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SEVENTEENTH YEAR OF PUBLICATION

The Canadian Mining Review

Established 1882

Vol. XVIII—No. III. OTTAWA, MARCH 31st, 1899. Vol. XVIII—No. III.

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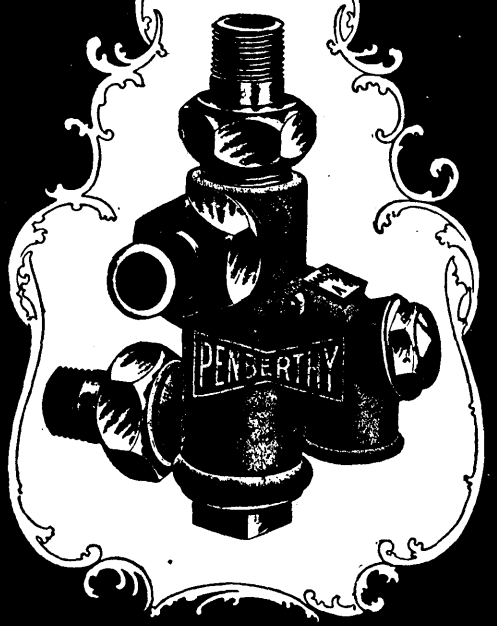

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Under the provisions of chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one 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.

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

THE HON. C. E. CHURCH,

Commissioner Public Works and Mines,

HALIFAX, NOVA SCOTIA.

17th YEAR OF PUBLICATION.

The Canadian Mining Review

Established 1882

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

B. T. A. BELL, Editor and Proprietor.
Secretary, Canadian Mining Institute, etc.

Published Monthly.

OFFICES { Slater Building, Ottawa; Windsor Hotel, Montreal.

VOL. XVIII., No. 3. MARCH, 1899. VOL. XVIII., No. 3.

The Gowrie & Blockhouse Collieries, Limited.

We have had the opportunity of studying the prospectus of the above named company, issued in November of last year, inviting the subscription of £29,000, wherewith to open up and equip a mine, shipping pier, etc., on the company's coal property at Port Morien, Cape Breton.

We are always pleased to welcome mining enterprise and to encourage efforts to develop the rich mineral resources of the Dominion. On the other hand, we have been taught by many sad experiences the incalculable amount of harm wrought by the promotion of schemes that are from their inception doomed to failure. We have from time to time warned our readers against companies foisted upon the investing public by plausible and misleading statements.

Now the company under notice seems to us to be one of this sort, nor can we see the remotest chance of the results promised from the expenditure of £29,000 being fulfilled.

We are somewhat late in the day with our criticisms, the subscription list having closed as far back as the 26th November last, but we feel impelled to explain our reason for fearing that the Gowrie & Blockhouse Collieries, Limited, will add one more to the gruesome list of mining failures in Nova Scotia.

1. The *fons et origo* of this venture, and numbered among the vendors, is one Colin Ochiltree-MacDonald, erstwhile of Great Britain, but for seven or eight years past an intermittent dweller in Cape Breton. During this period his career has been somewhat checkered. Descending upon the rugged shores of Cape Breton with a stock in trade which consisted of a hyphenated name, a stove-pipe hat and a glib tongue, he has been successively a working miner in the Gowrie pit, the editor of a mining paper which dropped into extinction under his management, and the paid agitator, spouter and writer for certain local merchants against the stores of the Dominion Coal Company. It is rather interesting to notice in this connection that among the objects enumerated in the memorandum of association for which the Gowrie & Blockhouse Collieries is established, is (4) "To buy, sell and deal * * * in stores and provisions."

From what we know of Mr. MacDonald, we should be very loth to buy or put money into a mine upon his recommendation, but we are bound to confess that hitherto we have underestimated his ability, inasmuch as we should have bet heavily against his being able to induce the very respectable gentlemen and men of business of Newcastle-on-Tyne, who figure on the board of direction, to take hold of this Port Morien coal scheme.

2. The area which the company proposes to develop is a sea area and lies outside the Dominion Coal Company's areas, which extend for half a mile or so under the harbor. Consequently, to win their coal, the Gowrie & Blockhouse Collieries must sink a slope on and through the Dominion Company's property for half a mile. Even then they only touch a comparatively small body of coal, and in order to win the bulk of it will have to tunnel yet another half mile. Now this does not sound very encouraging, nor does it appear that, as compared with neighboring mines, this new one will possess "unequalled advantages for cheap working" To do this work and generally to put the property into shape for mining and shipping 180,000 tons per year, will cost, according to the company's estimate, $70,000. All we can say is that if Mr. C. Ochiltree-MacDonald or any other individual can do the work for this figure, he will be entitled to be considered a remarkably smart man.

3. "The importance of the Gowrie coal to Canada" is not, in our opinion, sufficiently marked to enable it to compete on equal terms with other coals sold by the Dominion Coal Company and the General Mining Association, nor will "the eager demand for it by shippers and steam users" force the sale of it to 180,000 tons per year, or anything like that quantity, unless at prices which would make terrible inroads upon the estimated profits. It is quite true that during the tenure of the old Gowrie mine by the firm of Archibald & Co., a large and successful business was done for many years; but the entire coal trade has recently been revolutionised, and what was possible a few years ago would be extremely difficult now, even were the energy and wide business connections of the firm in question available. Without them it would not only be difficult. but impossible. Certain it is that from the date of the taking over of the mine by the Dominion Coal Company, Gowrie coal, side by side and on equal terms with other coals, became practically unsaleable, and as is well known the mine was soon closed down and dismantled. The prospectus holds out as a valuable aid to success the co-operation of the firm of Archibald & Co. in pushing the sale of Gowrie coal, but with every respect and good wish for the personnel of the firm as now constituted, we doubt if it can accomplish more in this direction than any other respectable firm of brokers. The gentlemen who made the name and fame of this widely known firm are all either dead or retired from business, and with them, we imagine, have disappeared the capital and influence which did so much to push the sale of Gowrie coal in the past.

4. The prospectus is bolstered up by reports of mining engineers, as is customary in such cases, and in regard to them we would briefly remark that (*a*) the report of Mr. Foggin (since deceased) reads very

much as if the writer desired to say what he had to say as pleasantly and favorably for the exploiters as possible without committing himself too deeply.

His statements strike us as somewhat vague and unimportant, and he deals in glittering generalities, in preference to going to the heart and vital aspects of the question. (*b*) Dr. E. Gilpin's report, to which a reference is made, was omitted in the copy of the prospectus which came to us, and we are therefore unable to comment upon it. (*c*) Mr. P. Neville's report is non-committal in the extreme. (*d*) As regards Mr. Anderson's report, we need only say that if, as we presume, he is the engineer of the old mines, whose valuable services have been secured, it is quite humanly speaking possible that his views may be somewhat biassed by his anxiety to enter upon the duties of his new position, and to draw its salary.

5. As regards the estimated profits, absurdly extravagant to our mind, while it is possible that a small independent colliery, owning a first rate coal and content to do a modest business, not exceeding say 50,000 tons per year, might do fairly well; we feel confident that for the Gowrie & Blockhouse Collieries, Limited, to storm the markets of Canada with 180,000 tons of Gowrie coal against the Dominion Coal Company, the General Mining Association, Springhill, Drummond and other well known producers, will be to court certain disaster. The prospectus boasts that as the old Gowrie mine has been closed, "the company has therefore a practical monoply of the business." Of what business, may we ask? Do these simple-minded friends of Mr. Colin Ochiltree-MacDonald imagine that coal consumers in Canada are filled with a sentimental regret for the vanished Gowrie coal, and that they will all flock back to use it once more?

6. It is a comparatively unimportant point as compared with other matters treated of in the prospectus, but Port Morien is described as "a magnificent harbor." It is in fact an open roadstead, much exposed, and decidely uncomfortable as an anchorage in easterly weather. The breakwater alluded to was erected by the Dominion government for the protection of fishing and coasting vessels, and would be of little service to steamers of modern proportions. The depth of water at the shipping points in the harbor is not sufficient to recommend it as a bunkering station, nor would the company be able to load large steamers of a modern type, and so secure advantage of the low freights of which mention is made in the prospectus.

7. Stress is laid upon another somewhat unimportant point in connection with this enterprise, namely, the importance of English capital controlling stations at which British ships can independently coal in time of war. The people of Newcastle-on-Tyne should know enough geography to be aware that Cape Breton is part of Canada, and therefore a British possession, and that the fact of certain mines being controlled by American capital would not "cut much ice" if British ships were at Sydney or Louisburg and required coal.

It may be well to point out that the Dominion Coal Company still owns the Gowrie and Blockhouse collieries, and that it is more than likely that they will take steps to prevent an improper use being made of the name to which they have a distinct claim.

We have not penned these remarks in any desire to see the Gowrie & Blockhouse Collieries, Limited, be, what we fear it will be, a failure and a sad disappointment to those who invest in it. Far from it. But the scheme is a weak and ricketty one under any circumstances, and when an attempt is made to foist it on the public by means of an inaccurate and bombastic prospectus, such as is the one under notice, we feel it our duty as a reputable journal, having the mining interests of the country at heart, to use plain language in criticising it.

The Law Relating to Company Promoters.

The vast magnitude of joint stock organizations, the range of their transactions, the secret character of the affairs which precede the creation and frequently pervade the business operations of so many of them, all render of first importance the body of written and unwritten law relating to the class called promoters. The birth of these creatures of legal status—the joint stock corporations—awaits the operations of a class related to the parturient companies as midwives, styled in literature *entrepreneurs* or exploiters, in law promoters. Related to most business operations, mercantile or commercial, professional or industrial, the "wilderness of single instances" of related law-cases and the labors of legislators have united to yield to compilers materials for text books which serve the purpose of codes. A recent useful handy-book on "The Law relating to Company Promoters,"* by two English barristers, *with 87 pages only of cited cases, affords convincing proof* that the class of operations involved in the creation of joint stock companies, especially mining companies, calls for remedial legislation in the interest of the public. The law as at present is all that the promoter could desire. It is a product of evolution so far in his interest, and it throws around him a protecting shield which only an idiot may not adroitly use; and if in some cases the two-edged sword of Justice has stricken *him* it would seem to have been because he has not cunningly averted the stroke, rather than that the deceiver's doom was his meed. Lord Chief Justice Russell has recently stated that the enormous sum of twenty-eight millions of pounds sterling has within a few years been taken from the British public in bogus company operations on the London Stock Exchange. The sum probably exceeds the measure of crime of all the convicted forgers and thieves in the United Kingdom in a quarter of a century. The egregious Hooley has lately fully exposed the operations of a reckless company promoter and his titled confederates,—yet with what effect upon public opinion but to make the dogs return to their vomit and carrion-devouring swine to wallow anew in the mire. Gladstone required his cabinet colleagues to resign directorships in public companies during their tenure of public office. The British House of Commons quite recently negatived the proposition that members of the Government should not be joint stock company directors. The speculating class whose interests lie on the side of maintaining things as they are is in the seat of power. The operations of joint stock companies have long ceased to be mainly industrial or co-operative. They are primarily capitalistic. The purpose of exploiting the pockets of the people is the chief end in view and altogether subordinate to this the purpose of earning continuing dividends. To this general statement there are happily a few notable exceptions. It remains broadly true, however, that the investor, the company promoter, the legislator, the public, nine times out of ten, know little and heed less of the intrinsic value of any joint stock enterprise, and that the early rise or fall of stock on the exchange is the principal measure of present value irrespective of its permanent worth

Is it necessary to say that gambling in the promotion of companies is not merely vice? It is crime. It hinders legitimate enterprise not only by withdrawing capital but by casting its shadow over honest undertakings. It gives its gains to the cunning promoter and market rigging broker and starves the scientific engineer and the practcial miner It corrupts legislation by the indirect bribe of the support of the aggressive class who league with the gamblers, while the masses, exploited and robbed, are believed to assent because they do not loudly remonstrate, or are supposed to be accessories after the fact who have no

*The Law relating to Company Promoters: By W. N. Hibbert, L.L.D Law Lecturer at King's College, London, assisted by Frank W. Raffety, Barrister-at-Law. London: Effingham Wilson, 1898.

right to complain because "they have put their money on the wrong horse."

Much of the iniquity which is let loose upon mankind under corporate names and seals is due to the laxity of Imperial legislation, which has served as a model for colonial laws. It is commonly supposed that the rules of the London Stock Exchange afford the public ample protection against swindling enterprises, and it is even so true in a measure. But the appalling losses mentioned by Baron Russell show that the protection is often merely technical and altogether unsubstantial. It is obvious that it is in the very constitution of joint stock companies that proper safeguards for honest dealing must be provided in order to prevent the wholesale swindling for which such creations are used. This subject, however, leads us too far afield from the matter in hand. It is sufficient here to advert to the fact that New York State affords in its joint stock company law a model well deserving the attention of some Canadian provinces, with whom the facilities afforded by the laws of New Jersey and Imperial Britain for gathering in accouchment fees from the illegitimate foundlings of all kinds of promoters have been preferably the object of legislation.

Anent the term "promoter," the editors remark that "unfortunately from the exposure of many schemes which have been out and out frauds, and the criminal implication of many company promoters, the term has attained a notoriety which has tended to bring the occupation of Company promoting into general disfavor, and in the eyes of a good many persons the word is regarded in any connection as almost synonymous with swindler." They present this book, however, with the idea of showing "not only that the functions of a company promoter may be discharged in strictly legal and at the same time remunerative lines, but further that in its proper exercise the office is as useful and as honorable as the many callings and professions that are justly held in esteem." Following upon mention of the altogether modern character of the law affecting company promoters and that "no statute has yet laid down the limits which shall define them," they remark that it is probably owing to a measure of uncertainty as to the strict legal position of company promoters that "many transactions which take place on the flotation of a company, if they were to be revised by a court of law, would not be upheld, and that a good many promoters are able to secure advantages from the proceedings which in law they would not be entitled to. The fact, for instance, that the promoter, buying on behalf of a contemplated company and not on his own account, cannot lawfully make a secret profit, it may be surmised, does not always prevent the price named in the prospectus being in excess of the price at which the promoter actually bought. Perhaps the most common fraud in connection with the flotation of a company is to put in the name of a fictitious vendor, with, of course, a fictitious price. An owner may, as a matter of course, sell his property at whatever price he pleases, but he must be the owner and not merely the nominal purchaser of a concern bought on behalf of a company with the company's money."

The common law action for "deceit" would no doubt in England afford a legal remedy for many actionable wrongs of promoters. Unfortunately in this and many American mining countries the remedy is of no practical value, the promoter being in most cases a predatory bird of passage or execution-proof. The wise legislator, assuming there are such who have no interest in multiplying licenses to swindle in the form of letters patent of incorporation, will therefore consider the social conditions which render actions at law abortive in this country, however useful elsewhere, and will labor for the amendment of the law in such wise as to render every concealment of transactions which precede, or are in any wise mixed up with, the organization of joint stock companies, cause for the prompt suspension of charters, and every undisclosed gain or profit to have been made for the benefit of the company and not the promoter.

"It is now asserted as beyond all question that promoters stand in a fiduciary relation towards the company they promote. The relation is not one of agency, because until the company is formed there is no principal. The company when formed cannot ratify the acts of its promoters, for there can be no ratification of acts done on behalf of the company when it did not exist. The relationship depends upon the doctrine of constructive fraud, and is analogous to that existing between parent and child. Promoters stand in a fiduciary relation to the company which is their creature. They have in their hands the moulding of the company; they have the power of defining how and when and in what shape and under what supervision it shall start into life as a trading corporation." These propositions are unfolded in the third chapter of the book in relation to (1) the sale of a promoter's own property to the Company he promotes—*(a)* where he acquired such before he became promoter, *(b)* or after he became promoter; (2) the sale of the property of third persons to a company through a promoter, and (3) the promoter's expenses. The cases cited under the first and second heads emphasise the principle that there must be no concealment on the promoter's part of any fact to the injury or disadvantage of the company. Under the head of remuneration the principle is supported by numerous citations, that where a promoter agrees with a seller that if an intended company shall buy a property, the seller shall pay the promoter a part—generally a large one—of the purchase money, the agreement if not disclosed is in contravention of the parental relationship to be expected from the promoter to his child the company, and renders the parent liable to pay the concealed gain to his offspring. The fourth chapter discusses the liability of the company for the promoter's acts, which, in view of the relationship above traced, is obviously a negative quantity. It is pointed out that frequently the company gets itself into a hole by making a fresh contract in the place of the one made by the parental promoter, and thus is led by its own express agreement to novate the promoter's contract. A class of operations not unknown to promoters renders them criminally liable, such as "rigging the market," as for instance where the promoters supplied some third person with money to buy the shares in the market and thus to bolster up the price. In a case where the promoter, director and solicitor of a company were convicted of conspiracy to defraud by false representations of gold mining prospects at an estate in South Africa, Mr. Justice Lawrence, in passing sentence, expressed the belief that before long a director who stood by and neglected his duties and was ignorant that a fraud was being committed, would be made criminally responsible.

The legal remedies of companies to rescind contracts with promoters and of shareholders to obtain damages from promoters who have induced them by false statements to take shares, are treated clearly in the final chapter of this useful book, which should be in the hands of every one engaged in joint stock company operations. It is hardly necessary to state that Effingham Wilson's handy publications on commercial law are standard authorities for ready reference and indispensable to bankers, brokers, and company secretaries.

The Canadian Mining Institute is vigorously opposing the Bill being promoted by the Canadian Society of Civil Engineers in Ontario. The views of the Institute were presented by a deputation before the Private Bills Committee on Monday, 27th instant. Similar legislation was successfully contested by the Institute in Nova Scotia and Quebec.

An Important New Consumer of Cape Breton Coal.

On Monday afternoon, March 20th, 1898, a most interesting, if not very imposing event took place at Everett, Mass.) not more than 20 minutes by electric car from the business centre of Boston), when Mr. Henry M. Whitney started the first fire under the first oven of the immense plant of the New England Gas and Coke Company. There was no attempt at display, and no bottle of champagne was broken at the launching of this great enterprise. Only a few handshakings and mutual congratulations passed between Mr. Whitney and Mr. Hirt, Doctor Sneiwind and the other gentlemen who have so ably carried the work of construction to the eve of successful completion, and yet, as Mr. Whitney was heard to remark, he had never performed an act which meant more to him and to the people of Boston than this one.

Inasmuch as these works will consume about 2,000 tons of coal per day, and as this coal will be Cape Breton coal from the Dominion Coal Co.'s mines, it will be seen that Mr. Whitney's modest little ceremony at Everett on March 20th meant a great deal to others outside himself and the good people of Boston, and therefore it is that this new enterprise comes within the purview of our columns and calls for sympathetic notice at our hands.

