reading room was being extended.

This being all the business, the meeting adjourned until Friday evening 9th September.

Montreal and London.

MR. BERNARD MACDONALD, M. E., REVIEWS THE OPERATIONS OF THE COMPANY DURING THE YEAR.

The following is excerpted from the report of Mr. Bernard Macdonald, M. E., reviewing the operations of the Montreal-London Gold and Silver Development Co., Ltd.:—

"With the close of the first year's active existence of your Company I wish to lay before you, for consideration, a general statement of the operations during that time.

Field Work.—During the period under review, many of the principal mines and prospects in various stages of development, in the most prominent districts of the Provinces of British Columbia and Ontario and Nova Scotia, have been examined and reported on by the undersigned, while an expedition (six men) under the charge of Mr. William McIntosh, was despatched to the Klondike gold fields in August of last year, under a two-years' contract, to explore those regions and locate claims therein for the Company.

NOVA SCOTIA.

The Company now owns the famous Dufferin Gold Mines in the Salmon River District, Halifax County, of this Province. The mining lands of this property are in a solid area measuring 8550 feet in length along the course of the veins, by a uniform breadth of 1500 feet. Included with these are some 1500 acres of wood lands, making an aggregate area of about 2000 acres in the property.

The records in Mines Offices of the Provincial Governmei show that while these mines were operated by the original owners, 95,000 tons of quartz were extracted and milled, from which was recovered $800,000 or $8.42 per ton in gold bullion.

During the period of this production the methods used in working the mines were primitive, and the machinery employed was antiquated and insufficient, thus accounting for the fact that of the total recovery of $800,000 from the quartz milled, only $300,000 were paid to the owners in dividends.

The area from which the pay quartz was extracted had an extreme length of 2,000 feet along the vein, and for this length it was lined to depths ranging from 20 to 300 feet. Throughout this area the width of the pay quartz varied from 18 inches to 15 feet. As to the future there is no reason to believe otherwise than that the pay quartz will continue downwards to great depths and extend horizontally for considerable distances in both directions into the remaining 6,000 feet of the property.

The belief as to the future of the property is strengthened by the fact that the geological conditions surrounding the occurrences of the ore in the Dufferin Mines are identical with those of the famous Bendigo reefs in Australia, which have produced enormous quantities of gold, and are still being profitably worked at a depth of 3,400 feet.

Since the acquisition of this property by the Company in December, 1897, the work of equipping it with modern plant of mining machinery, and of opening up the ore reserves, has been proceeding.

Machinery Installed.—A battery of three 60-horse power high pressure boilers; the double hoisting engine; a compound condensing duplex air compressor of 12-drill capacity; a lathe; a drill press; a Cornish pumping plant; and supplementary steam pumps; electric lights, etc., constituting a complete plant of mining machinery, have already been installed and are in successful and satisfactory operation. This plant is acknowledged to be the most complete in any of the gold mines of Nova Scotia.

Mining Work.—At the present the mining work consists of the sinking of two three-compartment shafts, one vertical and the other on the dip of the vein. These have already attained the depths of 200 and 300 feet respectively, and their sinking is being continued as rapidly as possible. From these shafts, at suitable levels, the veins will be opened up by drifts and crosscuts, through which the ore extracted will be trammed to the stations and raised to the surface.

Surface Improvements.—The machinery above described is housed in substantial buildings and offices, and boarding and lodging houses for the Company's employees have been erected and furnished. The necessary roads, approaches and yard-room have been completed, and are of the most suitable and permanent character.

Stamp Mill.—In accordance with your decision, a modern stamp mill, consisting of sixty 1,000 lb. stamps, arranged to drop 100 times per minute, is to be erected on this property. Grading for the foundations of this mill has been completed and the foundation stone-work is now being laid. The machinery for 30 stamps—or the one-half of this mill—has already been contracted for, and will be erected and put in operation at the earliest possible moment, while the remaining half will be added later on. Mills of this character have the capacity of treating four tons of ore per stamp per day.

The machinery is of the most modern type, and its arrangement is planned to make it as nearly automatic as possible.

Power.—The mining and milling machinery installed on the mine will, for the present, be operated by steam, but I would recommend the splendid water-power, appurtenant to the property, being later on developed and utilized for this purpose.

Mining Facilities.—The facilities for mining and milling operations at the Dufferin Mines are exceptionally favorable. The plants are complete and compact; the machinery modern; arrangements automatic; fuel, labor and mining supplies are cheap, and the property is easily accessible, being within 4½ miles of salt water transportation (via Salmon River Harbor), and 70 miles north-east of Halifax; the ore is the ideal free milling gold quartz; all of which combine to make the operations most economical.

Profit.—I estimate that with the full milling plant of 60 stamps in operation, there would be an average of 200 tons of ore milled per day. Assuming, in order to leave a margin wide enough for absolute safety, that the average recovery from the ore milled will be $5.00, instead of $8.00, as heretofore, and that the costs of mining and milling will amount to $2 50 per ton, which if $1.00 per ton more than probable, owing to the character of the veins, the favorable facilities and low wages, the recovery or net profit would be $2.50 per ton, or $15,000 per month, or $180,000 per annum.

It is confidently expected that this production can be indefinitely maintained, owing to the extensive area of the property, and the comparatively shallow depth to which any portion of it has been worked.

IN BRITISH COLUMBIA.

The Company is the owner, by outright purchase, of the following named mineral claims:—The *Slocan-Sovereign*, the *Iron Crown Group* (comprising the Iron Crown, San Berdino and Kenneth) and the *Silver Queen*.

Slocan-Sovereign.—This mine is situated near the town of Sandon, and is located on the southern extension of the famous Reco vein, covering within its boundaries 1,400 ft. of such extension.

Under the immediate supervision of Mr. B. C. Riblet, the company has been developing this property since October, 1897, with very favorable results.

The developments consist of two adit tunnels, upraises and winzes, aggregating 1,800 ft. in length. In the tunnels the vein is shown to have a width ranging from 4 to 12 ft., and to carry pay streaks of high grade galena ore, ranging from a few inches up to 2 ft. The first-class ore assays from 80 ozs. silver and 60 per cent. lead per ton up to 226 ozs. silver and 70 per cent. lead per ton.

In the course of development work there has been extracted a large amount of concentrating ore, which remains on the dump at the mines. Returns from shipments of the first-class ore already made have given from $26.68 to $32.50 net per ton, after deducting duty and cost of freight and treatment.

To complete the development of this property, and place it on a permanent dividend paying basis, a third tunnel on the vein is necessary. The site for this tunnel has been selected, and work upon it has already commenced, and when completed the vein will be developed and drained to the depth of 600 ft., between which depth and the surface the ore will be then blocked out, ready for stoping.

Iron Crown Group.—This group of mines is situated about 2½ miles north of Sproule station, on the Kaslo and Slocan Railroad, and covers an area of 150 acres.

Four fissure veins ranging in width from 4 to 10 ft., and carrying streaks of high-grade silver-lead ore, traverse the claims of this group. Owing to the steepness of the mountain upon which these claims are located, the veins may be developed to depths up to 1,600 ft. by adit tunnels, a comparatively inexpensive and efficient method.

The Eureka group, which adjoins the Iron Crown group to the west, has recently been developed into a steady and profitable shipper, and, in my opinion, the Iron Crown group will become a dividend paying property when the veins are properly developed. I would recommend that the systematic development of this group, as indicated, be commenced at an early date.

Silver Queen.—This claim is situated some four miles south of the town of Nelson, adjoining the famous Silver King group of mines, owned by the Hall Mines Co., Limited. It covers an area of 1,500 ft. in length by 600 ft in width, and contains the southerly extension of the Silver King vein, which is easily traced into it by a very prominent outcropping.

The development on the Silver King vein has been carried up to within 250 ft. of the Silver Queen in pay ore, and it is believed that similar ore

bodies will be found in the Silver Queen. As the workings of the Silver King group are being extended towards the Silver Queen boundary, I would recommend waiting their nearer approach, before beginning work on the Silver Queen. The position of the ore bodies will then be more definitely located, and favorable arrangements for their extraction may be made.

In the Klondike.

Ten claims on Walsh Creek have been located, and application for registration made for the Company by the expedition. Some of these claims have been hastily prospected, and colors of gold have been found wherever work has been done.

With further development, it is hoped that they will be found to contain paying deposits of placer gold. The experience gained by the expedition during the winter should greatly assist it in doing effective work during the present season.

While there is always more or less uncertainty and luck in this class of mining operations, yet I am confident that the present season's work in this branch of the Company's business will result in satisfactory profits for the shareholders.

In Ontario—Lake of the Woods District.

In this district, this Company have a substantial interest in "The Bullion Mining Company of Ontario, Limited," which control the following mining claims :—

Name of Group.	Official Description.	Area.
Lansdowne	Location No. T. T. 12	175 acres.
French Portage	Location No. Mack 26-29	175 "
Northern Light	Location No. D. 262	55 "
Stanley & Preston	Location No. R. T. 42-43	65 "
Master Jack	Location No. P. 640, 208	143 "
Monck	Location No. S. 126	46 "
Lorne	Location No. S. 109	80 "
Lord Lisgar	Location No. S. 150	85 "
Aberdeen	Location No. S. 151	106 "
Sutherland	Location No. D. 20	14 "
Montreal	Location No. D. 233, 239	120 "
Edinburgh	Location No. D. 389	60 "

As may be seen, these claims cover an area of 1,124 acres, and upon nearly all of them veins of free milling gold quartz have been discovered. Upon a few of them a considerable amount of development work has already been done. The *Montreal Group*, Claims No. D. 233 and D. 239, immediately adjoins the celebrated Mikado, and has the extensions of one of the rich veins now being worked on that property. (Note.—The Mikado is owned by an English company, and during the past year a 20 stamp mill has been in successful operation on it, and a very large amount of gold has been produced.) The other claims have been examined by local experts, who gave encouraging reports as to their future.