Some two or three years ago Mr. Whitney announced his intention of producing coke in New England under the Otto-Hofmann process, from his Dominion coal, and of supplying, as by-products, gas, both illuminating and heating, tar and ammonia, at prices greatly below what had hitherto been charged for these commodities. Naturally there were grave difficulties in the way, and the opposition from selfish vested interests that he had to overcome, would have crushed any ordinary man. But he emerged triumphant from the struggle and to-day controls every gas company in the city of Boston, except those of Charlestown and East Boston Hitherto Boston has been supplied with the deadly water gas, with its death record of one victim a week. This noxious commodity will now disappear, because the new process makes it possible, for the first time, to manufacture gas as cheaply from coal as from naptha. Gas for fuel in domestic uses is also promised at 50 cents per M. Thousands have been already using it at $1.00, but in a short time the old-fashioned cooking stove will be doomed, and gas will be the fuel in houses, and in thousands of small industries.

In addition to gas, and treated as the staple product of these works, there will be for sale each day about 1,500 tons of coke, besides quantities of tar and ammonia Ammonia is always in demand, and at the greatly reduced price at which the new company will be in a position to sell it, will be eagerly sought after. The entire output of tar has already been sold—a large New York concern has contracted for it and has leased 6 acres of land adjoining the works, where buildings in which the tar will be treated will be erected. Nothing, in this Otto-Hofmann process, goes to waste.

The coke will be dumped from the ovens into cars on tracks which connect with the Maine & Albany roads. No handling could be simpler or cheaper. Hitherto coke has not been largely used in Boston and vicinity on account of its high cost. But with the reasonable price at which Mr. Whitney promises to supply it, it is confidently expected that it will to a very large extent and in a short time replace soft coal on locomotives and in manufacturies, and no further excuse will exist for the continuance of the "smoke nuisance" of which so much is heard in the city. The demand for coke has already begun. Mr. Whitney has not waited for the large consumers to take the initiative. He has advertised in local papers promising to deliver coke in the early summer. The result has been a deluge of enquiries and orders from all over New England. It is evident that hundreds of thousands of people want it in small ways and for small plants, and even before the larger consumers have fallen into line, the ready sale of the entire coke output has been assured.

Those works at Everett when completed will be the largest of this kind in the world, and as we have endeavored to point out, they will mark the beginning of a new industrial era in New England. But although the enterprise is so revolutionary in its nature, it must not be supposed that Mr. Whitney is investing millions of money on a mere hypothesis. The process has already been carefully tested. The tentative and experimental stages have been passed in Halifax, Nova Scotia, where the People's Heat and Light Co., controlled by Mr. Whitney, has, since 1897 furnished illuminating and heating gas, tar and ammonia from by-product coke ovens. Working tests for the Everett plant were also made last year at the works of the United Coke and Gas Co., Glassport Penn., where the Otto-Hofmann by-product oven is in operation. These tests were carried out by Dr. F. Sneiwind with washed slack from the mines of the Dominion Coal Coal Co., Cape Breton.

The ten ovens in use at Halifax have effectively demonstrated what the 400 ovens at Everett will be able to do, with the difference that in the latter certain economies have been adopted, with better facilities for handling the coal and its products. Consequently Mr. Whitney and his associates know to a fraction just what these 400 ovens will produce from every ton of coal used, and at what cost.

It may be interesting to note the results arrived at by the small plant at Halifax. As an average sample instance, in 24 hours 37 short tons of coal were coked, furnishing 310,000 cubic feet of gas, of which 100,000 cubic feet (32.26 per cent.) was illuminating gas, averaging 18 candle-power, sold at $1.40 per M., and 210,000 cubic feet (67.74 per cent.) heating gas. Of this latter 170,000 cubic feet (54.84 per cent.) is consumed in coking, leaving 40,000 cubic feet of heating gas, averaging 8½ candle-power, for sale at 40 cents per M. A long ton furnishes on an average five pounds of ammonia gas, and 12 U. S. gallons, 120 pounds, of tar. The ammonia liquor is distilled with milk of lime and furnishes a shipping ammonia liquor with 17 per cent. ammonia. The tar is utilized in the summer in the manufacture of tar-paper; in the winter it is distilled, furnishing creosote, pitch, etc. Lastly, the commercial coke, forming 75 per cent. of the coal charged, is broken and sold at the rate of $4.00 per ton for domestic purposes and as boiler fuel, the price of anthracite coal being $4.25 a ton.* It is quite certain that these results will be improved upon at the Everett works.

The location of the new works at Everett, just across the Mystic River from Boston, did not appear to advantage when visited by the writer on March 20th, a cold, blustery day. Mud flats are not inspiring at any time and least of all so on such a day. It is said that when Mr. Whitney was hunting around Boston for a suitable site for his newly conceived coke works, he found that these few hundred acres of unmistakeable and uninteresting mud alone afforded all the facilities essential to such an undertaking, plenty of room, close proximity to tide-water, easy access to railroads, and, with all these essentials, not too great a distance from the city. But some such idea had for years been floating in the brain of a shrewd old Irishman in a humble way of business in Boston, who foresaw that some day this expanse of mud would possess solider and more valuable charms than the most beautiful and fertile land elsewhere, and so from year to year and piece by piece he had bought up this mud flat until he owned it all. Needless to say his speculation turned out a veritable bonanza. But cheerless as is its aspect to-day, it will not take long to

* Vide papers by C. Hofmann in Engineering and Mining Journal of Oct. 8 and 15, 1898.

effect a change. Already a large section of these marshes has been converted into a regular hive of industry, where workmen are busily putting the finishing touches to the huge gas-holder (capacity 5,000,000 feet), the enormous coal bin, the coke ovens, and the buildings where the various by-products are separated, treated and stored—and it does not require a very strong imagination to picture the whole area teeming with kindred manufactures, bringing back to New England industries that have been forced away by costly fuel.

Only 50 of the 400 ovens commenced the "Warming" process, which last 6 weeks, on March 20th. The balance of the ovens will take another fortnight to complete, so that i will be fully two months before they are all "warmed" and ready to be charged with coal.

We heartily wish every success to the New England Gas and Coke Company. These enterprises of Mr. Whitney re-act most beneficially upon the whole Province of Nova Scotia, enlarging the output of coal from the Cape Breton mines, and swelling the Provincial revenues, and he is entitled to congratulations and best wishes for his Everett Works, from all who live and move and have their being in that part of Canada.

CORRESPONDENCE.

The New McGill Mining Laboratories.

SIR,—My attention has been called to a letter in the January issue of your journal, in which the new mining laboratories of this University are somewhat severely criticised.

The writer—who claims to be an old graduate of the mining department of the University—makes several statements in regard to the laboratories and then draws conclusions. His letter deserves no serious consideration if judged merely on its merits, but unfortunately the statements regarding the equipment of the laboratories are wrong in almost every particular, and I must therefore ask you to give space to the following comments:

"Alumnus" visited the laboratories during the recent reception, when they were swept, garnished and thrown open to the friends of the University, and his observations made on that festive occasion may be briefly summarized as follows:

(1) The machines are so big that they "eat up the ore" before results can be obtained, and furthermore the use of these big engines taxes too severely the strength of the students.

(2) The modern "idea" of automatic progress of material from machine to machine is ignored and the ore must be handled and re-handled during the operations, thus again so exhausting the students that they become "intellectually sluggish" and unable to understand what they are doing.

Now it is a fact that the department is equipped with machines that are big for a laboratory. Usually the smallest commercial size of each unit has been chosen for the very good reason that we wish to show our students the real thing and to give them an idea of what actual ore dressing and metallurgical machinery is like. It is also true, however, that practically every big machine that the students use has its counterpart in miniature. There is a big crusher and near it a little one to be run by hand. The trommel is big, but near by is a small shaking screen run by power and still smaller a set of sieves. The big jigs have a carefully designed and costly counterpart that can successfully treat a double handful of ore. The Wilfley table is one quarter size and we usually find fault with the frue vanner for being too small, —not too big. Similarly the stamps—although large—have beside them a small Huntington mill, and on the other side a small tailings pan and a series of experimental pans, the least of which is overloaded with half a pound of rock.

In the metallurgical room the same obtains. The big roaster is, it is true, nearly one-sixth as large as the ordinary small roaster of smelting works, but near it is one in which a shovelful of ore is a charge. The same is true of the cyaniding and chlorinating apparatus and in fact everything in the laboratories with one or two exceptions, where experimental science has as yet failed to design a miniature that will work.

Furthermore, even when the big apparatus is to be run we have no trouble to get all the ore we want for it, and the 60 h.p. electric power plant of the department has thus far proved quite sufficient to turn over the machinery without assistance from the students.

In this connection it may be said that we have never yet had a student complain of overwork in a physical sense, and on the other hand we have frequently been asked to discard a "small" test and let them use one of the larger machines, of which they get too little—not too much.

Finally, instead of their being no attention given to automatic handling of material, there is every attention to it. From the sampling and crushing floor, to which the ore is hoisted by a hydraulic lift to the settling tanks in which the tailings are caught to keep them out of the city sewer the series of automatic elevators, landers, pipes, etc., is continuous and practically perfect,—and not one stroke of manual labor in re-handling material is required of the students or anyone else. In fact, if it were not that the automatic conveyors can be and usually are deliberately cut out to a certain extent, the students of the department would be in danger of getting too little idea of what work really is, rather than too much.

We do not claim that the laboratories are perfect, and we heartily welcome all straightforward and intelligent criticism of them, as by means of them we hope to be able to make many additions and improvements both to equipment and methods of use; but I think the above statement is sufficient to prove that the criticisms of "Alumnus" are based on such a complete misapprehension of the facts that they are practically of no value.

Yours, etc.,

JOHN BONSALL PORTER.

MONTREAL, February 21, 1899.

The Alice A Mine.

SIR,—Thorough tests with a steam stamp mill on the "Alice A" mine in the Rainy River District of Western Ontario, covering different parts of the property and a period of several months, prove that the ore averages $9 per ton in free gold. Now comes proof that the by-products in the concentrates will cover all cost of mining and milling and pay a small profit besides. Last fall, W. D. Ramsay, an English mining expert, representing a London syndicate, visited the "Alice A" mine and spent close to 3 months making an examination of the property and mill tests of the ore. His report was so favorable that his clients are negotiating for a large block of stock with an understanding that a mill of not less than 50 stamps be erected.

When Mr. Ramsay returned to England, he took a quantity of concentrates from the "Alice A" ore. Those were analyzed by Johnson, Matthey & Co., Assayers and Melters to the Bank of England and Her Majesty's mint. The following certificate was returned to Mr. Ramsay:

"We have carefully analyzed the sample of concentrates and find the following to be the proportion in every 100 parts:

Iron	24.90
Lead	10.25
Copper	1.10
Zinc	4.35
Alumina	traces
Magnesia	1.20
Sulphur	20
Phosphorus	traces
Siliceous insoluble matter	27.25
Moisture	1
Gold, silver, carbonic acid, oxygen and loss	9.95
	100.00

	Oz.	Dwts.	Grs.
Produce of gold	..	14	15
Produce of silver	3	10	..

Per ton of 2,240 lbs. of concentrates.

JOHNSON, MATTHEY & Co."

In his letter accompanying the certificate, Mr. Ramsay said:

"I have the pleasure of forwarding you assay carried out by Johnson, Matthey & Co., Assayers and Melters to the Bank of England. The result more than realizes what I stated when we were at the mine, *i. e.* that there would be sufficient values in the concentrates to pay for mining and milling. The tests which I, myself, have made are within a fraction of the results brought out by Johnson, Matthey & Co. This is highly satisfactory to parties here who sent me out to investigate your property. No doubt your American stock holders will be pleased at the result if they only realize the very high percentage of concentrates that the matrix of the "Alice A" contains, together with the free gold."

Colonel J. S. Hillyer, president of the "Alice A" Company, has left for England, where he not only will arrange details for a 50 stamp mill, but expects to secure a heavy increase in that number.

The "Alice A" property has an ore body of schistose quartz from 500 to 800 feet wide and has been called the "Homestake of Canada."

JOHN G. MORRISON.

Duluth, 20th March, 1899.

The Iron Industry in 1898.

By GEORGE E. DRUMMOND, Montreal.

The past year has been a record one in the principal iron producing countries of the world, and, as far as Canada is concerned, 1898 may be considered as marking a new era in the native iron industry, the beginning of a modern expansion in the manufacture of pig iron within the borders of Canada that will in due time give us a respectable position among the great iron producing countries.

Following the usual course and reviewing briefly the iron markets of the world, we have first the United States, showing a most remarkable record for 1898 as far as production is concerned, and a wonderful rate of consumption that already in February, 1899, indicates almost a famine in iron and products of iron. Figures for 1898 show that the United States produced 11,773,934 tons of pig iron, and this enormous production goes on at an increasing ratio, using up the available ore supplies at such a rate that the greatest difficulty may be experienced before the close of the present year in keeping the furnaces supplied with raw material.

The present great revival of trade in the United States, brought about by two successive years of splendid crops and consequent increase in railway earnings, which enabled the railway companies to undertake vast expenditures for new rolling stock, is the cause, no doubt, of a great deal of the revival, but everywhere most satisfactory expansion is marked in all lines of manufacture of which iron is the the basis. The lessons of the war with Spain will probably result in a great expenditure being made by the American Government in perfecting their coast defences, and all this is in the direction of an increased utilization of iron.

The export trade in the United States in 1898, in all kinds of metals, reached the enormous sum of $120,000,000. In the item of pig iron alone they exported 250,000 tons. With the scarcity of iron for home requirements at the present moment, it is not likely that they will press the export trade unduly in 1899, and the iron producers of other countries (and not least of all Canada) will have a chance to gain strength to meet future competition in the United States.

Great Britain.—The British iron masters hold second place as the iron producers of the world to-day. The total records of iron produced in Great Britain in 1898 are not yet to hand, but it is pretty safe to estimate an output aggregating 9,500,000 tons as against a production in 1897 (revised figures) of 8,796,465 tons. The use of British iron has almost ceased in Canada, and while that does not mean that Britain is not holding her own in other markets, still the situation is a somewhat grave one for British iron producers inasmuch as their ore supply is growing more precarious every day. The life of the Spanish iron mines, upon which Britain draws heavily for supplies, is already well understood to be but short. The product of the home mines grows steadily less, and it will be well for Great Britain to look to her Colonies, such as Canada and Newfoundland, for her future source of ore supply The indications are that this alone will enable her to hold the position that she has held for so many years. The British home trade in iron has been very prosperous in 1898, exceeding that of any previous year. In ship yard and railway work, and in all branches of the iron trade, manufacturers have been exceedingly busy, and with more or less freedom from strike difficulties. Great Britain emerges at the close of the year with a splendid record, but Canadians regret to note how very much "out of touch" they are to-day with the British iron masters, who formerly supplied this country, and who have been replaced to a very great extent during the past few years by the iron producers of the United States.

Germany and Luxenburg.—Enormous strides have been made by the Germans during the last three or four years in their iron industry, and the figures of production for 1898 (Germany and Luxenburg) 7,402,717 metric tons, come so close to the records of the British iron masters that there is grave cause to fear that unless most vigorous measures, political and economic, be taken by Great Britain, her rank as an iron producing nation will be displaced by Germany, as it has been by the United States.

Canada.—The output of the Canadian furnaces for 1898 exceeds that of 1897. Advices received from Hamilton, Ont., New Glasgow, N.S., and Radnor Forges, Que., report a combined gross tonnage produced of 75,920 net tons of pig iron, 23,541 tons of steel, and 2,276 tons of forgings. The combined tonnage of pig iron in 1897 was 57,904 net tons.

The works at Londonderry, N.S., were closed down throughout the year, the company being in liquidation, but this not because the market could not absorb its full output had the works been running. Everywhere the product of these Canadian furnaces has given entire satisfaction, so far as the quality of metal produced is concerned. The work of developing the Canadian mines has been carried on quietly, but steadily, by those interested, and the new year opens with splendid prospects for a very much larger production of Canadian metal in 1899.

The new charcoal furnace constructed at Deseronto during 1898, has just been put into blast, with an average output of 30 tons of charcoal metal per day, practically doubling the daily production of charcoal iron in Canada.

A new charcoal furnace is projected for Midland, Ont., by the Canada Iron Furnace Co., Limited, of Montreal and Radnor Forges, this being a branch of their business at the latter point, but the intention being to manufacture at Midland an iron similar in quality to Lake Superior charcoal, and which is required for mixture with the

special charcoal metal now made at Radnor from the bog and lake iron ores of the district of Three Rivers. The new Midland furnace will have a daily capacity of from 60 to 80 tons of charcoal iron.

A four furnace coke iron plant, of large capacity, is projected by American and Canadian capitalists at Sydney, C.B., where the ores of Newfoundland will be smelted with Canadian coal.

Other furnaces are talked of, but those already mentioned will turn out sufficient iron in the near future to care for all the immediate wants of Canadian iron founders, and doubtless a considerable quantity of the metal produced will be exported to Europe, especially perhaps from the proposed Cape Breton plant. The time is rapidly approaching when the product of the Canadian furnaces will have to be carried (on a larger scale than at present) to the finished stage of of iron and steel of all descriptions, there being an ample and increasing home market for such products.

The following are the records of the furnaces at Hamilton, Ont., New Glasgow, N.S., and Radnor Forges, Que., for 1898 :

THE HAMILTON BLAST FURNACE CO., LTD., HAMILTON, ONT.

Ore smelted (tons of 2000 lbs.)	77,023
Scrap and mill cinder	8,614
Limestone	13,799
Coke	50,407
Pig iron product	48,253
Average number of workmen	130
Wages paid for labor	$ 61,476
Value of pig iron at furnaces	530,789

THE NOVA SCOTIA STEEL CO., LTD., NEW GLASGOW, N.S.

Pig iron made	21,627 net tons.
Steel made	23,541 "
Forgings made	2,276 "

The material used being as follows :—

Coal	107,000 net tons.
Canadian ore	19,000 "
Newfoundland ore	15,000 "
Spanish or Cuban ore	6,000 "
Coke	32,000 "
Limestone	18,000 "
Average number of men employed	750
Wages paid about	$280,000

N. B.—These figures do not take into account the men employed in mining coal, nor does it include the various parties employed professionally and otherwise and not paid directly by the company.

In addition to the operations carried on by this company they have during the year been working their Newfoundland iron ore property more extensively than ever before, having shipped to Germany and Scotland about 75,000 gross tons, besides bringing over 30,000 tons to their own works at Ferrona.

THE CANADA IRON FURNACE CO., LTD., MONTREAL AND RADNOR FORGES.

Owing to the plant being overhauled and improved during the year, the campaign was only of about eight months' duration. The production during that time was :—

Special charcoal pig iron	6,040—420/2000 tons.
Chaocoal made	580,100 bushels.
Ore made	14,400 net tons
Limestone flux made	1,432 "
Average number of men employed.	600

As usual, the labor in connection with this furnace was principally drawn from the farming class, and the field work is therefore of a more or less intermittent character, being performed at seasons of the year when the farmer is not engaged in his usual agriculture pursuits. A very large number of horses are also employed in teaming the ore and wood necessary for the supply of the furnace.