In conclusion, I desire to congratulate the company upon the successful operations of the past year. There can be no doubt but that a large amount of this success can be directly attributed to the fact that the Company has avoided the expensive mistakes which almost invariably attend the early operations of new companies.

After the development and equipment, now progressing on the properties owned by the Company, shall have been completed, I am confident the Company will be in a position to begin and continue indefinitely the regular payment of dividends.

Respectfully yours,

(Signed) Bernard Macdonald.

Montreal, Aug. 8th, 1898.

Our English Letter.

London, 5th August, 1889.

As usual at this season of the year, business in the London Stock Exchange is of insignificant dimensions, and apart from the interest taken in the declaration of English railway dividends, and the prospects of a peaceful settlement of the war between the United States and Spain, the record of July is uneventful. So far as the Mining Market is concerned, transactions are still on a very limited scale, Canadian descriptions having been neglected and lower. This is best shown by the following table, which includes the best known Canadian land, mining and exploration companies dealt in on the London Stock Exchange:—

COMPANY.	Making Up Price End of June.	Making Up Price End of July.	Rise × or Fall —
Alaska Gold Fields	1½	1 7/16	— 1/16
B. C. Development	1	⅞	— ⅛
Big Creek	1/16	2s.	× 6d.
B. America Corp'n	17s.	15s. 6d.	— 1s. 6d.
B. C. Devel, Ass'n	1	1	....
B. C. Financial Trust	¼ dis.	¼ dis.	....
Dawson City Trading	1	10s.	— 10s.
Dom. Mining, Devel. & Agency	1¼	1⅛	— 1/8
Dundee	1s.	1s. 1½	×1½d.
Fairview	1	⅞	— 1/8
Explorers of Canada	1	1	....
Golden River Quesnelle	¼	¼	....
Hall Mines	1 3/16	1	— 3/16
Klondike & Col. Goldfields	1	1	....
London & B. C. Goldfields	1 1/16	1	— 1/16
Mikado	3⅛	....	....
New Goldfields of B. C.	1¼	⅞	— 3/8
Ontario Limited	1s.	3d,	— 9d.
Ontario Govt. Gold Concess.	Par.	¼	....
Regina	5	5	....
Vancouver Synd	1¼ pm.	1⅛ pm.	— 1/8
Waverley	Par.	Par.	....
Whitewater	....	⅞	....
Yukon Goldfields	Par.	Par.	....

I have thought it advisable to include only those shares which are quoted in the Official List of Mining making-up prices, that is the schedule of shares of companies in which, presumably, business has been done during the account to which the list refers. There are, of course, a lot of other Canadian securities in which dealings, no doubt, occasionally takes place, but as the changes in these are so infrequent as to be useless as a criterion of market movements, I have not thought it worth while to include them. If further proof were needed of the dulness of the British Columbian and Canadian mining section, it is afforded by the decision of Messrs. Whitehead & Chown—one of the first prominent firms in this city to associate itself with the Canadian movement—to publish their useful list of Canadian mining prices only three times a week for the present, instead of daily. Changes in prices, as you will observe from the foregoing table, have been in nearly every case against the holder, and this, of course, cannot be regarded as a matter for congratulation, for naturally all the while the shares in existing Canadian mining concerns are quoted at nominal prices, and in many cases at substantial discounts, the public will not be disposed to regard with favour new ventures. In proof of this I need hardly do more than refer to the failure of the Associated Gold Mines of British Columbia—brought out a few weeks ago—to convince the public that it was a good thing, and deserved support, A friend of mine who was offered a seat on the Board refused to go on it, and I believe that Sir William des Vœuex, the Chairman, retired directly it was found that the whole thing was a frost. This is the company, you will remember, which was formed under the *ægis* of Mr. Hardiman, of Vancouver. He certainly must have been much disappointed at the poor results of his efforts to obtain English capital for the exploitation of the properties and areas referred to in the prospectus. For my own part, I am not a bit surprised to find that the English public were not willing to furnish such a heterogenous combination with the funds necessary to carry out their ambitious programme.

The most important new issue in connection with the Yukon that has yet been introduced to the public is the White Pass and Yukon Railway Co., Ltd,, which with a share capital of £1,000,000 in £10 shares and a very influential list of directors, &c., proposes to carry out and develop the charter rights and concessions of three companies, viz.: (1) The British Yukon Mining, Trading and Transportation Co., by special Act of Parliament of the Dominion of Canada, 60 and 61 Vic., cap. 89; (2) the British Columbia and Yukon Railway Co., by special Act of the Legislature of British Columbia; (3) the Pacific and Arctic Railway and Navigation Co., a company duly incorporated in the United States of America. Under their several powers the objects specially authorized are: The construction, equipment and working of the above railway; the construction, equipment, maintenance, and working of telegraph and telephone lines for the transmission of public and private messages to any point in the North-West Territories, north of the northern boundary of British Columbia; the acquisition of all necessary land required for the construction of docks, slips, wharves, piers, and public works generally; and for all or any of the above purposes, the compulsory acquisition of land under the Railway Acts. The following particulars may be of interest:—The present issue is £250,000 6 per cent. first mortgage debenture stock, and this is certainly a novel departure in connection with Canadian enterprises. I need not point out, however, that with such a strong board, and such a well-known firm of London stock-brokers as Messrs. Coates, Son & Co., the issue will at all events receive the careful attention of those people who are in the habit of attaching importance to the auspices under which a company is launched. The prospectus published this week, and which leaves little to be desired in the way of lucidity and detail, states that the Pacific Contract Co., Ltd., which has a capital of £300,000, whereof £200,000 is subscribed, and from which this company acquires the right to carry out and develop the charters already specified, has a large staff of engineers, and over 1,500 laborers now at work constructing the first division of the railway of a gauge of 3 ft., from Skagway Harbor to Lake Bennett; and has contracted to complete and equip that division of the railway to the satisfaction of this company's engineer for £500,000, payable as to £250,000 in cash, and as to £250,000 in shares, and not to take any money on account from the trustees for the holders of debenture stock until it has expended at least £100,000 on the line in manner above stated. The balance of the share capital, £750,000, will be issued to the contractors in consideration of their handing over all the charter rights and concessions over the 325 miles above mentioned, and providing the company with necessary working cash capital as provided in the contract.

For the moment the company promoter seems to have come to the conclusion that sufficient companies have been registered for the exploitation of the Dominion, and therefore the crop of new propositions is by no means so abundant as in past months. The following is the list of

New companies recently registered.

Pyramid Mining, Smelting and Refining Co., Limited.—Registered on June 14th, by E. H. Thruston, 20 Bucklersbury, E.C., with a membership of seven, who are each liable for 10/- in the event of winding up. Objects: To carry on mining operations in B.C.

Consolidated Gold Fields of B.C., Ltd.—Registered 13th July. Capital £1,000 in £1 shares. Objects: To enter into an agreement with the Financial and General Syndicate, Ltd., and to acquire, develop, work, turn to account, and deal with any mines, lands and rights.

British Canadian Gold Fields of the Klondike, Ltd.—Registered 16th July by E. Andrew & White, 27 Clements Lane, E.C. Capital, £275,000, in £1 shares. Objects: To adopt and carry into effect an agreement expressed to be made between the Yukon Pioneer Syndicate, Ltd., and G. C. Saddington, as trustee on behalf of this company, for the acquisition of certain mineral properties in Canada, and to develop and work the same; and further to acquire any other mines, mining, water, and other rights, grants, leases, claims, concessions, options of purchase, alluvial ground, mineral deposits, &c., in any part of the world, and to carry on the business of a mining,

smelting and trading company in all its branches; to acquire and turn to account any fishing and forestal rights; as provision dealers, shipowners, carriers by land and sea, engineers and metal founders, printers and publishers, company promoters, bankers, financiers, and concessionaires, etc.

English Canadian Co., Ltd.—Registered 22nd July by Burchell & Co., 5, The Sanctuary, Westminster, S.W. Capital, £400,000, in £1 shares. Objects: To acquire certain mines, mining rights, etc., in Canada, and to develop and turn to account the same, to acquire any other mines, mining, water and other rights, grants, leases, claims, concessions, options of purchase, alluvial ground, etc., in any part of the world, and to carry on in all or any of their respective branches the business of a mining, milling, smelting and trading company; as quarry owners, manipulators of ores of all kinds; as manufacturers of all plant and machinery, dealers in bullion, specie, coin and precious stones; to deal in and with any real or personal property, as shipowners, commission agents, etc. Registered without articles of association.

Edmonton Gold and Platinum Dredging Syndicate, Ltd.—Registered 27th July, by E. Lydekker, 40 Old Broad Street, E.C. Capital £50,000, in £1 shares. Objects: To adopt and carry into effect an agreement bearing date 26th July, and expressed to be made between H. D. Risbee and M. J. Harvey as trustee for and on behalf of this company for the acquisition of certain mines, mining rights and other property in Canada or elsewhere, and to develop, deal with, work and turn to account the same; and, further, to acquire any other mines, mining, water and other rights, grants, leases, claims, concessions, options of purchase, alluvial ground, mineral deposits, etc., in any part of the world; to carry on the business of a mining, milling, smelting and trading company in all its branches, etc., as maltsters, hop merchants, corn merchants, licensed victuallers, bottlers, manufacturers of aerated waters, as hotel and restaurant keepers.

MEETINGS.

The most important meeting of the month in so far as Canada is concerned, was that of the Hudson's Bay Company, over which Lord Strathcona and Mount Royal presided. Dealing with the present position of affairs in connection with the development of Canada's vast mineral resources, the noble chairman, who has done so much good for Canada in the past, uttered a warning regarding the recent creation of Klondyke "wild cats," which many of us regret his Lordship was not in a position to deliver twelve months earlier. The following extract from Lord Strathcona and Mount Royal's speech deserves to be incorporated in my letter, although, no doubt, you have already read a cabled summary of his speech in your own daily press. "Mining in the western part of Canada, notably in the Kootenay country and the mining districts of southern British Columbia, had made great progress. Several large companies had been successfully floated, and were considered to be on a paying basis. He was afraid, however, that of not all of those companies that had been got up for mining in the Yukon and Klondyke districts could that be said, and the Board were of opinion that great care ought to be taken in investing money in what, after all, was but a venture."

There are two other meetings which deserve notice. The first was that of the New Goldfields of British Columbia. At this gathering, Sir Charles Tupper was able to tell the shareholders that the Company during its eighteen months operations had been able to earn cash profits sufficient to pay seven per cent. upon the issued capital of the Company. He made a most encouraging statement regarding the position of the Company, and said that although the fact that they were increasing their capital by £25,000 in order to enable the Company to properly finance its varied interests in different parts of Canada prevented them from recommending the distribution of the cash surplus, yet he (Sir Charles) had every faith in the future prospects of the Company. The President of the Company, who has taken such a keen interest in its affairs from the date of its incorporation up to the present time, was inclined to be optimistic regarding this year's wash-up on the Upper Yukon, and as you will gather from the separate report of his speech, which I send you herewith, Sir Charles thinks that the future of this Company is assured. In this country directorial apathy is far too frequent a feature in connection with mining companies. The Board of the New Goldfields of British Columbia, however, have set an excellent example to the directorate of similar companies, for I learn that during the eighteen months during which the Company had been at work the number of Board meetings held was much nearer 200 than 100. One has to be vague in matters of this kind, because statistics are not readily available, probably owing to undue modesty on the part of directors, but I should say from what I know privately of the affairs of this Company, that its directors have paid more attention to the affairs of the New Goldfields Company than can be said of the board of any other British Columbia company at present in existence.

The second was that of the Bank of British Columbia, over which Sir Robert Gillespie presided. This was held in the middle of the month. The Chairman, in moving the declaration of a dividend at the rate of 5 per cent. per annum for the half year ending June 30th last, said the balance of profit and loss account, after making provision for all ascertained losses, was £18,445, and after the payment of the dividend £3,445 would remain to be carried forward. This result bore favorable comparison with the three previous half-years, and he was hopeful that it was an indication of future greater success. It was true that an important improvement in the trade of British Columbia had taken place during the last six months, but rates of interest had been unusually low and the employment of capital difficult, while the competition among banking institutions had undoubtedly lessened the opportunity of making better profits. The price of cereals had assisted greatly in the improvement, as also had the demand that had sprung up for all descriptions of merchandise for the mines and those engaged in mining. It was too early yet to estimate the success of the year as regarded mining, but should the output of gold be what some anticipated, the improvement in the trade of Victoria and Vancouver, more particularly, must be great. The financial position of the bank was very strong, the investments having been recently increased to £180,761, while they had money at short call to an equivalent amount.

After the Bank of British Columbia, came the Bank of British North America's announcement of a dividend for the past half year at the rate of 5 per cent. per annum, payable October 7th.

The following dividend comparison may be of interest:

	1898	1897	1896	1895	1894	1893
Bank of B. C.—1st half year....	5 %	4 %	4 %	5 %	8 %	8 %
do do 2nd do	5	4	5	8	13	
Bank of B.N.A.—1st half year....	5	5	4	4	5	7
do do 2nd do	5	4	4	4	4	8

The results of the past half year's operation of the Canada North West Land Co. are very satisfactory. The farm land sales for the six months to June 30th last were 40,058 acres for $216,319, as compared with 17,200 acres for 94,035 in the corresponding period last year. The town site sales were $15,437 as compared with $11,373. The receipts were $121,970 in shares and $5,890 in cash, as compared with $78,147 and $4,452,

Although Ontario has hitherto been much neglected in so far as its mining possibilities are concerned, the recent official report issued by the Bureau of Mines was accorded considerable space in the columns of the London financial press, and had it not been for the apathy of the mining market generally, it is possible that the progressive figures dealt with might have been reflected by some movements in the few companies already known on the London market, but only occasionally dealt in, and not particularly favourably regarded either by the public.

In so far as British Columbia is concerned, the public still continues to display a waiting tendency, and does not seem at all anxious to get unduly excited over the prospects of this Province. Of course the sharp setback in the price of British America corporation's which has taken place since the beginning of the year has acted as a check to the British Columbian section generally, and the heavy fall in Hall Mines which has taken place owing to development work getting behind hand has not helped to cheer those who have taken on their shoulders the herculean task of making a market for Canadian mining securities. The better known groups have been fairly firm, without much business, but the Turner-Pooley group have been decidedly dull, and Dawson City Trading are practically quoted at 50 per cent. discount. Efforts have apparently been made to galvanize this group into activity, but with disheartening results. The developments in connection with the Le Roi have been closely followed, but what at first looked like a serious reverse to the policy of the British America Corporation has been, I am assured, counteracted by the alternative plan adopted by Mr. Mackintosh as a safeguard against the recent adverse result of the meeting of stockholders at Rossland. I have taken the trouble to seek information in the proper quarter on behalf of the REVIEW, but I am assured by the managers of the Company that as they had already provided for such a contingency by acquiring a controlling interest in the property, they do not mind a little bit the recent action of the minority. They are quite prepared to allow things to take their proper course, being confident that sooner or later a persistent absorption of all the stock offered on the market will enable them to acquire complete control of the mine, which has aroused so much interest both in British Columbia and London. At the end of the month there was a tendency to call prices a little dearer, notably in London and B.C. Goldfields deferred, B. A. C. Alaskan Goldfields, and Waverleys, the latter on the excellent returns from the property; but Goldfields of British Columbia were dull, probably on the severance of Mr. Grant-Govan from the management of the Company. Hall Mines remained weak, and Klondyke and Columbian Goldfields found a difficulty in keeping up to par. As an instance, however, of the unreliable character of many of the Canadian mining prices published in the press, I may mention that although Canadian Pacific Explorations are quoted in several lists and papers at a substantial premium, this is purely fictitious. The shares have been held privately, and up to the present time I should not think there have been half a dozen transactions in the whole capital of the company. As a matter of fact shares were not obtainable, those who were holders being firmly persuaded of the value of the properties and options possessed by this company, and being probably unwilling to sell at the premium generally quoted. Vancouver and British Columbia General Corporations have declined still further, but Galena Mines have been a shade firmer, and B.C. Development Associations were firm on the prospective profits to be earned from the sale of a charter possessed by the company. Klondyke shares generally have been dull and inanimate, and but little notice has been taken of the satisfactory cables to hand regarding the gold already sent down from the Klondyke. This is not because these cables have not been given sufficient prominence, but simply owing to the fact that the public is not in a mood to be influenced by even good news. That the press is ready to do all in its power to advertise both the Yukon and British Columbia has been abundantly proved by deeds. The latest evidence of the desire on the part of the conductors of the financial press in this country to accord justice to Canada's mines was afforded by a very careful contrast of the prospective output of the Yukon for the season with the earliest results of the Rand. The comparison, although a difficult one to institute, and not altogether, perhaps, a fair one, was decidedly in favour of the Yukon.

From an all Canadian point of view, the most important point of the month was the announcement that Imperial penny postage was, in part, if not in whole, *un fait accompli*. Canadians must be especially gratified to find that the resolution for its adoption was moved by the representative of the Dominion. We are, of course, highly gratified at the result of the postal conference, and no doubt it is only a matter of time before the Australasian colonies and India will see that it is to the mutual advantage of all members of the Empire to accept a proposal which will go down to posterity as one of the most sweeping measures of the century.