The product at Radnor Forges continues to attract most favorable consideration from engineers abroad as well as at home. During the year shipments of "C.I.F.," special charcoal metal were made from the furnaces to leading establishments in Great Britain, France, Germany and the United States and the demand for this special iron is an increasing one.

While the figures for 1898 do not show a very large increase over those of 1897 (this being largely accounted for by the liquidation of the Londonderry Co's affairs) yet the furnaces in blast show a healthy strong business growth, and the projected furnaces (all in strong hands) now coming into the field, is good evidence of the fact that we are on the eve of a very considerable expansion of the native iron industry. A great factor in bringing this about is the settled condition with regard to the governmental policy of encouragement. If that policy is steadily maintained for a few years to come, Canada will have an industry that she may well be proud of, and that will strengthen and build up every other kindred industry in the Dominion, an industry that will be useful too in an imperial sense, making for the Independence of the Empire in so important a commodity as iron.

Mining in Quebec Province in 1898.

By J. OBALSKI, M.E., Quebec.

[Read before the Canadian Mining Institute.]

The following remarks and statistics will give a fair idea of the progress made by the Mining Industry in this Province during the past year :

Bog Iron ore operations have been carried on as usual, the ore being raised in many different localities and transported to the Drummondville and Radnor furnaces. These latter were operated for about eight months of the year, utilizing 13,363 gross tons of ore and producing a total of 5,762 gross tons of charcoal pig iron.

No other iron ores have been worked, but inquiries have been received concerning the Magnetic sand found on the north shore of Gulf of St. Lawrence, and possibly something may be done in this line before long.

The Ochre producing plants have done a fair season's work in the Three Rivers district, the product finding a market abroad as well as in the Dominion.

Chromite operations have been steadily continued in the Coleraine district, and improvements in the system of extracting the mineral were remarked. Special attention was given to the idea of concentrating the ore, in order to produce a 50 per cent. grade, the standard in demand. In this connection, two mills have been erected, and will probably be ready for work during the coming summer.

Our *Low Grade Copper Ores* of the Eastern Townships have been worked with the usual success by the two Capleton companies, and some important prospecting work has been done by other parties. At the Harvey Hill Mine, the present owner is deepening the Whitburn shaft ; and in view of the rise which has taken place in Copper, we should see this year a notable increase and activity in this industry.

Up to a recent date, *Nickel and Cobalt* had not been found in this Province in any appreciable quantity, the only instance reported being in the Township of Orford. Last summer Mr. E. P. Cowan while prospecting in the south part of Calumet Island, in the County of Pontiac, located a remarkable deposit of this mineral. This district, as established by the Geological Survey, is overlain by a band, unquestionably Hurnonian, and in connection with the Diorite, it

contains, several varieties of minerals have been found. The work performed by Mr. Cowan consists of a shaft 20 feet deep sunk on a small band of Diorite, 12 feet in width, carrying in a disseminated state, numerous grains of nickeliferous pyrrhotite, and which at one point concentrate in a small vein 8 inches wide. A specimen of the ore tested gave: Nickel, 3.33 per cent.; cobalt, 0.35 per cent. Besides the above, a small vein of yellow mineral, established by the Geological Survey to be "Niccolite," or arsenical nickel, presents itself in one place two inches wide, and probably patches of same are disseminated through the whole mass of Diorite, which latter lies in a N.N.W. direction with a dip 20 deg. E. The claim is situated on lot 12 or 13 in the XI. Range. Although numerous indications of pyrrhotite are found in the vicinity, I have not seen any other than those above mentioned, containing nickel in commercial quantity.

Molybdenite attracted attention last year on account of its new uses for metallurgical purposes, but up to the present time, no deposit has been worked, and as a matter of fact, we have no idea of the actual form of the deposits. This mineral has been found at several points in the Gatineau Valley, in the Counties of Ottawa and Pontiac, and also on the north shore of the St. Lawrence. We hope that some of those deposits will be worked in 1899.

Operations on *Galena* have been carried on to some extent at Lake Temiscamingue and Calumet Island; at the latter place, the ore is mixed with a large proportion of zinc blende. The development work here may lead, in the near future, to some important discovery.

Alluvial Gold mining in the Beauce district has been continued, and some good prospecting work was done on the Gilbert River; no doubt there is a fair profit to be obtained here by intelligent action and we may expect to see a marked increase in development,

Some prospecting work was done in other parts of the Chaudiere Valley which promises well. Altogether, there should be a much larger output of gold in 1899 than during the last few years.

The production of *Asbestos* is now a firmly established industry, and large quantities of fibre were extracted in the Thetford and Danville districts. Danville was also a large producer of Asbestic. A certain amount of work was done at Broughton and Black Lake, and to a lesser extent in the Ottawa District.

Graphite (in the vicinity of Buckingham) was but little worked in 1898, notwithstanding the fact that there was a fair demand for the prepared article. In 1899, we hope to see activity, as it is reported that a company is being organized to operate on a large scale.

Phosphate mining was practically neglected, and only a few hundred tons were produced in the Ottawa district, being taken out in the process of mining for mica.

The Mica mining industry showed a somewhat increased activity compared with the last couple of years, e. g. there were 250 men employed last year, as compared to 50 to 100 in 1897, prospecting and working. Mica is now shipped chiefly in the "thumb trimmed" condition, firstly because it is more easily handled, and secondly because the duty on the mineral in this shape is less. The demand for Canadian mica is strong, and the prospects of this industry for the future may, with safety, be said to be bright.

Feldspar has been taken out in fairly large quantity at Templeton and shipped principally to the United States market.

The building material industry has been maintained in about equal volume to former years.

Prospecting for other minerals has been done, and in this connection, I should specially make mention of the work done in the Gaspe Peninsula in boring for petroleum. The results met with were encouraging. In the north shore of the St. Lawrence, some prospecting in the Magnetic sands was also done.

In the following statement, I show the quantities and values of the raw material at the mine, of the various minerals produced in the Province during the year, but not including the building material, and mineral waters, as complete returns of same could not be procured.

The value of the raw material at the mine, *i.e.*, the quantity shipped or used in 1898 is $1,700,000, approximately.

The mining industry generally employed about 4,000 hands at various points in the province.

	Quantity shipped from the mine, or used.	Value of raw material at the mine.
Charcoal pig iron (gross tons	5,762	$116,154
Bog ore "	13,363	37,027
Magnetic ore "	22	66
Ochre (tons of 2,000 lbs.)	1,260	12,600
Chrome iron (gross tons)	1,805	25,000
Low grade copper ore "	35,686	143,884
Zinc, blend and galena "	1,300	21,900
Gold (ounces)	370	6,500
Asbestos (tons of 2,000 lbs.)	15,893	496,340
Asbestic " "	7,122	14,916
Plumbago (prepared) " "	85	8,500
Phosphate " "	870	5,975
Mica (thumb trimmed) " "	275	81,000
Feldspar " "	2,000	5,000
Sulphate of Baryte " "	55	275
Slate " "	3,432	37,374
Flag stone " "	946	3,580
Cement (barrels)	20,000	32,000
Lime (bushels)	1,000,000	140,000
Bricks	120,000,000	600,000
Total		$1,672,837

The Golden Seine River.

The following appropriate lines adorn an exceedingly handsome and well prepared report of the operations to date of the Golden Star Mining and Exploration Company of Ontario (Limited), reference to production of which is made in our Company Notes in this issue:—

On the shores of Bad Vermillion,
In the District of Seine River,
In the heart of the great gold fields,
Stands a stamp mill of late pattern
Stamping out the precious metal
From the quartz of a great gold mine
Named the Golden Star, and rightly,
Being the foremost of the district,
Of the great and mighty district,
Of the district called Seine River,
From the production of this stamp mill,
Great profits are divided,
Divided regularly to the holders
Of the stock in this great gold mine.
Other mines are surely hidden
In this great and mighty district,
Awaiting capital to develop,
To develop into gold mines.
All the quartz found in this district,
Contains free gold in great plenty;
Quartz veins outcrop on the surface,
Outcrop plainly everywhere
Through and out this mighty district,
Throughout this district called Seine River.

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ROCK DRILLS, COAL CUTTERS

STAMP MILL MACHINERY. **ORE AND ROCK CRUSHING PLANTS.**

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Prospecting for Iron Ore in Newfoundland and Cape Breton.

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

(Read before the March meetings of the Canadian Mining Institute.)

The subject of this paper may perhaps have some special interest at this time owing to the general activity displayed in iron ore and pig iron brought about by the remarkable revival of the general iron trade, especially in the United States, and by the increased demand for ore, and even pig, in Great Britain and the Continent. The Spanish ources of ore supply are not as available as in former years, owing partly to measurable exhaustion in certain districts, and partly to the increased developments of Spanish iron works, which have a tendency to cause the Spanish Government to take measures that will prevent too rapid an exhaustion of this very profitable resource of their country.

This increasing European demand for ore and pig is really the key note to all the activity displayed in iron ore developments in the sections that I am now describing, and these matters have been well understood among those interested in Canadian iron developments. The time for taking action, however, had been unpropitious until last year, and since then developments have been rapid.

The success of the Spanish-American war gave the necessary impetus to this revival in iron, as well as in many other industrial lines, and as a result an almost feverish activity has taken place in some sections of the countries referred to by these notes.

In Newfoundland the movement towards active development has been going on for some time, stimulated particularly by the remarkable deposit of ore discovered on Belle Island, and which was brought to the first stage of its full development last year. The fact that so large and uniform a deposit was found naturally gave reason for supposing that there were others equally as good, and it seemed unreasonable to suppose that this should be the only one of this nature in a country which showed signs of ores in many localities, and whose whole geology was in many respects so nearly akin to that of the famous Lake Superior regions; in many cases the fact was undoubtedly lost sight of that this Belle Island formation was entirely unconformable, and had no apparent direct relation to any of the surrounding geological formations. Nevertheless, the general public interested in iron naturally jumped to the above conclusion, of where this was there must be more, and English capital has been heavily interested already in many localities, while the prospects are that next spring and summer will see a remarkable activity in prospecting and developing this colony, with, it is to be hoped, good results.

There is no need of my describing the Belle Island deposits, as this has been done most thoroughly by Mr. R. E. Chambers, at the March meeting, '96, of the Mining Society of Nova Scotia, and Mr. J. P. Howley, of St. Johns, Newfoundland, has made a close study of the geological formation.

I will only add that what strikes one as being peculiarly interesting is the remarkable fact of this ore being in regular stratified formation, so that it enables the miner to make definite calculations as to quantities contained in the areas, which is so great a departure from the usual run of ores throughout this whole country that it deserves special mention, and should be kept in view, so as not to mislead one in prospecting the rest of the country.

Its real value lies not so much in its richness of iron (it averaging about 55 p.c., which a Lake Superior man would call low grade), but in its extreme uniformity, both of quality and size of vein, and its proximity to the most available iron smelting point on this side of the water for English consumption.

A feature of the districts I examined in Newfoundland, outside of Belle Island, was the rather striking geological similarity to those of some of the Lake Superior districts; in fact this general similarity is noticeable all through the northern iron bearing districts, including Nova Scotia and Cape Breton, and a study of the monograph by Henry Lloyd Smith, on the Marquette iron bearing district of Michigan and other U.S. geological reports emphasizes this in very many points. These ores occur almost invariably in the older formations and are irregular in lenses or basins, sometimes only in small seams, frequently pinched out by rock. The slates here were underlying the volcanic granulites, and penetrating through these latter were found the thin seams of ore, following apparently cracks in the granulites, and constantly varying in thickness. The great question apparently will be whether these crevices widen out into hollows and basins filled with ore, or whether they are merely the remnants of the large ore-bearing formations which appeared to have centered their deposits in the Lake Superior regions. The theory of ore solutions penetrating and filling these volcanic formations wherever cracked or hollowed out, in blow holes or otherwise, seems to be pretty well accepted, and is, perhaps, the most reasonable one. The prospecting of these deposits, therefore, is one of extreme uncertainty, and it appears that the diamond drill is the most suitable method to employ; driving shafts in the hard granulites is expensive work, and the ease with which the drill can be changed, and the large territory that can be covered with it from one point, makes it the most available and economic factor in determining the presence of ore in these sections.

In Cape Breton we have somewhat similar conditions to deal with; various ore properties have been partially exploited and abandoned because of their irregularity, yet I think some very fair deposits can still be found. The irresponsibility and unreliability of many prospectors, coupled with ignorance in many cases, is a serious drawback in all these countries, and I would utter an earnest word of caution on this subject, as it is bound to react on the whole country if persistent mis-statement and exaggeration are laid before the public, especially before English investors. I can speak feelingly on this subject, as I have lately had experience in these matters, where, in various cases, there was no foundation for reports that claimed large quantities of ore, and where it was evident that no more than mere superficial examinations had been made. I will not impute worse.

We are entering a new era where especially English capital is looking this way, and only fair and honest treatment in such matters can bring and hold it here. It is easily made timid, and any one large deal based on fraud or ignorance would turn away dozens of others that might have merit. I trust that some of my speculative friends in this country will take these words to heart and remember, that after all, as an ordinary business policy, honesty pays best.

I will speak of one deposit in Cape Breton which shows some of the difficulties to be contended with in all prospecting—this is at Whycocomagh; the vein was discovered some 150 feet up the side of the mountain, and a tunnel put across it. This struck some 15 feet of ore and rock; the ore being part magnetite and part hematite. Then we cut a vein of ore some 9 feet thiek, which was a 56 to 58 per cent. part hematite, part specular ore, mixed with a little magnetite. I append some analyses, and also a sketch showing the work done in endeavouring to determine how this deposit ran. On the surface all indications pointed to an almost vertical dip with a well defined hanging wall; yet subsequent developments by tunnel and Diamond Drill plainly showed that while the apparent dip of strata continued for a space there was no sign of ore below, and the drill has not yet definitely determined which way it is running. This sort of experience I have met with at other places here, and the only safe way is to arrange for the cost of a sinking and pumping plant and follow the ore. Nature here will not allow you to take anything for granted.

You have just got to put up your cash and patiently follow her wherever she leads.

In connection with this account of the difficulties of prospecting in Cape Breton, I would like to bring to your notice a proposition that has occurred to me on reading an article on the subject of bounties recently; in this article it was proposed that a bounty should be paid on iron ore so as to encourage the prospecting and developing of the ore and iron industry down here. That some Government aid for this purpose could and should be given is undeniable. The objections to a bounty however, are that it is purely individual and you cannot draw the line; every other mineral operator has as much right to ask for bounty as the iron miner, and you would have endless complications. In place of that I would recommend that the Geological Survey of Canada be empowered by the federal and local Governments to take certain areas under certain conditions and make detailed stratigraphical maps of them; this would be of lasting benefit to the whole country, extend the value and practical influence of the Survey and be of more specific value to the intelligent prospector than any bounty would. No one could raise objections to this, as it is not an individual, but a general matter of interest. In taking up an area the Survey would necessarily have to make it large enough to get a clear idea of formations, follow any faults, foldings, etc., and thus get up a map that would be available for any and all metals that that section might contain. After a few years there would be a series of such detailed maps, which when studied carefully would undoubtedly show the co-relation of these sections and give very clear ideas of the intermediate and undetermined sections.

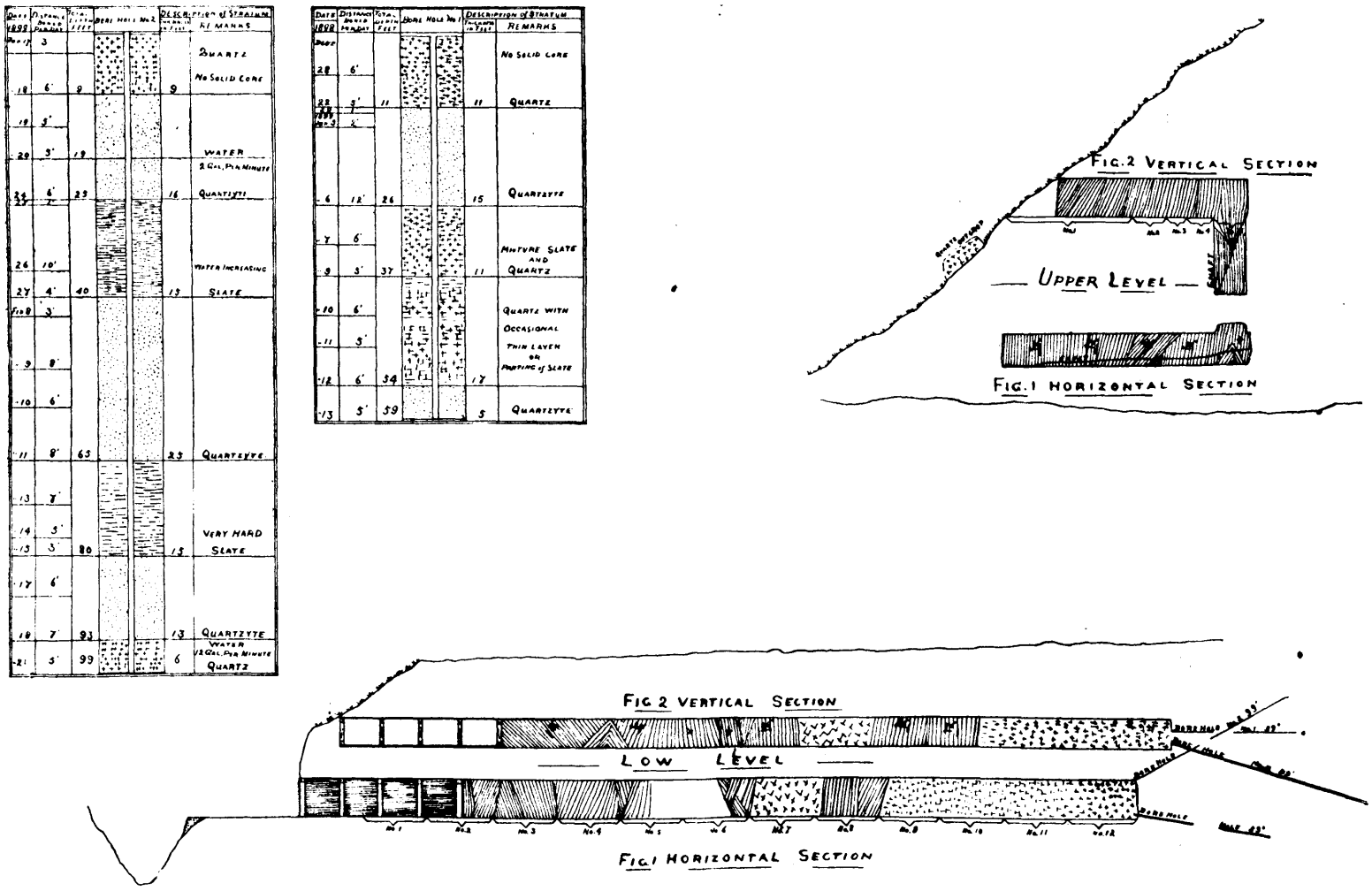
A Geological Survey to be of real value should of course be economic as well as purely scientific, and that this is fully realized here is plain by the very interesting and encouraging correspondence that I have had with the various members of the Survey, from the Director down.

In the United States the practice now is to put the Survey into any section which is likely to show economic value—make a careful study of it and thus enable the prospecting and development of these sections that is at times surprising; while here we still have to grope in the dark, try to do our own work largely with many disappointments and imperfect and unsound data to go by.

The investigations of the Springhill coal fields are perhaps an example of the very great economic value of the Canadian Survey when so applied. We certainly have the very best material in the Survey to do this work.

Just how the Survey should be called in is a question that would have to be decided upon; they naturally could not come at the beck and call of every speculator who thought he had millions in sight, but it would be an easy matter for the Director to satisfy himself that there was sufficient ground for undertaking the work, arrangements would have to be perfected that would insure intelligent co operation between the Survey and the prospector. I think such an understanding would tend to encourage development companies who would go into the matter with sufficient capital to meet if necessary some disappointments, and who could thus do the work much more intelligently and of more lasting benefit than the small prospector whose few hundred dollars come to an end, cause the abandonment at what may be a critical stage of his prospect.

In making these remarks and suggestions I am well aware that this is a subject that has been discussed and urged by some of the ablest and most far seeing mining men in Canada, and that apparently it has not met with that encouragement which its scope and encouragement should receive. It is a proposition that cannot be carried out in a day or even a year, but requires constant and patient work on the part of all those interested in the economic development of Canada, particularly the legislative powers.



Paper illustrating Mr. C. A. Meissner's paper "Prospecting for Iron Ore in Newfoundland and Cape Breton."

West Kootenay Ore Bodies.

By R. W. Brock, Ottawa.

(Read before the March meeting of the Canadian Mining Institute.)

Within the limits of the present paper it is of course impossible to do more than take a brief and very general survey of a field as extensive and varied as West Kootenay. It is proposed merely to review briefly some of the observed facts relating to its geology so far as it is connected with the ore deposits, and to the ore deposits themselves, and to indicate to some extent their practical bearing. Some of these observations may have been already recorded, others have been suggested as being probable and now stand confirmed in the light of further study. If any apology is needed for such a re-statement let it be that such observations have a direct economic importance, for anything that contributes to a more exact and definite conception of the nature and mode of formation of a group of ore deposits has a commercial value, since it makes possible more intelligent exploitations of the particular members of the group, and more accurate forecasts, beyond present workings, of their probable form and extent. In discussing the ore deposits, while it is possible to separate them into a number of different classes, it is here proposed to touch upon merely some general features. The progress, prosperity and possibilities of the district are now so well known, and can be so eloquently supported by statistics, that it is quite unnecessary to go into such matters.

Geologically the district is a complex consisting of several series of crystalline schists and stratified rocks dyked, metamorphosed by, and caught up in multifarious eruptives which in turn treat each other in like manner. The crystalline and stratified rocks, while limited in distribution, include a considerable variety of rocks.

There is a series of grey gneisses, mica schists, quartzites, crystalline limestones and dolomites with old intercalated crushed igneous rocks. These rocks have been referred to the Shuswap series of probable Archean age. They occur typically developed on Kootenay lake north of Crawford bay and the west arm. They are also found on the north end of Slocan lake, on Slocan river, at the head of Snow creek, on Upper Arrow lake. Numerous small inclusions of gneiss in the eruptives in various portions of the district may probably be also referred to the Shuswap.

A series of slates occurs, more or less altered to mica, staurolite and andalusite schists, with bands of greenish schists, quartzites and dolomites. This series has been classed with the Nisconlith series of the Cambrian. It is most largely developed in the southern portion of the district where a band several miles in width, interrupted once or twice by granite intrusions, extends from a point just south of the West Arm of Kootenay lake, a little east of Nelson to the international boundary. Along the boundary it has considerable width, extending from four miles east of the Pend d'Oreille crossing to within a few miles of its mouth at Waneta. It is also found in a narrow band north of Kaslo, parallel to Kootenay lake a short distance inland. Rocks which may also be referred to this series occur near Deer Park, on Cariboo creek near Burton city, and on Upper Arrow lake.

This series is overlain by a great thickness of rocks that have been classed with the Selkirk series. They consist of various schists, quartzites, conglomerates, dolomites and green eruptive rocks. They are found east of the Salmon river on the divide between the Salmon river and Kootenay lake at the head of Wild Horse, Sheep and Lost creeks and down Summit creek for half its length. They are also found east of Kootenay lake from about Lockhart creek to near Gray's creek. They also occur in a band west of Upper Kootenay lake, succeeding in a westerly direction the Shuswap and Nisconlith rocks. This band, north of Kaslo, has some width but gradually tapers as it continues southward till it runs out near the West Arm.

On Summit creek they are apparently overlain by a great volumn of quartz and mica schists which extend eastward to Kootenay lake. These are classed as Upper Selkirk.

Another important group of stratified rocks is that known as the Slocan series. They consist of a group of dark and banded rocks composed of tuffs and ash rocks with some impure slates and limestones. They occur all around the north end of Slocan lake, southward, cut by one or two granite bosses, as far as Four-Mile creek, and eastward to the forks of Kaslo creek. From here a band extends south to the West Arm between the band of Selkirk rocks and a great granite mass. Similar rocks also occur on Cariboo creek.

Varied as are the schists and stratified rocks, the eruptives show still greater complexity. Among the oldest and most important economically is the Columbia group of volcanics. This group includes porphyrites of various kinds, monzonites, diabases, gabbros, breccias, tuffs, agglomerates and dark fine-grained slaty ash rocks. The monzoniths are interesting rocks, both on account of their petrographical peculiarities and also as being the country rock in the War Eagle, Le Roy and other famous Rossland mines. It is a peculiar type of rock referred to the syenite family. It exhibits wonderful differentiation ranging according to relative proportions of feldspar and colored constituents through syenitic, dioritic and gabbroitic types. Along the border of a mass it may present even a more basic facies.

The Columbia volcanics cover a considerable area. They are largely developed in the Rossland district and also east of the Columbia, where they extend eastward to the Salmon river and northward to the west arm of Kootenay lake and Kootenay river. Around Nelson and along the Columbia river they are cut off by granite, a large mass of which extends as a peninsula from the Columbia eastward into the volcanics. Porphyrites and associated rocks, which are probably to be referred to this group, occur on Arrow lake in the neighborhood of Deer park, and up Cariboo and Snow creeks behind Burton city.

Younger than, and cutting all the rocks so far mentioned, is the grey granite, the commonest rock of the district It is a biotite hornblend granite, usually, but not always, grey in color. It varies considerably in texture and composition, being in places syenitic or dioritic, but apparently having a prevailing granitic habit. The feldspars are often large and porphyritic, in which case it is very striking and easily recognizable rock. When crushed, as it sometimes is, this porphyritic facies makes a beautiful augen gneiss It occurs in large and small areas throughout the entire district, and is intruded through all the older rocks. A typical development of this rock may be seen at Nelson. Another granite, younger than the grey, is the older red granite, a very feldspathic rock found on Lower Arrow lake near Deer park, and elsewhere along the Columbia valley.

Under the head of younger eruptives may be grouped a series of rocks which shew a wide range of structure and composition, ranging from plutonic to volcanic types, from granitic to at least dioritic. They are sometimes developed in quantity, as the younger red granite along Lower Arrow lake and also near Trail creek, and north-west of Rossland. As dykes they occur in almost every part of the district, cutting all the older rocks.

The most important of these dykes are the "white dykes" or white porphyries. These are usually white compact dykes varying in size from broad masses to little stringers, which cut sharply through the country rock. So far as is yet known, in structure and composition they appear to range from rhyolites to diorite porphyries, including felsites, granophyres, granite porphyries, and syenite porphyries. The acid, however, appear to be the prevailing types, at least in the northern part of the district and along the Salmon. Though varying in character these dykes may usually be recognized by their light color and their sharply defined contacts with the country rock. Near

Rossland and in some other portions of the district, darker types are, however, to be met with. This system of dykes seems to have immediately preceded the formation of the ore deposits.

Younger than this system of dykes and the ore bodies, and consequently cutting these, are the black dykes, a group of lamprophyric and perhaps basaltic dykes.

The above constitute the main groups of rocks of the district so far as connected with the ore bodies. They present many facies, which have not been here noted. Other rocks occur, as comparatively fresh andesites, diabases and such volcanics, but as these have not been observed to be connected in any way with the ore deposits, we need not stop to consider them.

The economic minerals which may be found in the ores are also various, as the following list shews.—Native GOLD, *silver*, copper and arsenic; stibnite, bismuthinite, tetradymite, molybdanite, ARGENTITE, GALENA, altaite, hessite, chalcocite, stromeyerite, *sphalerite*, cinnabar, greenockite, PYRRHOTITE, bornite, CHALCOPYRITE, *pyrite*, gersdorffite, marcasite, *arsenopyrite*, danaite, jamesonite, *pyrargyrite*, *proustite*, TETRAHEDRITE, tennantite. The gangue is principally country rock, quartz, siderite, calcite, sphalerite. Oxydation products of the metallic minerals, such as the oxides, carbonates, sulphates, are found in the weathered zones.

The above list could probably be enlarged, but it will serve to shew the variety and general character of the economic minerals.

The character of the ore varies more or less with the district, thus in the Rossland ores the auriferous iron and copper sulphides predominate, in the Slocan the lead and silver minerals with argentiferous tetrahedrite are characteristic, while the Nelson district mineralogically as geographically lies between the two. But while in the different portions of the district there is considerable variation in the relative proportions and mineralogical combinations of the principal elements, the elements themselves remain practically the same throughout. But why in one place the ores should be *mostly* silver-lead minerals, and in another *mostly* auriferous iron and copper ones, or why in one place there should be large bodies of metallic sulphides and little gangue, and in another the value should be in a small quantity of sulphides and much gangue, or why the silver and gold tenors should vary so, these are points which cannot yet be very well explained.

It may be remarked, however, that the production of the quartz veins appears to have been about the last stage in mineralization; also that in places it appears that the country rocks exerted some chemical influence, causing the deposition of the iron and copper sulphides in the massive rocks and the silver-lead in the fragmental, but this has not always been the case.

As to the age of these deposits nothing definite can be asserted, except that while all the evidence tends to show that they are comparatively recent, they are certainly pre-pliocene. To go into this evidence would take too long, but it may be said to to be derived from the relationship of the deposits to the dykes, from the differences in the character of the country rock and deposits at high and low elevations and Tertiary erosion.

On account of their comparatively recent formation and the fact that the factors which determined the deposition were physical rather than chemical, they may be looked for in all the rocks except the latest dykes (and probably the younger eruptives) wherever the physicial conditions are favorable.

As to manner of formation, the evidence afforded is conclusive that they were formed by mineralizing solutions, which followed lines of fracture, dissolving away the country rock and replacing it with mineral matter in return. In a large ore body, or where the country rock is a homogeneous one, such as some of the Slocan rocks, this history cannot be so clearly read as when the deposit is small and the country rock is a heterogeneous one, such as granite. Here it is sometimes possible to trace the alteration from the unaltered granite to the solid sulphides; first the more easily decomposable constituents show signs of alteration, then one constituent is removed and replaced, then another, until of the original rock only a skeleton of quartz remains, and finally this is almost completely or wholly replaced. But even if the process had not been exposed as in the example above, the evidence would still be complete For in many of the large deposits cores of the unaltered country rock still remain; the country rock near the deposit has often been silicified, producing "capel" like bands. This silicification has proceeded in places till it almost amounts to complete replacement. Calcification in places has also been extensive. The country rock has often been more or less mineralized, and if it contained feldspars, bisilicates, and such alterable minerals, these often have been attacked in such a way as to indicate the action of hot mineralizers. In one case on Pine Ridge in the granite adjoining a small deposit, the feldspars have been altered, pyrite probably represents what once were bisilicates, and a violet-colored secondary fluospar has been disseminated through the rock. A violet colored quartz present is probably of the same origin as the fluorite.

Natural processes are rarely simple, and the slow process of vein formation is no exception. While replacement of the country rock seems to have been the chief mode, it is highly improbable that there has not been to a certain extent deposition in open spaces—in fact there is evidence to indicate that this did occur, to a limited degree. In certain parts of some deposits there is a distinct crustification. Now, while it is true that a banding may be and is produced by slight alterations in the conditions during the progress of slow metasomatic change, it may be doubted if a deposit in clear-cut, distinct crusts is ever so produced. So that it is probable that such portions of a deposit have been formed in cavities. Dissolution sometimes may have proceeded in advance of deposition, and thus the space would be produced. But in some cases the ore is found between slickensided walls, sometimes with selvage. This indicates that movement has taken place. As the deposit itself shows no signs of it, it must have preceded the vein formation. It may be that the slickensided walls do not belong to the same fissure, but to two parallel ones, and that the intervening rock has been replaced. But still, any movement of the walls of an irregular fissure, such as these are, would open up spaces—which might, of course, be partially filled with triturated rock. It is thus altogether probable that some open spaces along the fractures did exist, to be filled by the mineralizing solutions But in the formation of these ore deposits the process of space-filling seems to be entirely subordinate to the replacement of the country rock.

From the nature of the minerals formed and from the composition of known thermal springs, one is justified in assuming that the mineralizing solutions contained hydrogen sulphide, carbonic acid, and sometimes, perhaps, sulphates, in addition to their metallic contents. These reagents would account for all the chemical changes involved in the replacement of the country rock and the deposition of the minerals and ores.

The mineralizing solutions, following lines of easiest penetration and substitution, used, to a large extent the lines of fracture and crushed zones of the country rock as highways, and as starting points in the formation of the deposit.

Coming from a region of higher temperature and pressure, and charged with the metallic sulphides and active chemical reagents, the solutions would readily attack the crushed and triturated material in these fractures. With chemical activity thus set up, and the nuclei

*The minerals printed in capitals are the most important economically. Those in italics rank next, while the others have so far been found only in small quantities.

of a deposit thus formed, with a constantly renewed supply of material and reagents from the circulation of the mineralizing solutions, metasomatic action could rapidly proceed.

There should be no prejudice against deposits formed in this way. There is no reason why they should not be as extensive, as valuable, and as permanent as bodies formed in large open fault fissures. Indeed—the history of mining has shown that the great fissures are not as a rule the great producers To any who may have misgivings about this class of deposit, it may be comforting to know that many or the best deposits, especially in western United States, are quite similar in mode of formation to these of West Kootenay.

Thus there is no reason why the ore bodies of West Kootenay should not display permanence in depth. The developments in the Whitewater Deep, Payne and Le Roi have shown that the ore chutes here have a considerable vertical dimension. The valley appears to have been largely sculped after the formation of the ore bodies. Now extensive ore bodies have been found in the deep valleys, thousands of feet below the highest mines, as well as at high altitudes. The surface which existed at the time of formation would be still higher. So that ore was deposited in quantity at great depths below that surface and below most of the present mines. That more mines have not been opened up in the deep valleys is easily accounted for by the difficulty of prospecting owing to the covering of drift and vegetation.

The best ore and largest ore bodies in any particular district are found in the rocks which are most fractured, as the greater facilities offered by crushed and fractured zones more than compensated for any chemical advantage a rock might possess. As before stated this might take place in any kind of country rock where the physical conditions were favorable.

Owing to the mode of formation, by replacement following lines of fissuring and crushed zones, the forms of the bodies may be very numerous and irregular. In general they may be said to possess a degree of irregularity corresponding to the degree of complexity of the preceding dynamical effects. To begin with, minor fissures or fractures are usually very irregular. They are usually numerous and co ordinated. They may be reticulating; they may be parallel so that the country rock is sheeted, with or without connecting cross fractures, and perhaps groups of these may be separated by bands of unbroken country rock. But the ore deposition may have been even more irregular. The ore bearing solution may have followed one fracture for some distance and then have crossed to another and so on, or it may have followed several parallel ones and the resulting deposits may or may not be connected with stringers forming what the Germans call *stöcke*. The ore itself may be found only in certain places in the form of chutes. To further complicate matters the replacement of the rock along the fractures and crushed zones may not have been uniform. Sometimes when three or more fissures intersect, the enclosed rock only may be replaced forming a chimney deposit. Examples of all the foregoing might be given from the Kootenay ore bodies, and if time permitted various other possibilities might be considered. But enough has probably been stated to suggest some practical considerations. It must be evident that no weight can be attached to either the presence or absence of walls. The absence of one or both walls is to be accounted for by the manner in which the rock has been replaced. The presence of apparently well defined walls may seriously mislead if they are considered as proof that the ore deposition has been confined within their limits, since however well defined they may appear to be a crosscut may reveal an adjoining parallel ore body. As an example, reference might be made to an important West Kootenay mine, where the mine captain took great pride in his walls. I tried to show the possibility of their being ore beyond, and the wisdom of judicious cross-cutting and received unexpected support. A shot near one of the walls where it was best defined did greater execution than had been intended, bringing out a large fragment of the wall. This revealed a large parallel ore body apparently equal to or better than the original.

So that in the development of the ore bodies all the attention should not be bestowed on sinking and drifting, judicious cross-cutting may sometimes be advisable. At Butte and in many other mining districts in Western United States, where similarly formed deposits occur, this principle of cross-cutting even where there are apparently good walls is practised often with great success.

Further should a good ore body apparently discontinue in depth, it may be that a little exploiting might reveal its downward continuance along another plane. Another point which is apparent is the advisability of *following* ore. In a *highly* mineralized locality even little stringers may lead to bonanzas.

In addition to the dynamic activity prior to the vein formation, which resulled in the complex fracturing of the country rock and which prepared the ground for the mineralizing solutions, there have been subsequent movements which have caused minor displacements, both normal and reversed.

Since the ore bodies show great complicity but are dependent more or less upon the fracturing of the country, and since matters are further complicated by subsequent faulting, it is evident how important it is that the mining engineer should make a careful study of the structural geology of his district, for by this means alone can a correct notion be obtained of the mode of fracturing of the country which prevails, of the ore body, and of the character and extent of the faulting. In the study of the latter he will find the dykes of great assistance, as they are numerous, clean cut and easily recognized and as many are as old as the deposits these must have undergone the same displacements. He will probably also find that the smaller veinlets will often afford the key to the solution of problems which his larger intricate ore body will not disclose.

On a *prospect* where the trend of an ore body is not definitely proved, it is obviously dangerous, instead of following the lead, to spend money on work which will be of value only if the ore body happens to follow a particular direction. To point to the number of shafts and tunnels on prospects in the Kootenay which have eaten up the prospector's capital, while proving absolutely nothing regarding the deposits, is all the comment that is needed on this point.

The light "porphyry" dykes to which attention was called while speaking of the rocks appear to be closely related to the ore deposits. They are abundant in richly mineralized portions of the district, and are conspicuously absent in such portions of the district as on parts of Midge, Cultus and Summit Creeks, where no deposits of value have as yet been found. That the dykes and ore bodies should be so associated appears to be more than a mere coincidence.