The British Columbia elections have attracted very little attention here, but Mr. Turner's explanation of the defeat of his party had better have been left unsaid, for although the majority of the Press simply ignored his cabled speech, *The Times* itself, in a dignified article, administered a rebuke which will go all over the world, as well as to Canada. *The Pall Mall Gazette* also took up the cudgels on behalf of *The Times* and was supported by *The Canadian Gazette* (the C.P.R. organ in London) and controlled by the editor of that stupendous compilation, *The Stock Exchange Year Book*. Mr. Whitaker Wright's organ, *The Colonial Goldfields Gazette* also pointed out the error of

his ways to Mr. Turner, and the *Daily Mail* assured him that he must regard his defeat as the "nemesis of Klondike," meaning, presumably, his connection with Klondike companies. As is pointed out somewhat bluntly by the *Canadian Gazette:* "There can be no doubt as to the real significance of the result of the Provincial elections which have just concluded. The Turner Ministry has been distinctly worsted. The united opposition, after a fight which may be truly described as the fiercest in the colony's record, have so far won the day that, if their unity is maintained when the Assembly meets, they will apparently be able to carry a vote of non-confidence in the ministry, although parties are so evenly balanced that a second appeal to the constituencies may speedily follow. The charges of gross extravagance which were freely levelled against the cabinet are by no means a novel feature of colonial election campaigns, and hardly warrant special remark. But more serious import attaches to the allegations against Mr. Turner and Mr. Pooley in regard to the use of their names in connection with certain Klondike enterprises. These charges and Mr. Turner's unfortunate references to the English Press and *The Times* in particular, were certain to attract attention on this side of the atlantic, in a manner which is not calculated to promote Canada's good fame, or to facilitate the investment of English capital in the development of the mineral wealth of the Province.

The London *Financial Times* announces that another "kind and good secretary" has turned up with a circular sending to total strangers advance prospectuses and offering them special privileges. The concern for which he is acting is the Thompson Siding Copper and Gold Mines, Ltd., and certainly the concern is putting on plenty of "side" for an enterprise that is only just beginning its business career. Its capital is £90,000, divided into 65,000 ordinary shares and 25,000 preference shares, which are described as 10 per cent. cumulative. The Secretary, Mr. M. R. Plunkett, announces in his circular that "The directors have received 10,000 preference shares for private issue, the subscribers, under arrangement with the vendor syndicate, to receive a bonus of 50 per cent. in fully paid ordinary shares of the company payable on allotment" "This [says our contemporary] is a very transparent dodge on the part of the C. E. Exploration Syndicate, Ltd., whatever that may be, to plant shares on guileless strangers. In the purchase price of £75,000 this syndicate as vendor takes all the 65,000 ordinary shares, so that the bonus, thrown in as makeweight, costs it nothing, and it is a significant commentary on the value of the 10 per cent. cumulative preference shares, that ground-bait is considered necessary to make the public bite. Mining ventures in British Columbia require careful watching and the policy adopted by the vendors in this case suggests that a particularly careful eye should be kept on the Thompson Siding venture, with its 640 acres of country, although in regard to the value of it we have statements from two working miners in addition to some remarks by Mr. H. B. Warren, M.I.M.E."

THE B. C. GOVERNMENT AGENCY IN LONDON.

I wonder on what system the British Columbian Government Agency in London is run? As my readers are aware, the General Election in British Columbia took place a fortnight ago. Thanks to certain energetic press correspondents, the English public has learnt that one of two results has taken place. Either (1) Mr. Turner's Government has been defeated by an adverse majority of two, or (2) there is a tie between the Opposition and the Government. One of my representatives sought information at the hands of the Government Agency, only to receive the extraordinary intelligence that not a single cable has been received with regard to the election.

It may be rare fun for Mr. Turner's agents in B.C. to keep the London agency in ignorance of what is going on, but I venture to suggest that it is not business. The importance of this election in the development of the country cannot be overrated and its importance from a general point of view is not small. Perhaps some one in authority will now take some step to ascertain and explain exactly how we stand in this matter.

C. J. W.

MINING NOTES.

Ontario.

LAKE OF THE WOODS.

There is not much that is new to record in mining operations during the past month. The local press, however, of recent date, contains an account of a deal on the James and Gordon property, situate almost immediately east of the Stella mine. The purchasers are the Chemical Mining Co. of Ontario, Montreal people it appears, and $5,000 is the figure named. A shaft to the depth of 35 feet was sunk on the principal vein last year, and some other prospecting done. During the early part of last winter some parties from Sudbury who had an option on the property did some prospecting on another vein a short distance south of the former, and dipping towards it, but with a more southerly strike. Farther north than either of these is the wide vein which crosses the Stella property. This vein is as yet untouched on the James-Gordon locations. These veins, like those of the Stella, Gold Hill, Golden Gate, Master Jack, etc., are very near the contact of the Huronian hornblendic schists and altered traps with the gneissoid granite.

The Stella.—Good progress is being made with the new shaft started this spring on the Stella vein. Arrangements have been made for shipping 200 tons of the ore to the Keewatin Reduction Works for treatment. The most serious part of the work will be the hauling of the ore over the three miles of bush road between the mine and the shore of Andrew Bay of the Lake of the Woods. The company expect to realize a handsome profit from this run of ore.

The Regina.—The new Tremaine Mills were started to work about the beginning of August, and the new air compressor plant is in operation. A dwelling for the manager has been put up on the shore of the bay, and a little eastward of the mill.

The Wilkinson Locations.—Adjoining the property of the Regina Mines Co. are a number of locations that were taken up by General Wilkinson. Mr. T. A. R. Purchase, a mining man, late of Johannesburg, South Africa, secured an option on these for some English capitalists, and is now prospecting the property for them. The work already done includes quite a large amount of stripping, and the sinking of deep test pits or shafts at five or six points. One of these is 35 feet deep, and another, in which work is still being carried on, is down over 30 feet. Mr. Purchase has gone to work in a very energetic and systematic fashion, and is meeting with much encouragement in the veins that are being opened up. In common with other prospectors this season, however, his work has been rendered more difficult by the excessive rains.

The Mikado.—They are burning coal at the Mikado at present, quite a few barge loads having been taken from Rat Portage. They have, however, lately given a contract for a large amount of cordwood, and will probably return to that fuel, for awhile at least, for one would think that as yet wood is cheaper fuel than coal on the Lake of the Woods. The arrival of gold bricks is noted at intervals, but authentic exact information is not available.

The Sentinel.—The shaft is down over 65 feet, a contract to put it to 80 feet having been given. The gangue has changed but the walls are the same, except that the foot is straightening up a little, and is becoming cleaner and smoother. A mill run of the ore on the dump is in contemplation.

Cameron Island.—The former manager, Mr. William Caldwell, resigned, and Captain Billy James, of Rat Portage, has charge of the mining now.

Toronto and Western.—This Company are putting a quantity of ore from their property adjoining the Mikado through the Keewatin Reduction Works.

The Burley.—Sinking is going on steadily on the shaft inside the coffer dam. The vein has not been struck yet, although quantities of quartz come up as blasting goes on.

The late Mr. G. R. Coates, whose death through a gun accident occurred a short time ago, was well known in Rat Portage, and his sudden demise is very much lamented by all who knew him. He was much esteemed for his manly and amiable qualities.

RAT PORTAGE, 16th August. J. M.

Quebec.

A correspondent writes: "I have been in Beauce lately, and I can tell you that Mr. Augers with his company has been working with eight men since last month, taking out a daily average of $30 to $40 of coarse gold, the work done being on lot 16 of the de Lery concession. Another small company has also been formed to work on lot 14. Other parties are also prospecting or washing on Meules creek, Stafford, and near the falls on the Chaudiere: it looks like a reviving of the gold industry in Beauce."

In Coleraine, two concentrators for chrome are in the way of erection, one by the "Coleraine Mining Co.," and the other by the "Eastern Townships Chrome Iron Mining and Milling Co."

Nova Scotia.

An occasional correspondent writes: "The Richardson mine at Isaac's Harbor continues to yield satisfactory returns to its owners, the mill crushing about 2,000 tons per month, and the yield a little over 2 dwts. The average monthly brick runs between 225 and 250 oz. The yield for the quarter ended 31st July last was 675 ozs. We are down on the apex of the anti-cline to a depth of about 300 ft. from deck head and the body of crushing material appears as great as ever, and as far as we have gone west on the north arm it appears all the same. The Hurricane Point is doing fairly well with an output of from 135 to 150 ozs brick per month. The Andrews Riley Co. have started up the Skunk Den mine and are about erecting a new ten-stamp mill and other mining plant. The Doliver Mountain property is about being taken hold of by a party who is taking out a test, and if it proves satisfactory will put up an extensive plant in connection with water power from the river, and in truth may say that the outlook is we are nearing the approach of quite a boom in this district."

James Stark, M.E., who represents a Scotch company, has just returned from England, where he has succeeded in placing the Eureka mine of Wine Harbor. The price, it is understood, is in the vicinity of $25,000. Mr. Stark has let a contract to a Nova Scotia firm for a complete plant, including ten-stamp mill, to operate this mine.

The 20-stamp mill for the new Tangier Mining Co. is nearing completion; Mr. Geo. Rowlins is making a first-class job. A hoisting and pumping plant of modern type will be erected at once. The ore from the mine is of the most satisfactory character. Tangier district was one of the first opened in Nova Scotia, and produced largely in the sixties, but bad management, inefficient capital and lack of knowledge, together with crude appliances, caused it to drop into idleness for a decade or more. We hope to soon see it producing largely.

Goldenville returns for July are most satisfactory. The Blue Nose returned 285 ozs, from 650 tons; Herschfield 93 ozs. from 165 tons.

Both the Richardson mine, of Isaacs Harbor, and the Modstock, of Forrest Hill, have installed Wilfley concentrators, and it is claimed they are doing excellent work. Both of these mines are making their usual satisfactory returns.