In the portion of the district in which I was working last summer between Slocan and Arrow Lakes, I found that almost without a single exception, wherever a deposit of mineral was observed, it was in the immediate vicinity of a dyke, frequently along the contact, or if not, in fractured country rock close by. Later on in the season, when on the North Fork of the Salmon, near the head of Burnt Creek it was found that the claims ranged along a dyke. The prospectors inquired about the influence about the white dykes, stating that wherever mineral was found in that portion of the district, it was in the neighborhood of the dykes.

I had not time to verify this statement except at the one point. Before the season closed a visit was paid to the mines around Sandon.

Here, as elsewhere, the same relationship between the dykes and ore bodies appeared to exist. A habit was formed of asking for the white dykes on a claim, as naturally as for the lead. I think in every mine visited not only were dykes seen in the vicinity, but one or more could be found in the workings themselves. Most of the

observant managers considered the white dykes to "form part of the deposit." One or two claimed that proximity to the dykes influenced the tenor of the ore. Even if the dykes could not be observed in or near every mine, this would not necessarily disprove the relationship, as they might be close at hand, yet not be exposed at the surface or in the workings.

It is quite probable that the volcanic activity which resulted in the injection of the white dykes may have been the cause of much of the fracturing or fissuring of the country rock, and thus of the production of the highways for the mineralizers. The white dykes themselves do not show this shattering. It is now generally accepted that eruptive rocks, especially acid eruptives, thermal springs and ore deposits, are intimately related in their origin. It is an observed fact that the closing stages of a period of volcanic activity are marked by solfataric action, the emission of thermal mineral-bearing waters. Now, as before stated, the West Kootenay deposits were formed by the direct agency of such hot mineral-bearing solutions. It is not improbable, therefore, that these were connected with some eruption. If this were the case it would be with the porphyries, as these mark the last period of volcanic activity which preceded the formation of the deposits. Moreover, the dykes themselves show evidence of solfartic action in the alteration they have often undergone. The feldspars are altered and calcified, so that it is sometimes difficult to make out the structure of the rock. Pyrite has been formed—often probably at the expense of what colored constituents the rock possessed. An interesting point with regard to these dykes is that they are to some extent auriferous. Profs. Nicol and Miller, of the School of Mining, kindly assayed three samples. They were small samples *selected as rock specimens*, one from a dyke in the Last Chance mine, Sandon, one from the North Fork of the Salmon, and one collected by Mr. McConnell from the Antelope claim. The last proved barren, but the Last Chance and North Fork rocks yielded distinct colors of gold. Considering the small quantity taken for assay (two assay tons), the result is very interesting.

From the evidence so far available I am inclined to favor the view that the solutions mark the solfartic stage in the period of vulcanism, during which were erupted the white dykes. On the other hand it might be held that the solutions came from depth and merely used as highways lines of weakness often occupied by the dykes; or mineralization might be considered by some to be due merely to the increase in physical and chemcal activity in the existing circulating currents, caused by the heat of the eruption.

But such speculations as to the precise way in which the dykes and ore bodies may have been related, while extremely interesting, are not of direct economic importance, and need not be here further discussed. The point of practical value to be established is that the relationship does obtain. If this can be done the value of such well-defined and striking bodies as these dykes as guides in prospecting and developing would be inestimable. While the observations made last summer, particularly in the mines, were not sufficiently extensive to warrant one in definitely asserting that such a relationship obtains throughout the entire district, yet they covered a comparatively wide field, and in many cases were of so positive a nature as to justify the conclusion that, in those particular instances at least, the dykes and the ore bodies were related. But the strongest evidence probably is the fact to which attention has already been called, that the districts rich in dykes are rich in ore bodies, and those barren of dykes appear to be barren of ore.

The attention of mining engineers is called to the matter in hope that they will test the point in various parts of the field, for it is only when supported by observations in the mines and prospects of the entire district that it can be considered definitely established for the West Kootenay district.

In a great many mining districts throughout the world such a connection between dykes and ore deposits has been observed. At Pontgiband, in Auvergne, silver lead occurs in gneiss and mica schist dyked by porphyry; the lodes generally follow the dykes and are productive only when so associated. *In the silver lead deposits of Eureka, Nev., the ore-bearing solutions were almost entirely due to solfataric action arising from the eruption of rhyolite, which dykes all the formations. The rhyolite dyke shows every evidence of solfataric decomposition. †Hague, in speaking of the same district, states that after a careful study he is forced to the conclusion that there exists the closest relationship between the rhyolite and the formation of the ore deposits.

§In speaking of the relationship between the deposits and the eruptions in the Mercur district, S. F. Emmons says that In searching for gold in that district the first thing to do is to learn to recognize in the field the porphyry in its many forms of alteration, and then gives rules to be observed in prospecting, based upon the relationsh'p which exists between the ore bodies and the eruptive.

‡Blow, in a paper on Iron Hill, Leadville, states that as a guide to future developments on Iron Hill, it may be well noted that wherever a dyke (of porphyry) of considerable size has been heretofore disclosed, an ore body of proportionate size has been encountered following it.

It will be seen that the West Kootenay ore bodies bear a strong resemblance to many in Western U.S.

Thanks are due to Mr. McConnell for information regarding portions of the district not visited personally and for other assistance. The notes on the rocks and their distribution are largely from Mr. McConnell's work.

Description of the Sultana Quartz Lode, and the Sinking of the Burley Shaft in Bald Indian Bay, Lake of the Woods.

By J. Burley Smith, C. & M. E., Winnipeg.

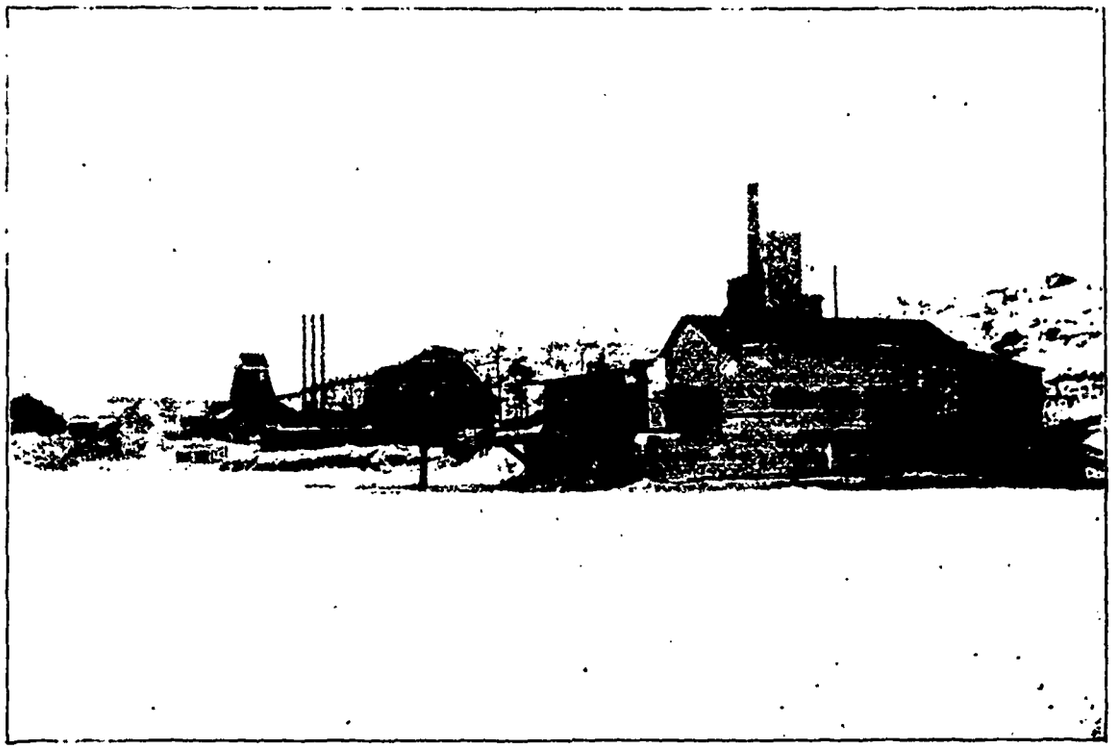
(Read before March Meetings of the Canadian Mining Institute.)

The Sultana lode is situated on the eastern shore of Bald Indian Bay, and about seven miles south of the town of Rat Portage. It has become famous chiefly on account of the well-known Sultana mine, which unquestionably owes its success to the indefatigable perseverance and enterprise of Mr. John F. Caldwell, of Winnipeg, the owner. Perhaps not a little of its more recent fame is owing to the prolonged dispute and consequent litigation as to the ownership of the continuation of the lode beyond the Sultana location to the south west on the land under water of Bald Indian Bay. The Sultana lode was discovered about the year 1882. At that time it was remarkable chiefly on account of its magnificent proportions and great length as visible on the surface, cropping up as it did here and there for a distance south-west of the Sultana location of more than 3,000 feet. The quartz at that time was not at first sight thought to be auriferous. The first official account recorded of this deposit occurs in the able report of Mr. Eugene Coste, M.E, to the director of the Geological Survey of Canada, dated January 16th, 1884.

He says: "This vein, called the Sultana Lead, is about 30 feet "wide. Its strike is 70°, and its dip south at an angle of 72°; the "quartz is yellowish, hard and void of minerals—I do not think it is "auriferous It reappears 500 or 600 feet to the east on another bay "of Indian Bay: and also a quarter of a mile to the west on the "island directly west of Quarry Island."

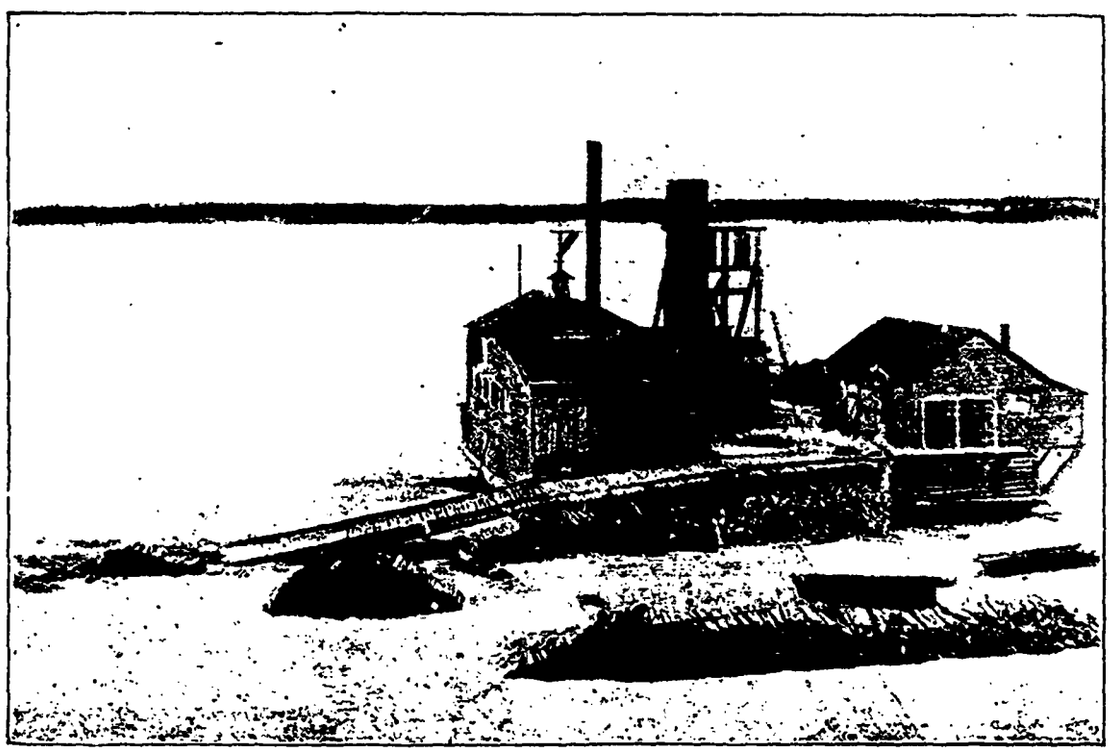
*J. S. Curtis, Mon. VII, U.S. Geol. Surv., p. 188.
†Monograph XX, p. 294.
‡XVI Annual Report, Part II, p. 369, Geol. Survey.
‡Trans. Amer. Inst. Mining Engineers, XVII, '89-'90, p. 156.

BURLEY GOLD MINING COMPANY, Limited.



Sultana Gold Mine.
Shaft House, 30-Stamp Battery.

Burley Caisson.



Surface Works of the Burley Gold Mining Co., Bald Indian Bay, Lake of the Woods, Ont.

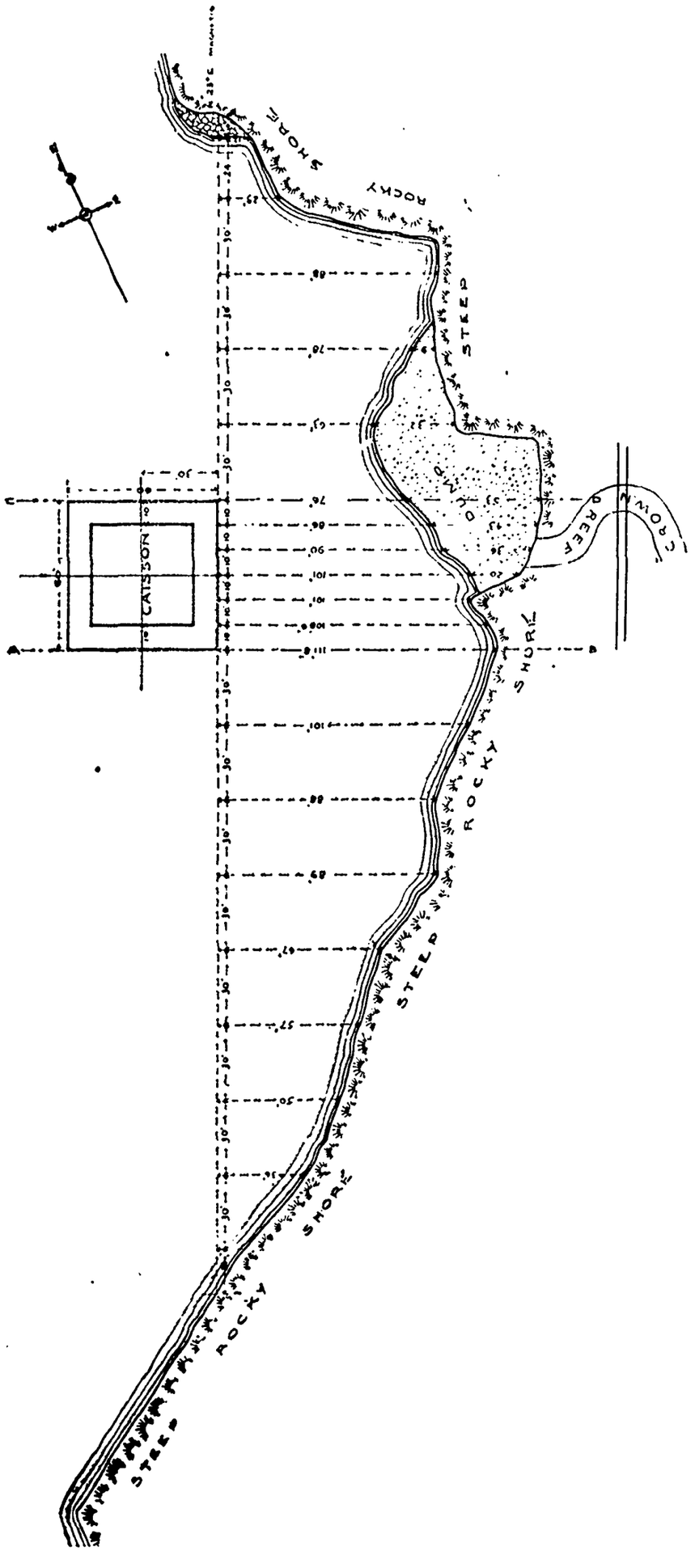


Plate showing Position of Caisson.—Burley Gold Mining Co., Lake of the Woods.