The Guffey-Jennings Co., which purchased the Lake Lode mine at Cariboo some time since, has recently purchased the Elk mine of that district, and is about to erect a new plant calculated to work the mine to greater depths. The progress of sinking the deep shaft on the Lake lode has been retarded by coming in contact with low rock, but is now progressing satisfactorily.

The Libbey mine, North Brookfield, produced for last month 353 ozs., 200 ozs. less than the former month, yet a most satisfactory return, leaving a handsome margin on the right side of the sheet.

T. N. Baker's mine, at Gold River, still continues its rich returns, His last returns for May and June were: 16½ tons rock, 156 ozs. gold; this from a little two stamp mill.

The last returns from the Gwen mine at Leipsigate are 182 tons, 205 ozs.

The Montreal and London Co. has been pushing things in the erection of the large plant on the Dufferin, and also in the development of the mine, which is understood to be very satisfactory in appearance.

The Golden Group Mining Co., of Montague, are erecting a modern plant, including a 10-drill air compressor on the Annand mine, which has been idle for some years. This mine was for years a large producer, but unfortunately fell into the hands of people who knew little of gold mining, and as a natural consequence ceased to pay and was allowed to go idle. We hope now to see it soon on the producing list again.

British Columbia.

Slocan District.

Although times in the Slocan are still comparatively quiet, an air of confidence is asserting itself in most of the towns such as has not been apparent for over a year. The majority of the mines are working to their full capacity, and while it is doubtful as yet whether the output this year will much exceed that of last, there can be no question that it will at least hold its own, with better things in store for the future. Capital is conspicuously inactive at present here as elsewhere, but with the restoration of peace and consequent calming down of the London market, we are expecting another influx such as was experienced early in ninety-seven. The negotiations now pending with regard to the re-opening of the Indian mints at a fixed ratio, may also have an appreciable effect on the silver market, which is bound to react with equivalent force on this section. The Payne easily maintains its position at the head of producing mines; since August of last year it has shipped in all considerably over 15,000 tons of clean, high grade galena, concentration in this case being unnecessary, and no diminution in its output is looked for. On the contrary, 140 men are now employed at the mine and another strike of 5 feet of ore is reported from the lower tunnel. The town of Whitewater is beginning to fairly hum with life; at the present time the mine of that name has a force of a hundred men at work and is engaged in the construction of a concentrator capable of treating a hundred tons of crude ore daily. The Whitewater Deep which has developed so promisingly, and as its name implies again demonstrated the continuity and value in depth of the veins in the slate, also has in contemplation the erection of a concentrator in addition to the compressor and electric plant which they are now installing. Whitewater indeed promises soon to be as busy as Sandon; the C.P.R. have every intention of extending their line from Three Forks at the earliest opportunity, and to that end have surveyors already in the field selecting the most suitable route. It has been frequently rumored that the Last Chance was one of the coming big mines of the Slocan, and latest advices more than confirm these reports. Over 2 feet of ore has been encountered in the No. 4 tunnel at a depth of 500 ft., and a tramway is to be constructed immediately together with new bunk houses and ore sheds.

It is significant that such a shrewd mining man as McCune of the Payne should become interested in the property at this juncture.

Since the Noble Five was acquired by James Dunsmuir, the coal king of Vancouver Island, development has been steadily pushed ahead and all shipments arrested for the time being. As a result of this policy a considerable quantity of ore is now on hand, which will be held until such time as the management considers it advisable to begin regular shipments. Mr. Dunsmuir visited the property himself recently and appeared quite satisfied with the progress made; the compressor is now operating two machine drills in the mine which will aid materially in the rapid exploitation of the property.

Among the newer and coming lights of the district, the Bosun may be singled out as looking at its best; though only slightly developed as yet, work is being pushed with vigor, and it is highly encouraging to know that there is 30 inches of solid ore in the shaft. The manager expects to be able to make a two-carload shipment before long, which is phenomenal when we consider that it is less than two months since work was started. This property represents a very fortuitous buy on the part of an English syndicate, having been purchased as a mere prospect for $7,500 cash; in its present condition and appearance it rivals the best mines in the Slocan in their earlier stages.

A second shipment will be made from the California before long; everything is progressing satisfactorily, and an abundance of good ore is in sight in the workings. The next payment on the Mollie Hughes is about due and judging by the vigorous manner in which the property is being worked there is little doubt as to its being met. A carload of ore will be shipped to the Trail Smelter this week which is expected to give highly encouraging returns. The ore shows merely a trace of lead and copper, but is high in silver and also carries an appreciable value in gold as well.

The much-boomed sampler at Rosebery turns out to to be as I predicted —merely a town-site fizzle; after spending a considerable sum on the building and preliminary furnishings, work was suddenly discontinued and has not been resumed to date. It is a great pity such means are resorted to in order to advertise the country, because in the end as is well known the object defeats itself by acting in a diametrically opposite manner to which it was intended. In this particular case it is doubly regrettable because there really is an opening at Rosebery for efficient works of this kind, and the representations previously made have in many instances acted as a false stimulant to prospectors and mine owners in a small way who desired to avail themselves of its advantages.

The number of concentrators in the Slocan is being vastly augmented, the latest convert to the desirability and profitableness of treating the lower grade of ore being the Comstock Mines, Ltd., a Glasgow syndicate operating on Four Mile Creek. They expect to have it in running order before winter and construction will be begun immediately. Since the disastrous collapse of the ore-bins at the Alamo concentrator, work has been practically suspended, but new structures are to be put in at once with a view to a resumption of operations.

Hugh Sutherland has been visiting his properties in the lower lake section and expresses himself as extremely pleased with the prospects ahead. He considers, however, that the time is hardly opportune for the introduction of English capital on a large scale. This latter is only a matter of time, however, and prospectors and miners being of proverbially patient and long suffering dispositions, there is no particular hurry; the mines will easily survive the longest wait, there can be no question about that.

HOWARD WEST.

New Denver, 22nd August, 1898.

Miscellaneous.

The following ore shipments from the Slocan District are officially reported for the half year ended 30th June last:—

Total shipments for half-year ending June 30th, from Sandon:

Payne	5,060	tons.
Ruth	2,006	"
Slocan Star	978	"
Last Chance	879	"
Reco	420	"
Queen Bess	175	"
Sovereign	40	"
Ajax	33	"
Goodenough	20	"
Wonderful Bird	7	"
Fountain Fraction	5	"
Argo	2½	"
Total	9,623½	"

Although the winter and spring have been anything but favorable to mining operations in these parts on account of the heavy snow fall, numerous slides and consequently bad roads till lately, the shipments from this section are very favorable.

The Queen Bess in addition to the above shipped 610⅓ tons at Three Forks; the Idaho, 1,880 at the same place. At McGuigan there have been shipped in the same period 385 tons by the Cariboo Rambler; 50 tons by the Antoine, and 45 by the Dardanelles.

The shipments from Rossland from 1st January to 16th July were:—

Le Roi	23,870	tons.
War Eagle	14,914	"
Centre Star	1,596	"
Poorman	453	"
Iron Mask	1,963	"
Cliff	140	"
Velvet	350	"
Monte Cristo	416	"
Sunset No. 2	15	"
Deer Park	6	"
Total	42,936	"

The following particulars of the hydraulic elevator plant recently installed by R. H. Campbell on the Williams Creek property of the Cariboo Gold Fields, Ltd.:—In the bottom is an inlet nozzle for the water under a head of nearly 800 ft., that will direct this stream of water up the pipe, in the lower side of which is an opening or gate into which the gravel is run by other streams and then elevated in the sluices by the force of the elevating jet from the nozzle. In this pipe the diameter is contracted to 12 inches at the throat, but above that the pipe is 18 inches in diameter. These elevators are set at an inclination of 30° from the vertical, and it is estimated that with the head of water, 1,200 to 1,500 cubic yards of gravel can be raised per twenty-four hours in each elevator with 600 miners' inches or 900 cubic feet of water per minute,

In beginning this work a shaft 5x8 ft. 4 in. was sunk to bedrock through 68 ft. of gravel, in which was placed the elevators; another inclined shaft sunk at right angles to the first one, down which pass the water pipes to the bottom of the elevators. The vertical lift from bedrock to the sluices is 88 ft. A pit will be worked out about the elevators and down to bedrock by using monitors with nozzles 3 to 4 inches in diameter to wash the material towards the gates in the elevators, and as this pit enlarges, the sluices will be extended and the elevators moved farther up the stream. On trestles 20 ft. above the surface, 800 ft. long, are the sluices, in two compartments, 4 x 4 ft., paved with wooden riffle blocks. The top of the pipe of the elevator is let into the floor of the sluice, and a hood is placed over the discharge. A drain tunnel, 2,900 ft., has been run to the bottom of the elevator shaft to drain all the water down to bedrock.

To carry the waters of Williams creek past these operations a small dam was built across the creek 1,400 ft. above the elevator shaft. A flume 2,200 ft. long, 6 x 14 ft., in two compartments, discharges near the lower end of the sluices. From a pressure box at the ditch two lines of piping, 5,000 ft. each carry the water to the foot of the elevators under a vertical head of 792 ft. The welded wrought-iron piping decreases the diameter from 36 inches at the top to 18 inches at the bottom, the lower pipes being of ¼-inch metal.

Fourteen miles of ditch have been completed to carry water from all the lakes and streams on the mountain sides tributary to Williams creek and reservoirs were made to impound all water that could be got. This ditch, 9 ft. wide on the top, 4 ft. on the bottom, 2½ ft. deep, with a grade of 9½ ft. per mile, is expected to carry 2,000 miners' inches of water.

In connection with the Le Roi fiasco, the friction which has prevailed between the Turner and British America Corporation interests has culminated in the issuance of an injunction by Judge Spinks of British Columbia on behalf of the British America Corporation to prevent the further shipments of ore from the mine. The injunction has been granted, and W. A. Carlyle for the British America Corporation has been placed in charge of the property as trustee pending the settlement of the case. The result is the discharge of 170 miners. Work will not be resumed until the case is settled. A Rossland dispatch, dated August 11th, says that the Turner interests have filed a motion in the Supreme Court asking that Judge Spinks' order appointing W. A. Carlyle receiver be set aside. The motion is supported by affidavits from Senator Turner and other minority stockholders, who are fighting the sale to the British America Corporation of a controlling interest in the company's stock on a basis of $3,000,000 for the entire property. They have brought suit against the majority holders and the British America Corporation for $780,000 damages.

The management of the British America Corporation is prosecuting development work on the Nickel Plate, Great Western and Columbia and Kootenay properties—at the latter sinking to get sufficient depth for new workings.

A 10-drill compressor has been installed at the Golden Cache.

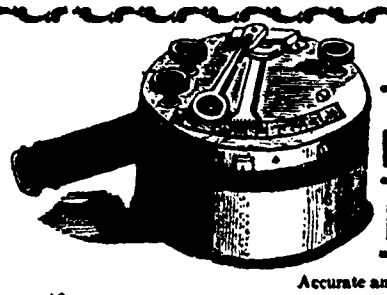
The Centre Star mine at Rossland has been sold to the War Eagle syndicate for $2,000,000. In reporting the deal the Rossland *Miner* says: "The Centre Star was located in 1890 and was not abandoned. The property was purchased by Mr. Durant for $25,000 and since then he has developed it by some 6,000 ft. of workings until now he has more ore in sight than any mine in the Kootenays. In this development it is said that about $200,000 has been spent. This money was obtained by the sale of stock. From first to last Mr. Durant has had the greatest faith in the Centre Star and now his faith is amply rewarded. Of the 500,000 shares of the capital stock Oliver Durant of the city, and Alex. Tarbet of Salt Lake City, Utah, own 360,000 shares; Sir Charles Ross, Bart., owns 40,000 and the P. A. Largey estate of Butte, Montana, most of the remaining 100,000 shares, a few scattered shares being held here and there.

About 50 persons are employed on the Porto Rico mine of the Canadian Pacific Exploration Co., Ltd., at Ymir, and the work of installing the mill and compressor plant is being vigorously pushed. The headquarters of the company have been moved from Rossland to Ymir with Mr. A. B. Irwin as local manager.

The 5-stamp battery of the O. K. mine has been moved to Trail where it will be worked by the Rossland Ore Sampling Works, under the management of Parker, Girdwood & Co, of Rossland.

10-drill air compressor has been installed at the Ironsides mine, Greenwood camp.

At a meeting of the stockholders of the Virginia Gold Mining Company held recently at Spokane it was decided to change the corporation from a foreign to a provincial one. The company was organized in Spokane October 26th, 1895. About eight months ago the company was reorganized, and the control passed into the hands of a Canadian syndicate, with C. R. Hosmer at its head. The property is near Rossland, on the south side of the Center Star Gulch, nearly opposite the Iron Mask. The shaft is down 300 ft., and a 100-ft. crosscut has been made to the south. A shoot of pay ore has been encountered. A small quantity of ore on the dump is being sorted into two grades—good pay ore, containing gold and copper, and iron ore, carrying a small per cent. of gold and copper. George Pfunder is superintendent.



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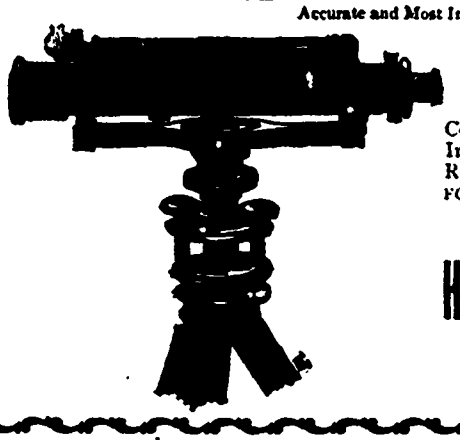

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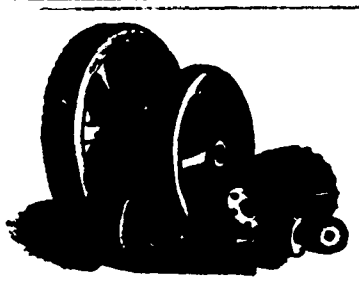

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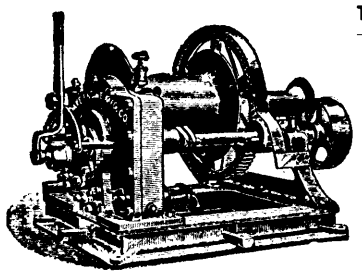

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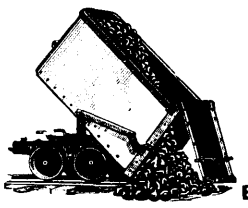

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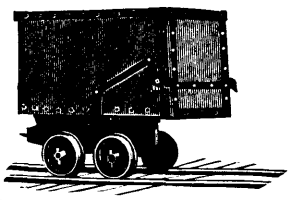

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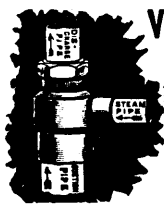

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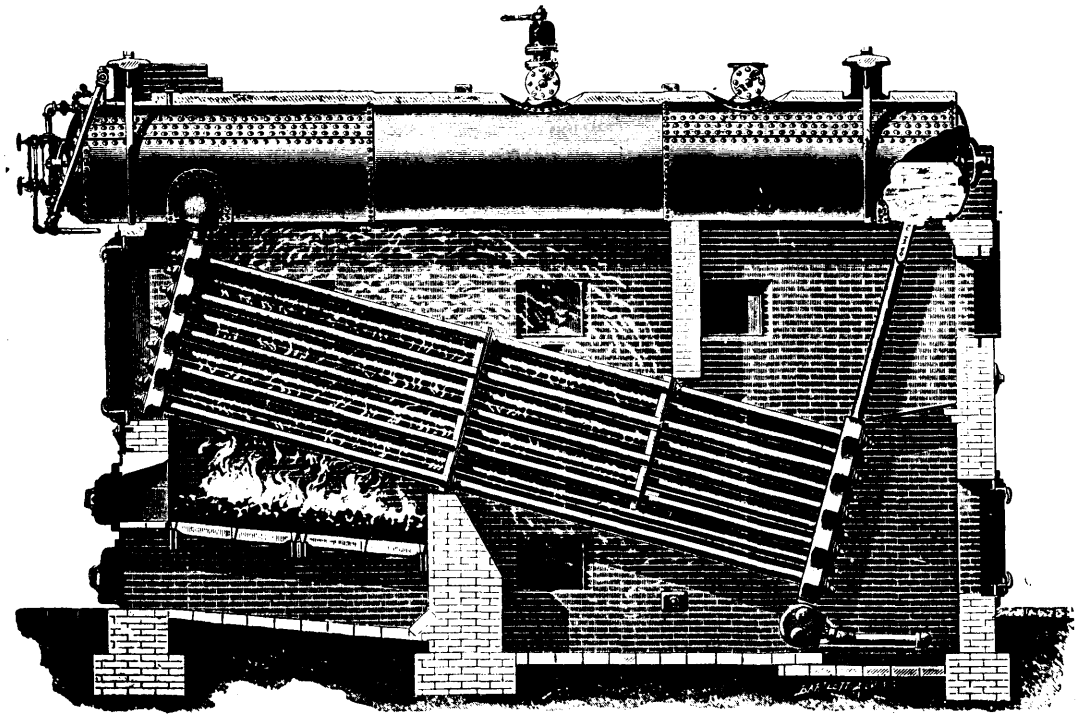

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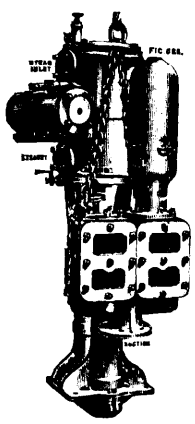

Fig. 620—"Griff" Sinking Pump.

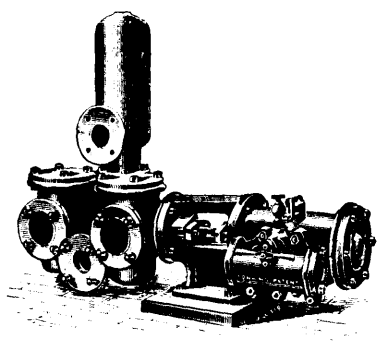

Fig. 598—"Cornish" Steam Pump for Boiler Feeding, etc.

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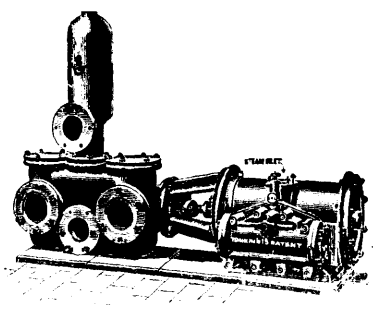

Fig. 600—"Cornish" Steam Pump for General Purposes.