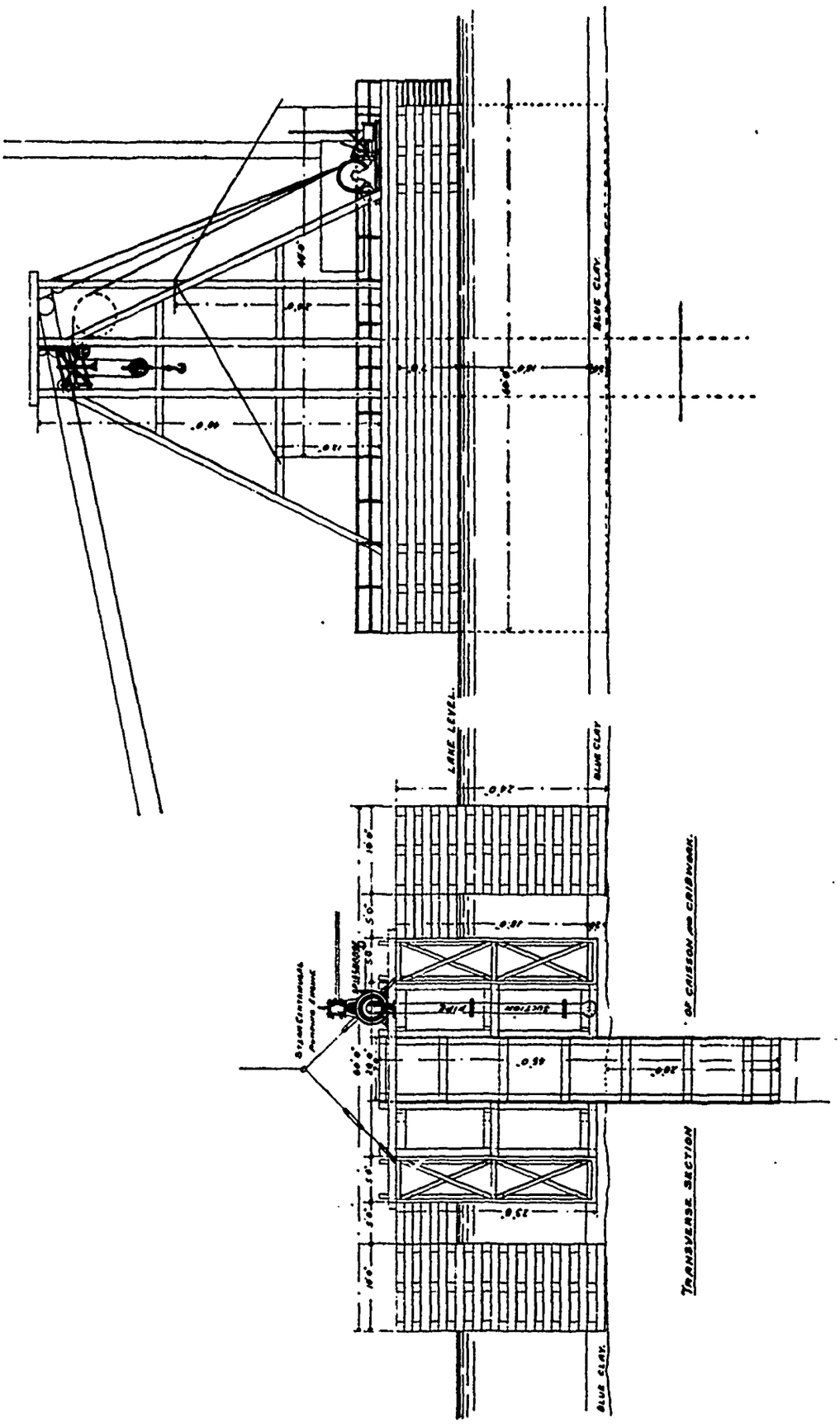
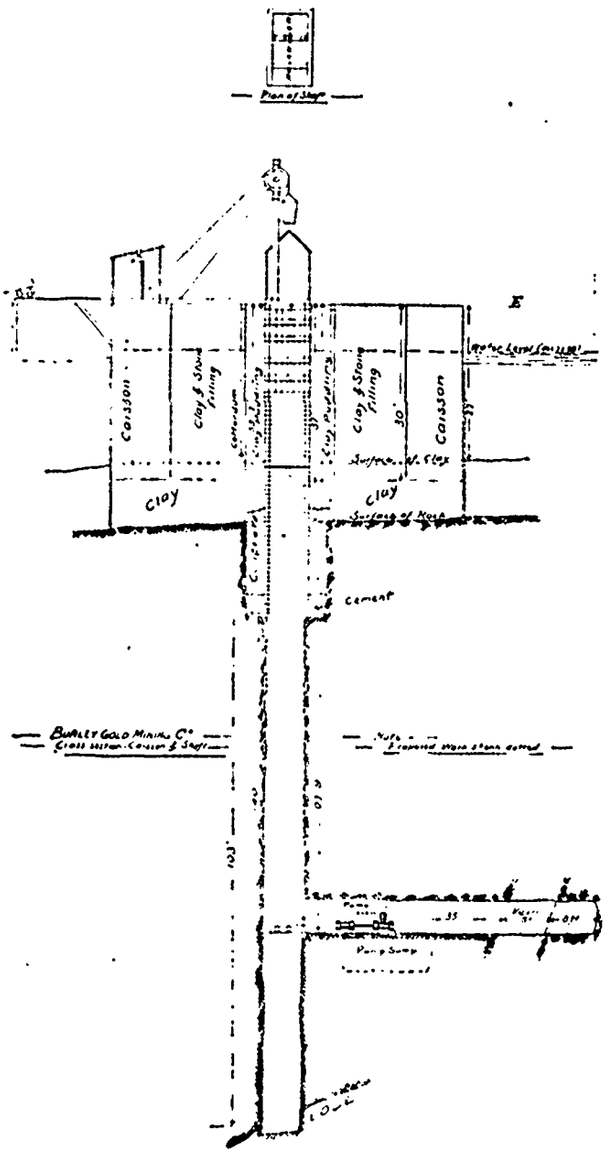
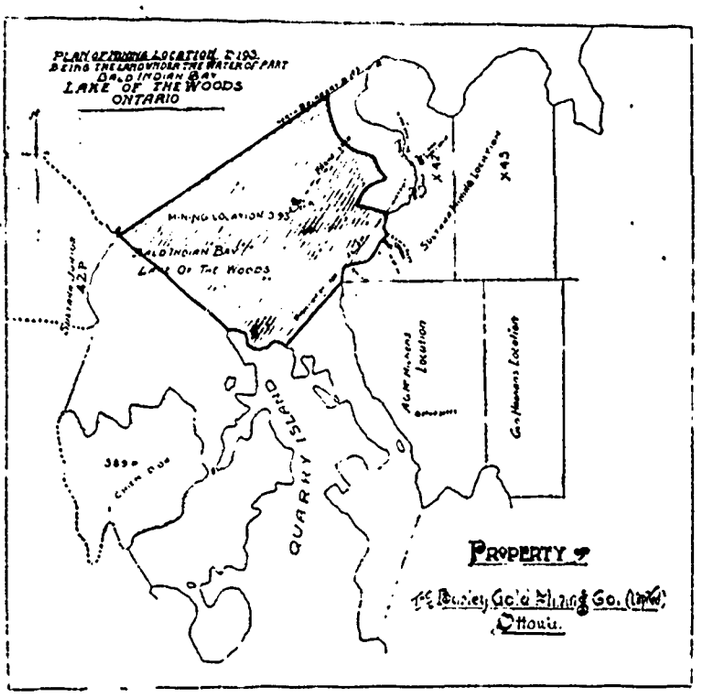
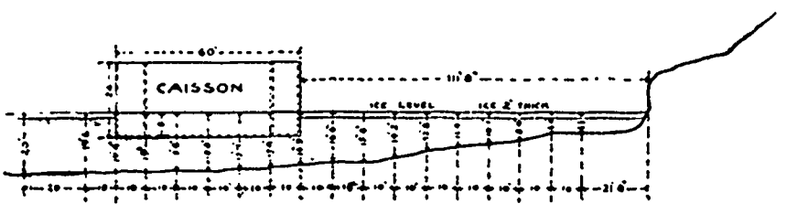


Plate showing Caisson Cribwork and Hoisting Conveying Apparatus.—Burley Gold Mining Co., Lake of the Woods, Ont.

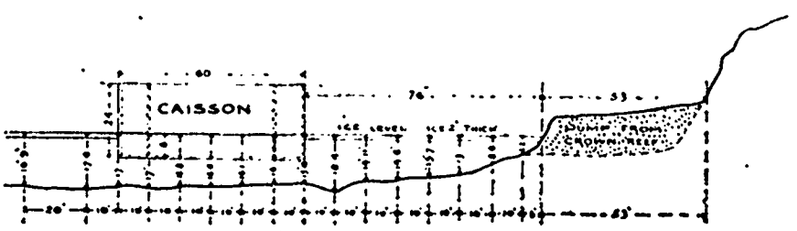






PROFILE ON LINE A—B

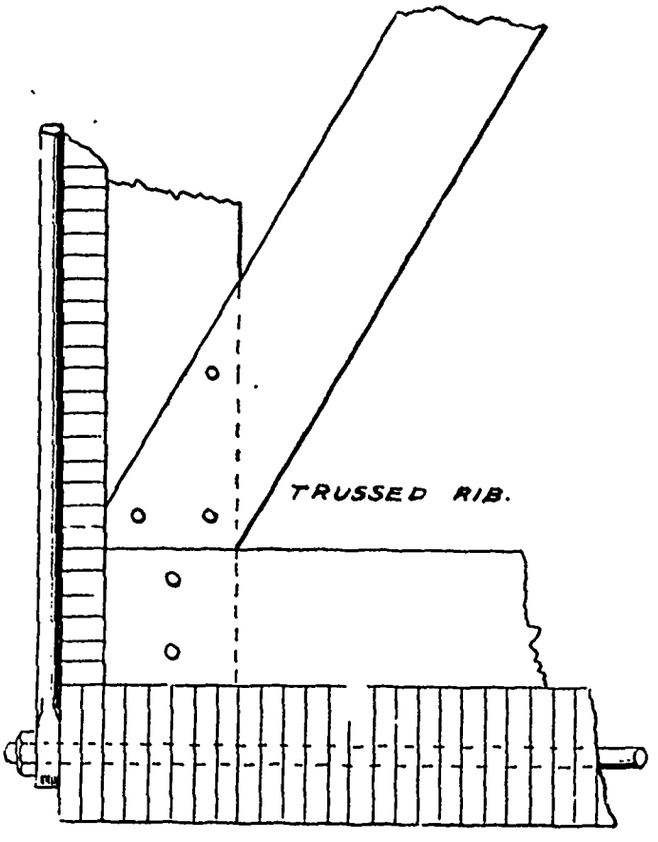
showing proposed position of Caisson with depth of water



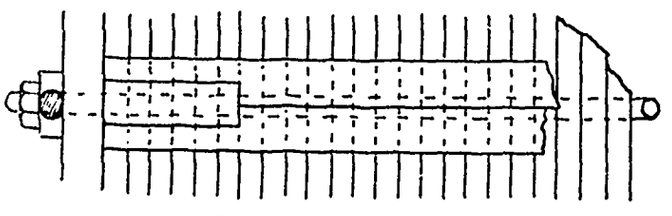
PROFILE ON LINE C—D

showing proposed position of Caisson with depth of water

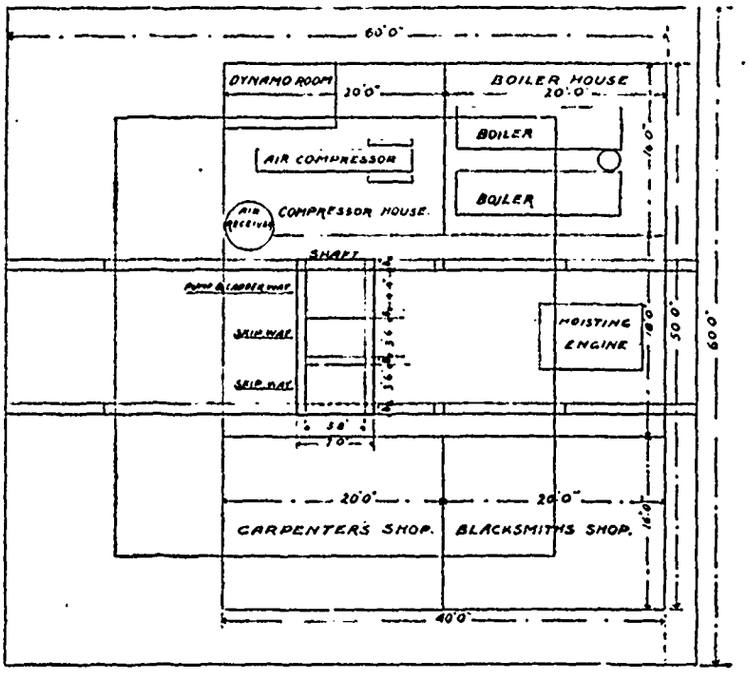
Plates showing Location, Position of Caisson, Cross Section of Caisson and Shaft of the Burley Gold Mining Co., Lake of the Woods, Ont..



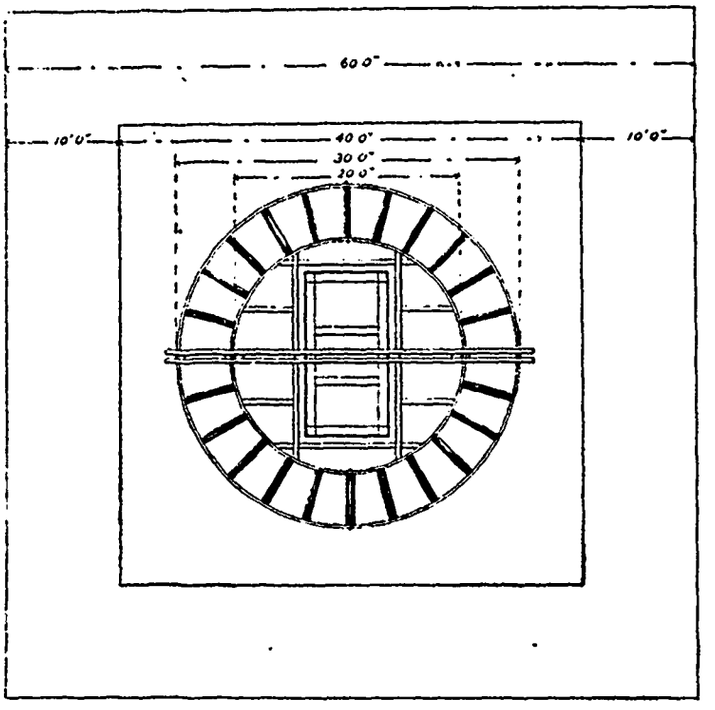
TRANSVERSE SECTION



PLAN OF BOTTOM.



PLAN SHOWING ARRANGEMENT OF BUILDINGS AND MACHINERY



PLAN OF CRIB. SHOWING SECTION OF CAISSON

Plates showing Method of Sinking Shaft under Water.—Burley Gold Mining Co., Lake of the Woods, Ont.

The doubt expressed as to the auriferous quality of the quartz is not to be wondered at, as there are several outcrops of quartz visible on the surface at various points along the outcrop of this lode to-day, having clearly defined walls and every appearance of veins, which, however, seldom carry more than the merest trace of gold.

Several diamond boring tests made on these locally termed "blow-outs," show that they do not continue down to any great depth—perhaps 50 or 60 feet at the most—giving place then to the huge lenses of auriferous quartz which are characteristic of this remarkable lode.

The Sultana mine of to-day, with its depth of 400 feet, its well-equipped mill of 30 stamps and its regular yield of gold bricks for the last six or seven years, is the best testimony which can be offered as to the auriferous character of the deposit generally.

The lode itself, where it has actually been worked for a number of years by the owner of the Sultana mine, has been exhaustively described by many eminent authorities in the annual reports issued by the Bureau of Mines of Ontario, notably those of 1893-4-5-8.

It will not, therefore, be necessary for me to supplement these by more than a general description of the deposit, showing where it strikes under the lake after leaving the Sultana mine location, X 42, on to location D 193 (the property of the Burley Gold Mining Company, of Ottawa, Limited), as shown on accompanying map, marked A.

The latter being one of land under water entirely, without any dry land save that of a very small island, shown on map as Reef 271 P, necessitated the sinking of a shaft through the water to reach the lode, proved by boring tests to exist in the rocks below, and to continue in a south westerly direction across the bay as far as Quarry Island and beyond to the Chien d'or Island, location 389 P, and the Queen Bee Island still further to the south-west (See map A.)

The Sultana deposit or lode, if it can properly be so called, may be briefly described as composed of huge masses of auriferous quartz, of lenticular shape, interbedded in the Keewatin schists (Huronian), at or near their contact with the granitoid gneiss (Laurentian).

Sometimes extending for a considerable distance as one enormous lense, again of a number of smaller lenses lying near together and separated only by a few feet of schist.

There are no walls to define the width of the zone or belt enclosing these lenses of quartz, and it is probable that this has not yet been accurately ascertained.

The walls that have hitherto been observed are, I am inclined to think, those enclosing individual lenses of quartz.

It is noteworthy that the schists separating the lenses of quartz is often to be found in the auriferous.

It is also well known that the lenses of quartz lying nearest to the contact with the gneiss are richer than those farther away, and appear to be much larger in size.

On what is known as Sultana Island, where the mine of that name is situated, there is an immense boss of granitoid gneiss, bare and rugged looking, and having almost the appearance of a mountain compared with the low lying hills of schist and altered traps in its vicinity.

This bold ridge may be noticed some miles to the north-east of the Sultana Island, breaking through the Huronian schists, and it is at this contact on both sides of the gneiss in which most of the gold discoveries in the immediate district have hitherto been made.

The general strike of the granitic boss is N.E. to S.W. The Sultana mine is situated on the N.W. slope of this hill.

This granitoid mass declines abruptly as it approaches Quarry Island, which it crosses, finally disappearing under the waters of the lake near the south-west extremity of Queen Bee Island. (See plan A.)

The lode, as might be expected, follows the general trend of the granite, its strike being N.E. —S.W.

It has been proved by means of a great number of diamond borings, to continue along the belt of schist, at its contact with the gneiss, from the Sultana mine to the point before referred to at the S.W. of Queen Bee Island.

A shaft sunk on this island within the last few weeks to a depth of 25 feet, shows a width of 24 feet of quartz in which there is much visible gold.

The general strike of the lode is shown on map A by a red dotted line crossing part of Bald Indian Bay, Quarry Island and Chien d'or Island, the Queen Bee not being shown on this map, and is N.E.—S.W. (Refer to map A.)

The north-east boundary of the Burley Gold Mining Company's location is about 700 feet from the Sultana shaft.

At a distance of 165 feet S.W. of this boundary, or 865 feet S.W. of the Sultana shaft, a cross section was obtained of the deposit by three diamond drill borings, to locate the position of the proposed shaft on the Burley water location.

A drawing of this section is shown on plan A, which speaks for itself, and will not require further explanation.

There being, however, insufficient clay covering the rock-bed of the lake at this point to insure a perfectly water-tight seal, a diver was employed to carefully examine the bottom, and finally a location was found having a covering of from ten to fifteen feet of fine plastic blue clay over the rock, 56 feet to the south-west of the point where the borings were put down.

It was at first intended to sink a crib 60 feet square on the outside and 40 feet on the inside, using an inner caisson for a water-tight compartment in which to commence sinking the shaft and to then carry a steel lining from a depth of 20 feet in the rock up to the deck of same, and afterwards to build a wall of concrete masonry round the shaft which would be carried up to the same level The space between this wall and the inner walls of crib to be braced strongly together with timbers and filled with rock. (Refer to drawing B.)

Owing, however, to unexpected delays, the lateness of the fall season and the stormy weather to be expected at that time, and the fact that we were at the last moment unable to secure any land in the immediate neighborhood on which to frame the crib, our plans had to be changed.

It was then decided to build a water-tight caisson on the Queen Bee Island, about one mile away from the proposed site of shaft.

A good sloping beach of sand was selected in a sheltered bay, ways were laid down and the work of building the caisson commenced.

Its dimensions are 60 feet square on the outside, 40 feet on the inside (leaving a box space all round about 10 feet wide for the rock ballast to be used to sink it), and 24 feet high

It was strongly ribbed and braced and sheeted throughout with eight inch square timbers, the whole bolted and spiked together in the strongest possible manner.

The heavy eight inch sheeting being caulked and pitched right up to deck.

Valves were provided inside the caisson to admit water, as it was known that the structure could not contain sufficient weight of rock to sink it without this addition.

The time occupied in building the caisson was something under two months.

At the end of November 1897, it was safely launched and towed by steam tugs to the proposed site of shaft, and a few days later it was frozen hard and fast in position by the ice. Shortly after this the caisson was filled with rock and sunk to the bed of lake.

To make doubly sure an inner coffer-dam was constructed inside the hollow square of the caisson.

The water was then pumped out with a powerful contrifugal pump and the clay inside the inner coffer-dam was excavated down to bed-rock.

The shaft was then excavated the full size of the inner coffer-dam, 12 feet into the solid rock.

A strong water-tight shaft-casing formed of timbers eight inches square was carried up to the deck platform of caission, which had previously been raised six feet higher to be safely above flood water mark of the lake.

Behind this casing and under its foot, careful sealing with the rock was made by caulking with oakum and filling in with hydraulic cement; the remainder of this space was then filled in with concrete up to some feet above the surface of the rock-bed of lake.

From this point upward to platform the space between shaft-casing and coffer-dam was filled in with puddled clay. (Refer to drawing C.)

The space still left between the inner coffer-dam and inside walls of caisson was filled in with clay and rock, after being securely framed and braced with timbers.

The platform on top was decked in the usual way, and on this platform are erected the temporary buildings containing the machinery and plant of the mine, and a temporary pit-head framing. (See drawing C.)

The sinking plant and machinery consist of one Ingersoll-Sergeant air compressor and three rock drills; one 80 h. p. boiler, one Ingersoll eight inch x 10 inch duplex double drum steam hoist; one portable steam derrick hoist; one direct-acting steam centrifugal pump, and some ordinary sinking pumps.

The shaft is six feet x 12 feet in the inside, and is now down to a depth of 153 feet

At a depth of 107 feet down a cross cut level was driven S.E. towards the shore as a test, and as expected crossed a lense of auriferous quartz eight feet wide, 35 feet from the shaft. (See cross section—drawing C.)

The shaft was continued down to a depth of 140 feet when quartz was again struck, showing visible gold in places.

Our manager reports in his last letter that the shaft is now down to a depth of 153 feet and is not yet through the quartz. (See cross section—drawing C.)

The lode dips to the N.W. The shaft is perpendicular and was expected to strike the deposit at a depth of about 150 feet, which, however, was reached at 140 feet or thereabouts.

Very little water has found its way into the shaft through seams or fissures, and we have every prospect of having a dry mine.

An Improved Method of Introducing Feed Water to the Stamp Mill Mortar.

By BERNARD MACDONALD, M.E., Montreal.

(Paper read before the March meetings of the Canadian Mining Institute.)

The details of this method are shown in the accompanying figures, cross-section (fig. 1), sectional plan (fig. 2) and back view (fig. 3) of the stamp mill mortar as installed by the writer at the Dufferin mine in Nova Scotia.

The method has proved so effective and satisfactory that it is thought a detailed description of it would be interesting to the members of the Institute. In considering this proposition in its various phases it will be assumed that the purpose and utility of a continuous feed of clear water to the stamp mill mortar while in the operation of crushing ore is understood, which being so, very few words are necessary to properly present the proposition.

The points of superiority of this method may be best seen if reviewed in contrast with the defects of the customary method, and for this purpose a brief description of this latter will be given first.

The customary way of feeding water to the stamp mill mortar is through iron pipes or rubber hose discharging over the top In this way the water streams down the falling stamps till it reaches the top of the pulp mass. (See position as indicated in fig. 1.) From this position it will be seen that the feed water, conditions being equal, is more likely to traverse the straight and shorter line I G than to follow the triangular and longer line I H G to the point of discharge, G. But the purpose of the feed water is to mix with and form a pulp of the ore as it is pulverized at the crushing surfaces of the shoes and dies at H, and to carry it in suspension to the point of discharge. Therefore it will be seen that a considerable portion of the feed water coming over the top of the mortar will be discharged before it can perform the duty for which it was introduced. But the greatest defect in this system is the fact that the clear water thus falling on the top of the pulp mass has a tendency to settle the sulphurets and fine slimes around and on the dies, in which latter position they are subjected to still further pulverization, which produces the sliming of the sulphurets and the unnecessary abrasion of the free gold particles that may settle on the bottom. These facts account for a very large part of the loss that occurs in stamp milling.

The "Improved Method."—The mechanical details of this method as shown in figs. 1, 2 and 3, already referred to, will, if studied, make manifest its points of superiority over the method already described. It figs 1 and 2 it will be seen that the water is fed into the mortar through six ¾" pipes entering the back of the mortar at level of 3" below the crushing face of the shoe when new, and would be on a level with the surface of the shoe when worn out on the 2" false bottom liners. It will be seen that the water thus admitted enters the mortar at the most advantageous point to sweep away from around the dies such portion of the ore as has already obtained a sufficient degree of fineness, and carries this portion upwards through the pulp mass to the level of discharge, where the fine material is held in suspension until it issues from the mortar.

Fig. 2 shows that the inflowing water is directed straight for the spaces between the dies, from which it washes away all the fine material, leaving in these spaces only the coarser grains of ore, say somewhat smaller than pea size, which form a kind of coarse sieve into which the coarse gold liberated from the quartz drops and remains undisturbed till clean-up day. The advantage of providing such a receptacle, where the coarse gold may be free from abrasion, is very material, for no inconsiderable loss occurs from the abrasion of coarse gold when mixed with quartz grains in the mortar under the repeated blows of the falling stamps

Further details of this method and its advantages may be seen by a study of fig. 3. This figure shows the rear elevation of the mortar in the background, made transparent to show within the position of the shoes and dies, the top level of the pulp mass and the points at which the water enters from without.

Details of Piping.—In fig. 3 may be seen in longitudinal elevation the piping details in scale. The main feed pipe A is furnished with a T, having 3" run and 1½" outlet, opposite middle of mortar. The main feed pipe is continued beyond this T and stopped on the end by a plug, which may be removed to clean out deposits of mud, or grass, or leaves, or to extend the water supply beyond. From the outlet of the T rises a 1½" connecting pipe. This pipe is furnished with a valve, B, which shuts off the flow of water into the mortar but allows it to flow through the branch underneath, to which the hose for washing the plates is permanently attached. This valve would also reduce the pressure when that would be required by throttling the flow of water

into the mortars. Above this, as shown in the figures, is the distributing pipe, C. Both ends of this pipe are stopped by plugs, which may be removed to facilitate cleaning. A gauge may be attached to this pipe to show the pressure under which the water enters the mortar. The pressure may be controlled by the valve on the connecting pipe, B. and otherwise as desired.

The distributing pipe, C, is tapped for the six ¾" feed pipes, which deliver the water into the mortar through holes E. These feed pipes are fixed with valves which adjust the amount of feed water, and with a piece of rubber hose in the middle to prevent the vibrations of the mortar from being communicated to the piping system which is attached to the foundation, and therefore entirely free from the jar of the battery.

Advantages of the Method. - Summed up, the points of advantage believed by the writer to be possessed by this system are:

(1) Increase of crushing capacity.
(2) Decrease of sliming and consequent losses.
(3) Preparation of the material around the dies to receive and protect the coarse gold from abrasion.

It is very probable that the mechanical devices of this process could be used to great advantage for the introduction of compressed air into mortars of dry crushing mills. An exhaust fan would be a necessary adjunct if used in this way, and if so used the crushing capacity of dry crushing mills would probably be very considerably increased, and the pulp would be of a more uniform classification.

The Gold Bearing Sands of the Vermillion River.

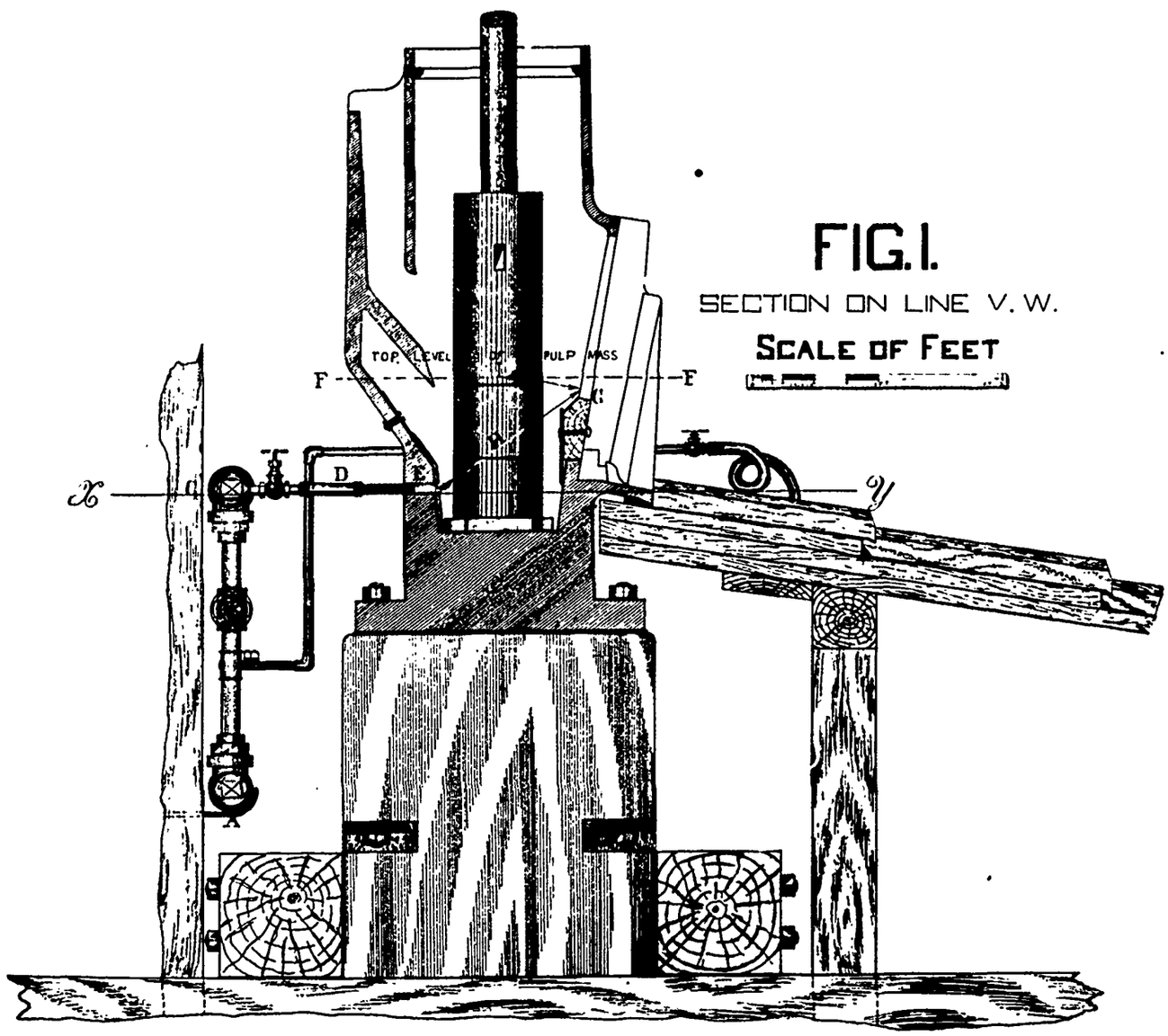
By Mr. J. W. Evans, C. & M. E., Sudbury, Ont.

(Read before the March Meetings of the Canadian Mining Institute.)

The alluvial deposits of gold bearing sand found along the banks of the Vermillion River, in the District of Nipissing, created considerable local excitement last spring and summer, but owing to the character of the gold the results obtained from a few primitive tests were far from satisfactory. In this paper I wish to draw attention to a few points which came under my observation.

In the majority of the deposits the gold is found in the first ten or twelve inches of soil, a reddish sand composed of quartz, granite and greenstone, containing garnet and magnetic iron with a quantity of coarse gravel, covered in patches with hardened clay Samples of this sand from the east bank of the river, in Hanmer township, within 20 miles of Sudbury, averaged from six samples, 60 cents per ton gold, and yielded, with very careful panning, from 100 to 200 colors to a 10 lb. pan.

The colors vary greatly in size, the larger ones being flat and much indented are very liable to float off in panning or washing, owing to minute air bubbles adhering to the indentations. I have frequently lost these larger colors when panning from one pan into another, even when exercising the greatest care.



An Improved Method of Feeding Water to the Stamp Mill Mortar.

A few panning results from samples taken to the depth of from two to three feet I have mounted upon slides for the microscope in order to show the variations in size and character of the colors. The average fire assay result on this lot was about 15 cents per ton, the number of colors varying from 40 to 80 per 10 lb. pan. As an example of the loss in treating the sand with a rocker I found on selected material assaying $1.15 per ton, that the washed coarse gravel which had been thrown out of the screen, yielded upon panning and breaking up the hardened clay sticking to it, 20 colors, which had remained attached to the clay, and assayed 45 cents per ton of gravel or about 25 cents per ton of sand taken. The tailings which were being washed into the river assayed 40 cents per ton of tailings, or about 15 cents per ton of sand taken, and the concentrates from the rocker 80 cents per ton of concentrates or about 10 cents per ton of sand. The sand taken was from about 10 inches from the surface. The fire assay result being $1.15 per ton leaves 65 cents unaccounted for, but as the sand contains galena, copper pyrites and some gold bearing quartz, a higher result in the fire assay is to be expected.

The fire assay results, without previous concentration, however, I find very variable on this work, for instance, taking 100 colors to a 10 lb pan, there will be only 3 colors, on an average in a 5 A. T. charge, assuming the sampling perfect, and as there is a great difference in the size of the colors the results are bound to vary greatly. In a 5 A. T. charge an error in weight of gold will be multiplied 6,400 times in calculating to a ton, while in a 10 lb. lot will be multiplied only 200 times, this will in a great measure offset the loss in panning.

The loss in ordinary panning on this sand I put down as about 50 per cent., but with proper care about 75 per cent. of the gold can be saved.

I found in every case where I passed the gravel through the crusher and assayed the pulp the results were higher than when the coarse gravel was screened out, proper allowance of course being made for the percentage of gravel. In one shaft which had been sunk to a depth of 60 feet, about 200 feet from the river bank, no gold was found after leaving the surface layer until within about ten feet from the bottom but from trouble with water the shaft was not sunk any further, and in no instance, to my knowledge, has bed rock been reached. Owing to the slight fall and thickly wooded nature of the country, sluicing on a large scale would be difficult if not impossible.

Gold has been discovered in many places further up the river, and in almost every case the gold gets coarser as one goes north.

On one slide I have mounted a fac-simile of the largest color yet found on the river, it comes from some distance to the north. The gold found so far is not much worn and the microscope shows pieces of quartz attached to many of the colors.

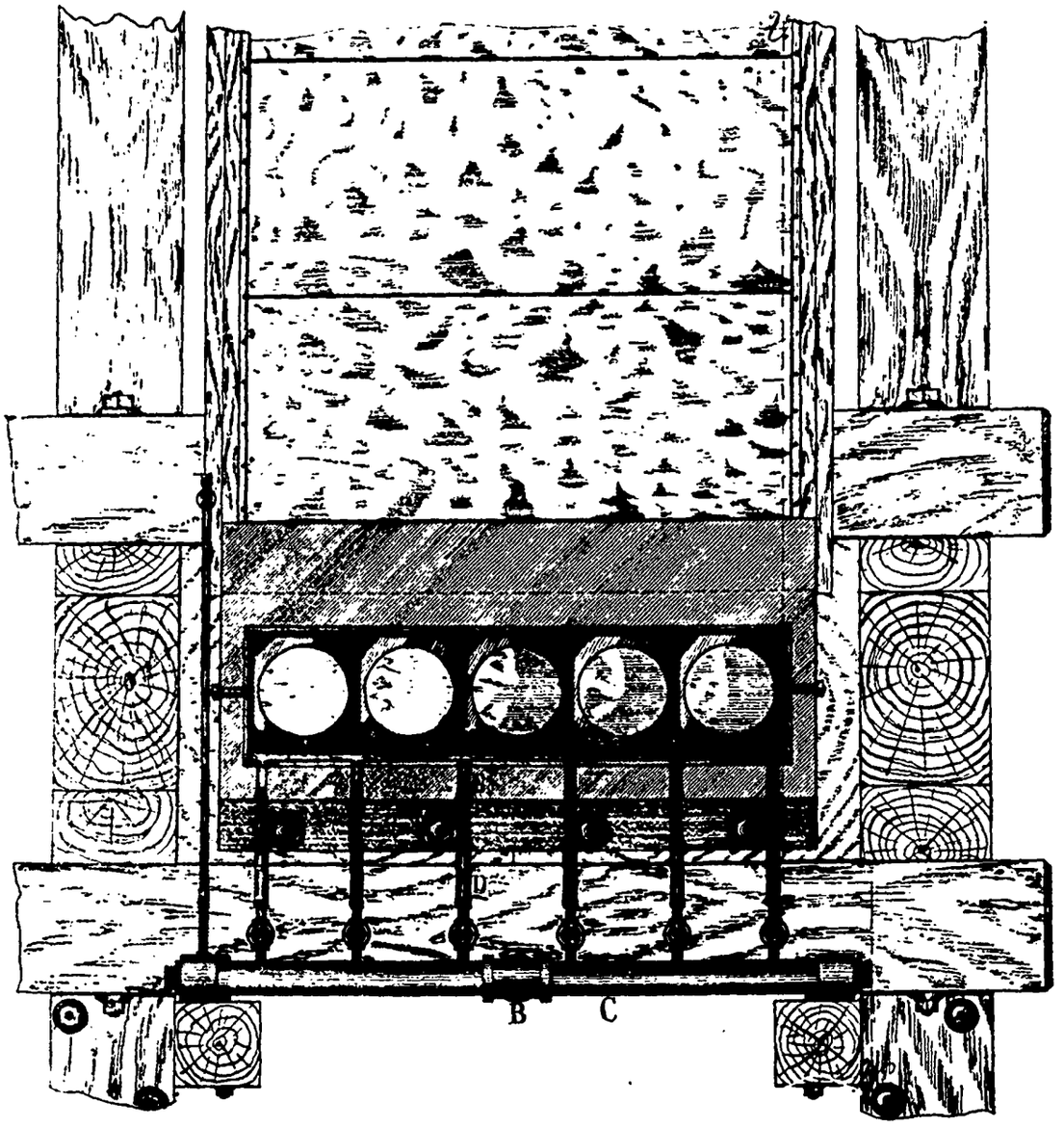


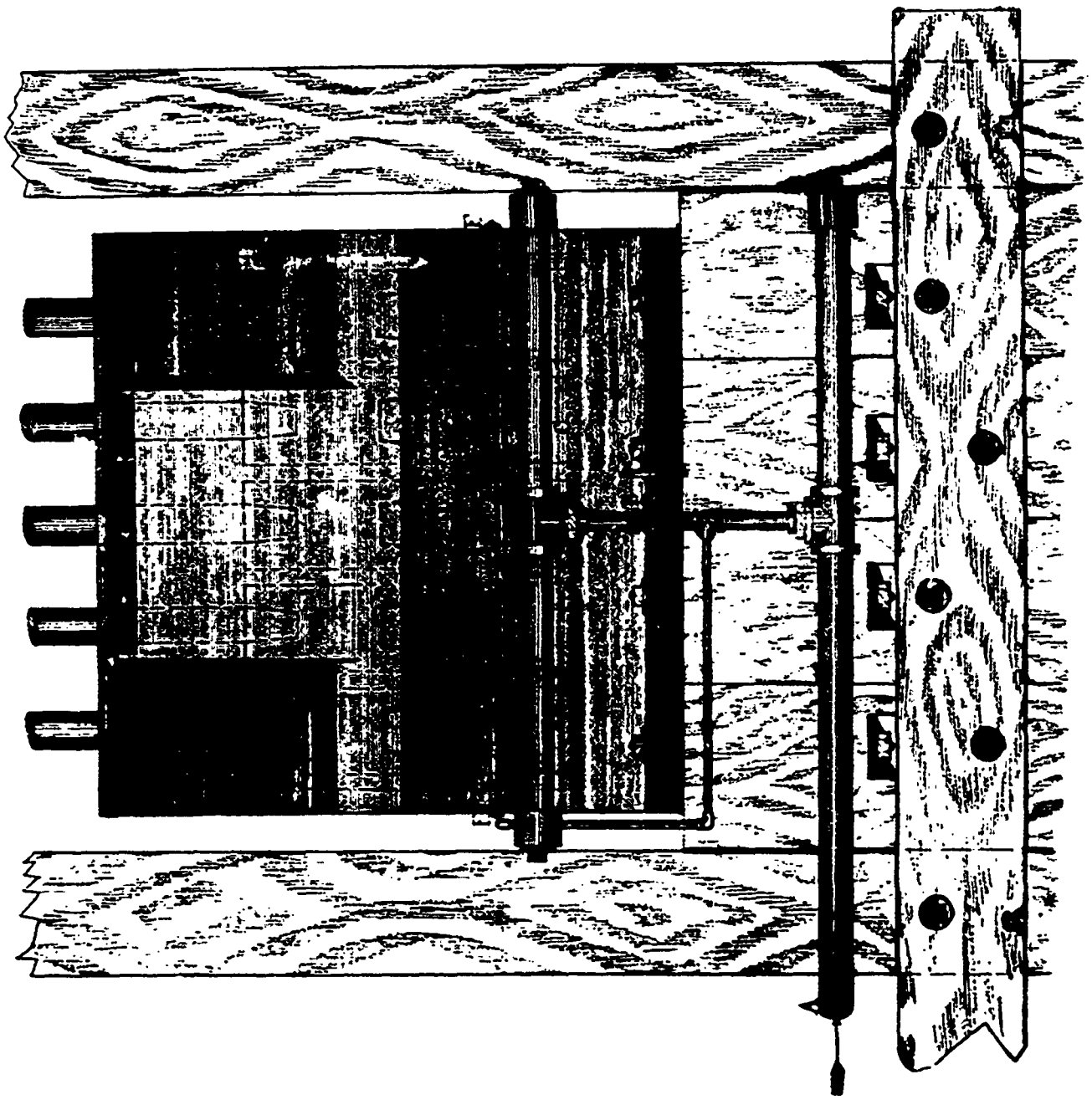
FIG. 2.
PLAN ON LINE X Y
SCALE OF FEET

An Improved Method of Feeding Water to the Stamp Mill Mortar.