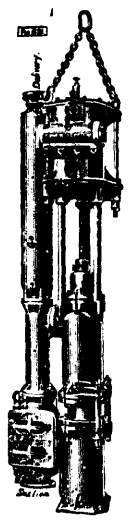

Fig. 621—"Cornish" Sinking Pump (Ram Type).

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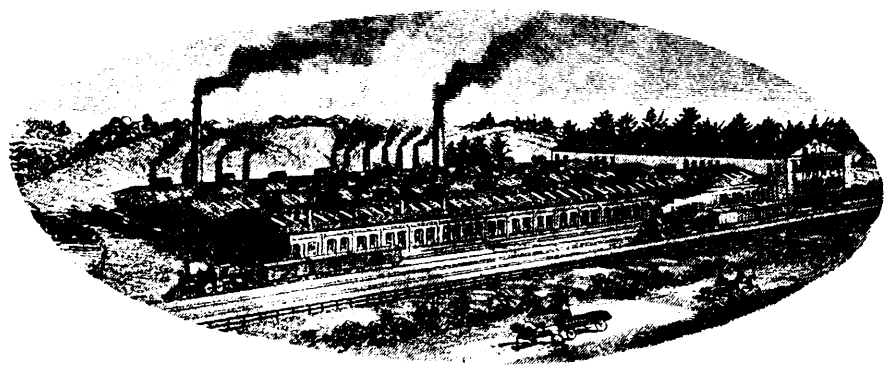

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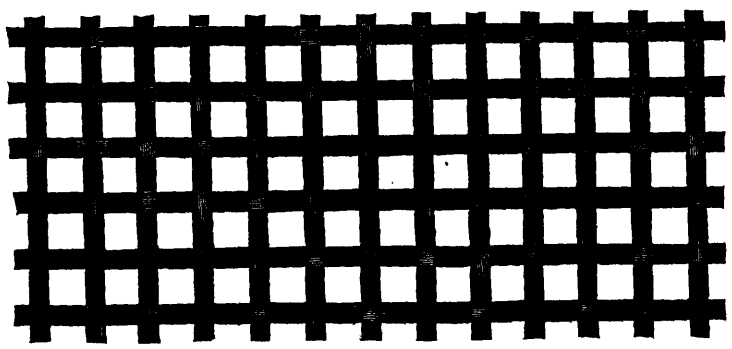

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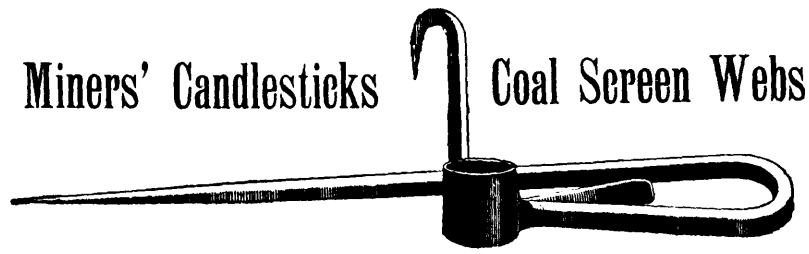

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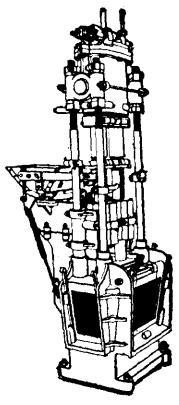

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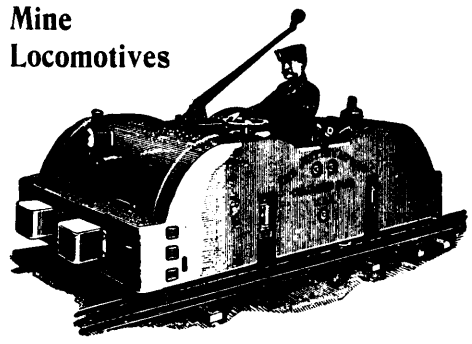

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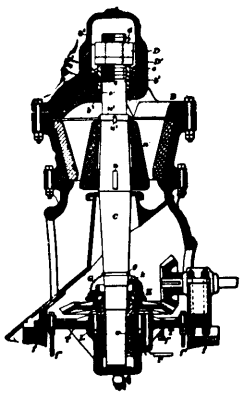

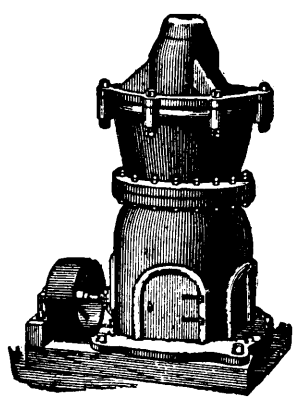

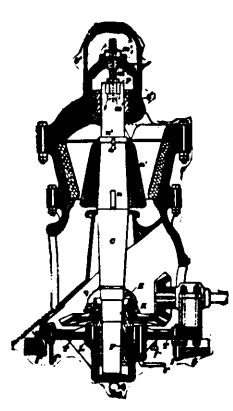

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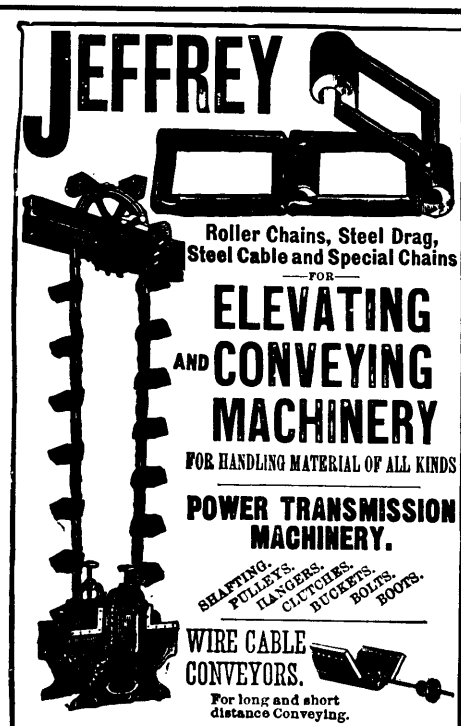

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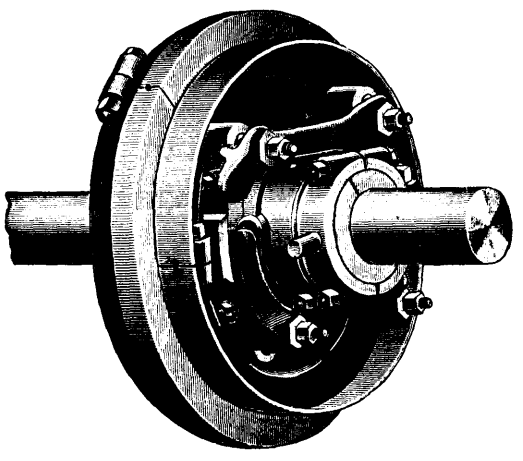

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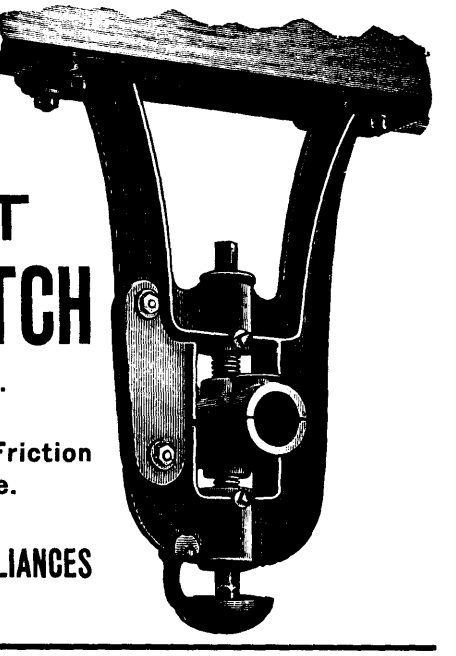

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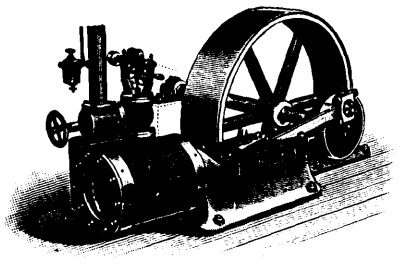

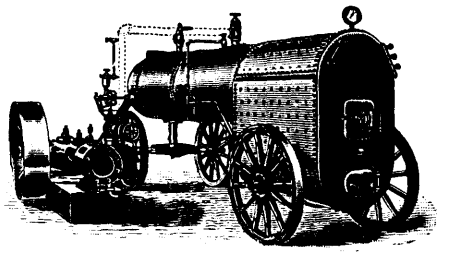

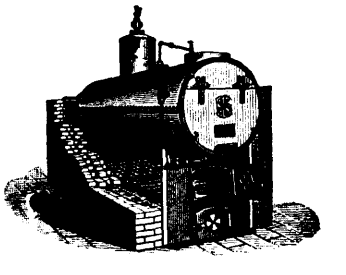

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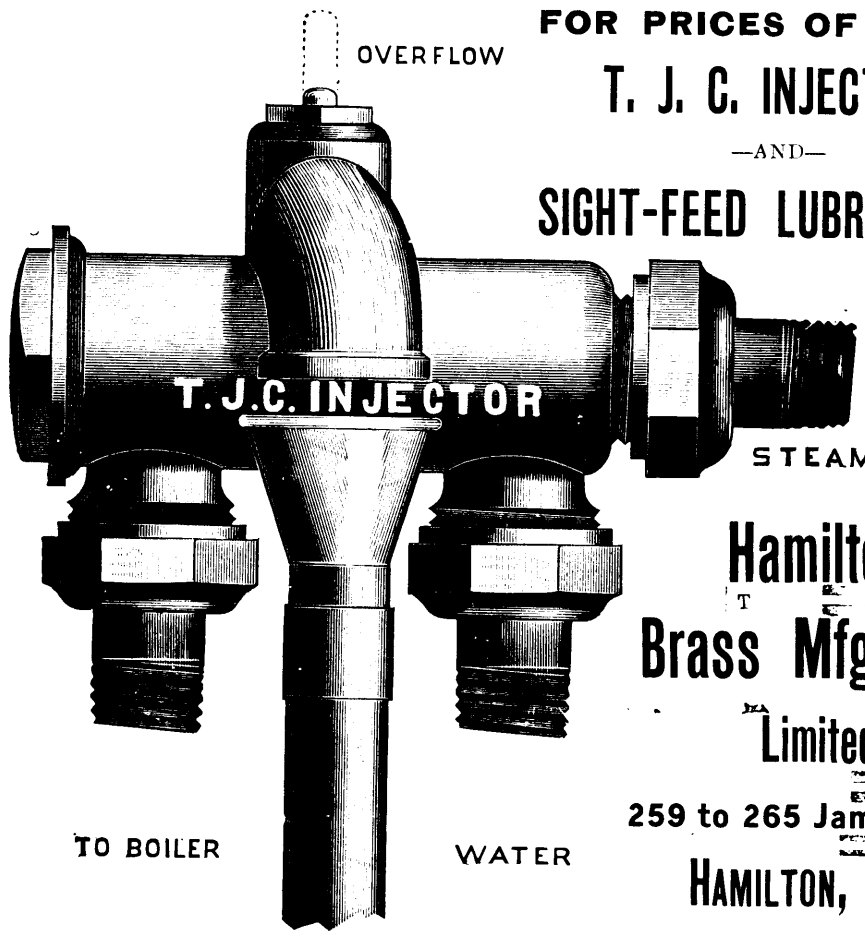

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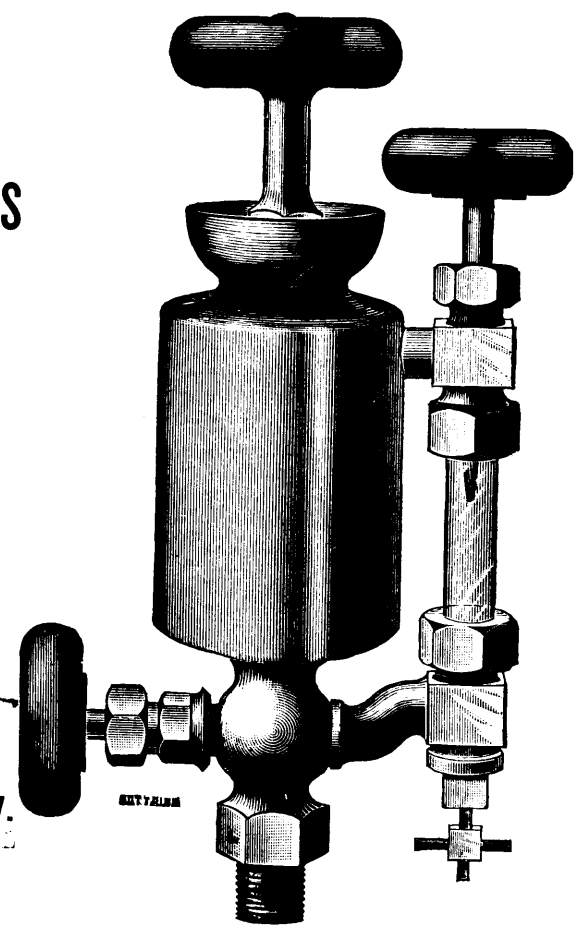

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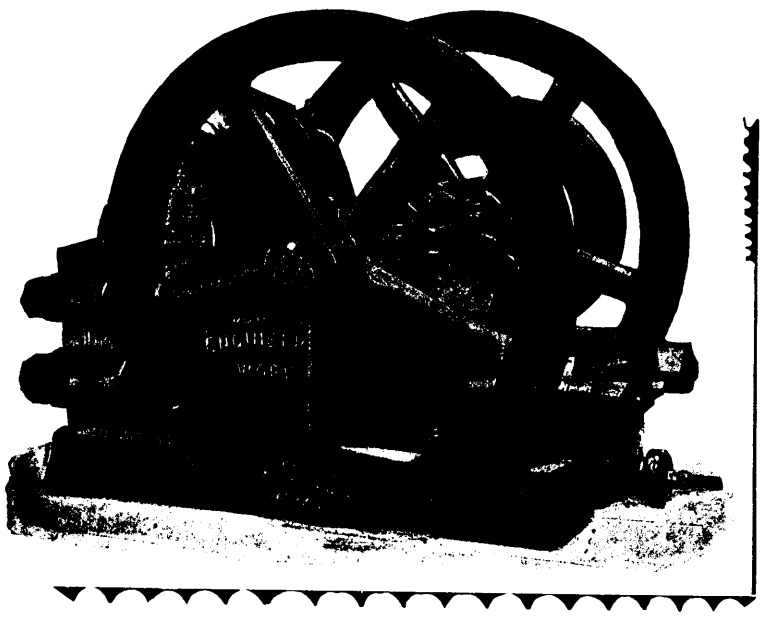

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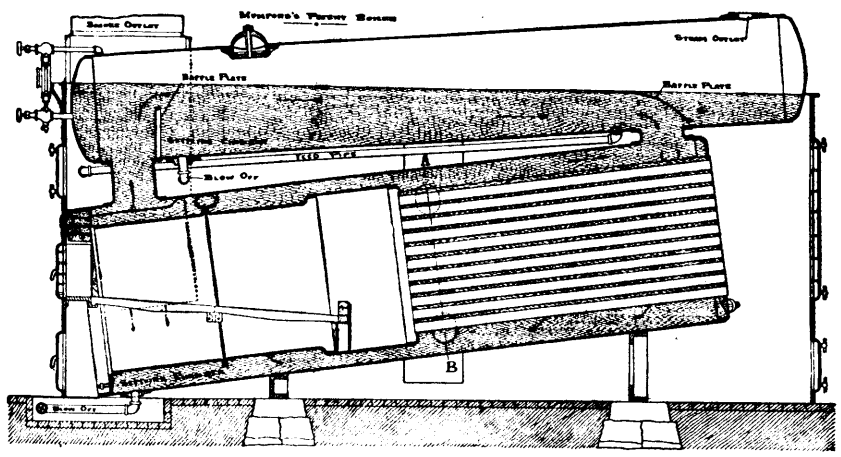

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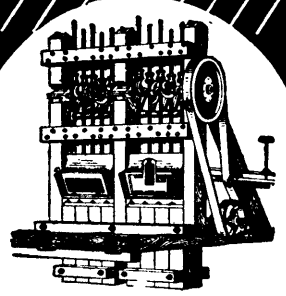

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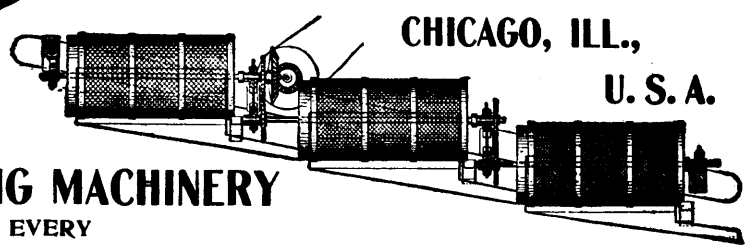

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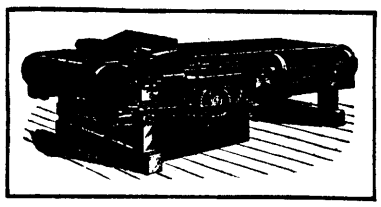

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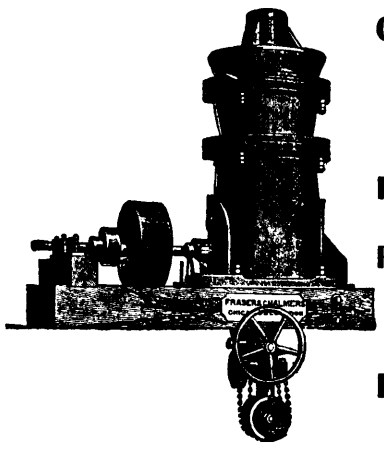

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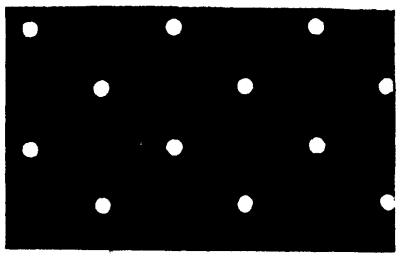

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