The sand on the hill side several hundred feet from the river bank gives almost the same result as that nearer the river, and as the course of the present stream is very sinuous it suggests the existence there of a much larger river at some time in the past. I think it very probable that some valuable deposits containing coarse gold will be found upon this river in the near future, and that many of those already found could be worked at a profit on a large scale, in some manner similar to the dredge work done on low grade placer deposits in California.

I am indebted to Mr. A. H. Robinson for help in the laboratory both in panning and fire assay work.

FIG. 3.
REAR ELEVATION
SCALE OF FEET



An Improved Method of Feeding Water to the Stamp Mill Mortar.

The Sampling of Argentiferous and Auriferous Copper.

By ALBERT R. LEDOUX, Ph.D., New York.

(Paper read before the March meetings of the Canadian Mining Institute.)

The practice of sampling of ores and furnace materials which can be crushed, has been reduced to a science. The methods and operations have been demonstrated to be correct, not only by their practical results, but by mathematical formulae. It has been proved that "time samplers" are to be relied upon to extract from a given mass of crushed material a portion sufficiently small for assay, that will accurately represent the lot. On this side of the Atlantic, machines are employed wherever possible, while hand sampling of ores is still the rule in Great Britain and on the continent of Europe. It is only within comparatively recent years that the demand has been made upon the sampler for a method which will produce an accurate sample of argentiferous and auriferous copper bars.

The sampling of lead bullion has a longer history, and methods have crystallized around a few precautions to be observed. Years ago, careful study was made of the distribution of precious metals in pig lead, and there is little or no trouble in obtaining fair samples of such material.

In copper, for a long time, the gold and silver contents were not important Lake Superior and Chili coppers were the chief products coming into the American and European markets, and they, like those produced on the Continent of Europe, carried small values in gold and silver. It was not difficult to obtain an average sample of such bars. In fact, the London Metal Exchange under its Contract "J," decreed what method should be employed, and simply specified that one bar in ten should be bored half way through on opposite sides and ends. This was sufficiently accurate for all material, which, however the copper might vary and the impurities be distributed, only carried low gold and silver values. To-day, Chili bars are selected with a view to their content of precious metals; for the electrolytic process can separate these so economically, that when the silver is as low as eight to ten ounces and the gold as low as 50 cents in value, to the ton, these values go perhaps one-third of the way toward paying the cost of electrolytic refining.

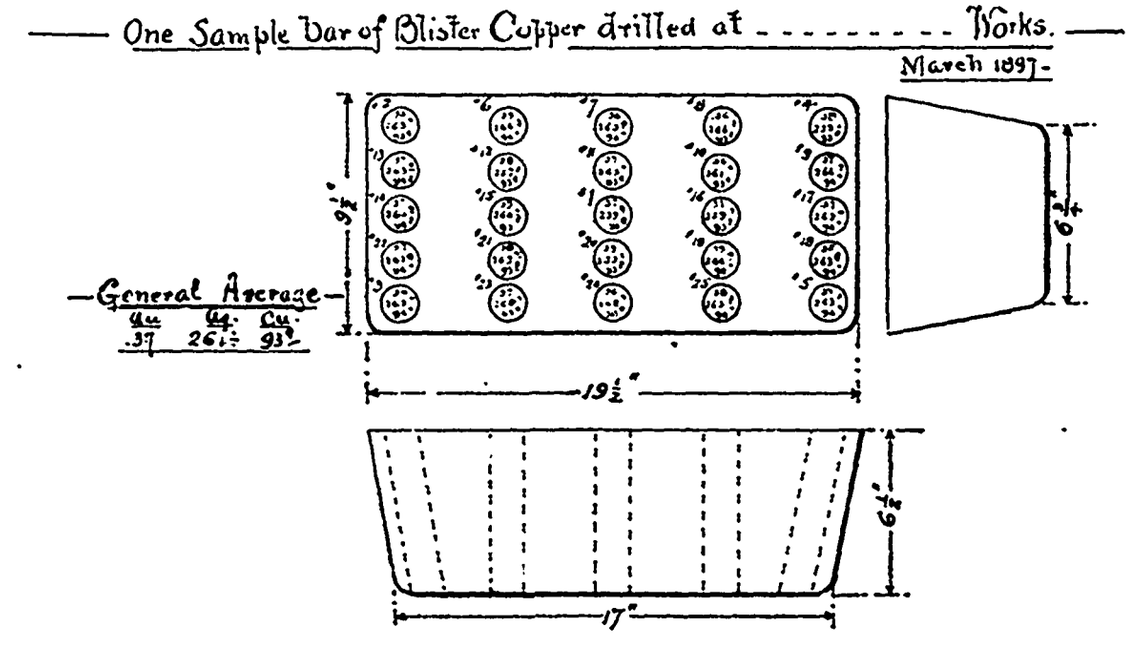
Argentiferous copper bars are sampled to-day in one of three ways:

By boring.
By taking dip samples.
By sawing.

It is to these three methods that I address myself to-day, and report for the benefit of my fellow engineers and assayers, and for furnace managers, what is the "State of the Art" at the end of this century.

It was soon found that, by the ordinary method of boring, prescribed by the London Metal Exchange, the results could not possibly be uniform. For in the ordinary pig of copper there was a segregation of the precious metals. It was sometimes found that the middle line, longitudinally, would generally contain some 25 per cent. more silver than would a line drawn, say two or three inches from, and parallel to, the edge of the pig. Dr. Keller in his admirable researches into the distribution of impurities in copper material, has shown that the distribution of precious metals bears some relation to the distribution of impurities. This has been my own experience. It was at first my belief that the precious metals were invariably concentrated near the centre of the pig. This belief was first shaken by a request which was made of my firm, by parties who were selling argentiferous pig copper quite rich in gold, on our assay, that we would not bore the pigs along the centre line, but would make the holes half way between the sides and centre, and at diagonally opposite corners. On making some experiments, I found that the gold and silver, in the copper pigs in question, were more concentrated nearer the edges than in the centre, although in other material of the same general assay, so far as copper was concerned, and of the same general content of silver and gold, the segregation of precious metals was usually near the centre. I found that the material in question contained between two and three per cent. of arsenic, and whatever may be the chemical or metallurgical reason, I am convinced that the presence of arsenic prevents the segregation of the precious metals along the centre line, to greater or less degree. As proof of that, I have been furnished with the results of some interesting experiments in this direction made by a Western smelter whose product generally contained from one to three per cent. of arsenic. The following diagram will show the results:

FIG. A.



Bar drilled through with ¾" drill. Weight of sample about 12 Ounces.

No pains spared in drilling to avoid mixing with dirt or other Samples.

Each sample ground in mill & well mixed before assaying.

Briefly stated, this experiment consisted in boring 25 holes through the pig, the holes going all the way through from top to bottom, on parallel lines. The assays of silver vary from 239 ozs. per ton, in the hole nearest to centre, to 268 ozs in two holes nearest the edge. The assays of silver in a quadrilateral embracing 9 holes nearest the centre were as follows: Centre line, 243, 239, 253. Line at left of centre, 257, 260, 263. Line at right of centre, 261, 259, 266. The samples at the edge, with one exception, all ran over 262 ozs. of silver, several running up to 268. In fact, the sellers of this particular blister copper were frank enough to admit, that a sample taken by boring holes through the middle, or on the centre line, would be too high, and suggested that the holes be bored not nearer than three inches from the side, which give an average, in their experience.

The great variation in the distribution of precious metals, in the blister copper upon the European market, has been shown by careful experiments, made public, by some of the sampling works in England and in Wales. There, as here, the air has resounded with the outcries of buyers who were sure that they had lost heavily. Unfortunately for the benefit of science, when a refiner receives more gold or silver than he pays for, he seldom makes a complaint, and, his ability to keep quiet is equalled only by that of the works manager, who has reason to doubt the accuracy of the assays, because his works are charged by the mine, with less gold than he can produce. But nearly all producers, of my personal acquaintance, are only anxious to get at the facts, and to buy, and sell again, on safe and accurate assays.

The following diagram shows the variation in certain argentiferous bars, as determined in England.

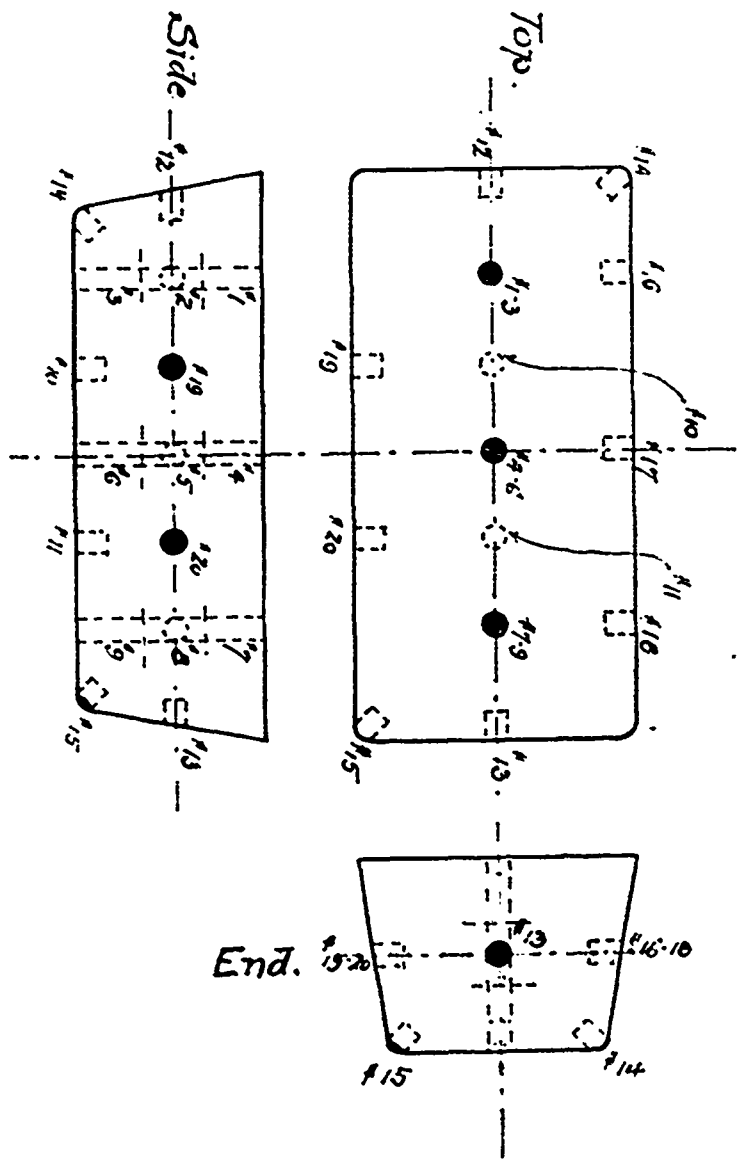


FIG. B.

This diagram shows that holes were bored on all sides of a pig of copper, traversing about one-third of the block in each direction. The following table shows the assays of 20 samples taken at the points indicated.

	OZS. PER TON.			OZS. PER TON.	
	Silver.	Gold.		Silver.	Gold.
No. 1	133.1	6 01	No. 11	68.8	4.32
2	101.6	5.14	12	61.49	4.16
3	77.2	4.40	13	65.7	4.10
4	135.7	6.00	14	76.5	4.49
5	90 8	4.88	15	101.59	4.57
6	66.6	4.22	16	64.17	4.10
7	137.8	5.93	17	68.10	4.41
8	101.6	5.18	18	68 43	4.41
9	66.7	4.16	19	69.41	4.41
10	73.5	4.24	20	71.14	4.31

It will be seen from this that in accordance with the point where the sample was taken the silver varied from 66.7 ozs. per ton to 133.1 ozs.; the gold from 4¼ ozs. to over 6 ozs. The average of all the samples, from 1 to 20, assay:

Silver..... 81.99 ozs. per ton
Gold ..... 4.67 " "

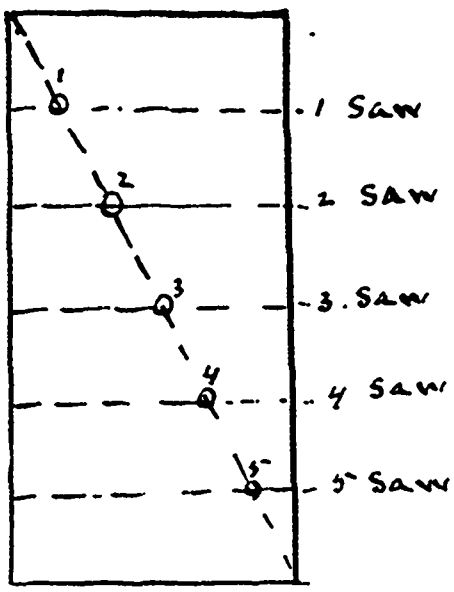
While the parcel was sold on the basis of:

Silver..... 97.5 ozs per ton
Gold ..... 4.99 " "

Was not this enough to frighten both buyer and seller!

Another series of experiments on Australian and American copper, side by side, is illustrated in the following diagrams:

FIG. C.



In this case holes were bored all the way through the pigs on diagonal lines, hole No. 3 being in the centre. The bars were then sawed across as indicated. The following are the results of the assays:

	LOT L.				LOT B.			
	DRILLED.		SAWN.		DRILLED.		SAWN.	
	Ag.	Au.	Ag.	Au.	Ag.	Au.	Ag.	Au.
	Ozs.		Ozs.		Ozs.		Ozs.	
No. 1	108.6	5.68	107.0	6.01	38.3	.16	32.7	.18
2	124.4	6.20	116.3	6.33	48.8	.19	45.7	.22
3	137.1	6.53	117.2	6.30	52.0	.16	44.1	.22
4	126.2	6.33	122.3	6.14	44.2	.16	49.0	.19
5	115.3	6.14	110.4	5.97	39.0	.16	32.7	.18
Averages	122.3	6.17	114.7	6 15	64.5	.165	40 8	.1.8

It will be observed how in each case the drillings in Lot L. increase in richness; 108 ounces of silver at hole No. 1 to 137 ounces at hole No. 3; and in Lot B. from 38 ounces at point 1 to 52 ounces at point 3. In this case there was a segregation of the silver and the gold from the sides towards the centre. This material is comparatively free from arsenic.

It is unnecessary to multiply examples of this kind. I could duplicate the above general conclusions by the score. The above is simply to show what may be expected in any material, and it can be taken for granted without further demonstration, (1) *that all gold and*

silver bearing copper varies in richness at different points. (2) *That while there is no absolute rule, each product being a law unto itself, yet in general, highly refined material free from arsenic has a concentration of the precious metals along the centre line, the maximum being at the middle point of the bar.* It can thus be seen that the old method of sampling described in contract "J" long ago had to be abandoned.

Five Bar Method. The first attempt at arriving at a method of sampling that would be fair to all parties, was by varying the position of the hole, and here began logically the development of the system of sampling which I shall recommend. In order to vary the hole location, the first change was adopting the custom which had been employed for some years by the samplers of argentiferous lead. Three or five bars were placed side by side. A diagonal line was drawn across them, and the point at which this line crossed the centre line or axis of the pig was marked. At these points drill samples were taken by boring all the way through. This will be shown by the following diagram:

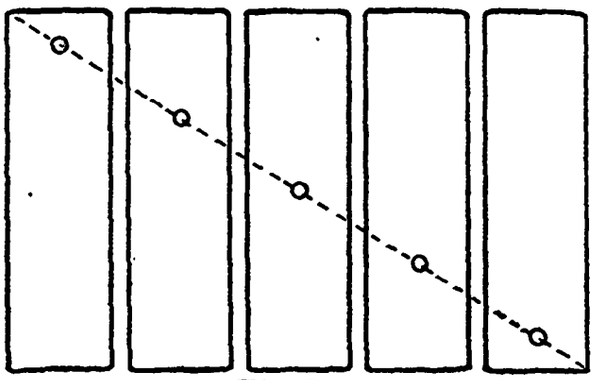


Fig C.

The difficulty with this is that while it takes account of the variation between the ends and middle of the pig, the holes are still bored along the centre line, and are likely to be richer or poorer than the average.

Just here it may be stated that our experience for years in our sampling works, has shown what Dr. Keller has recently published, that anodes cast from pigs, no matter how variable the latter were originally, will be quite uniform in composition, no matter where you bore them. Therefore, some smelters are already sending their copper to market in the form of slabs not over three inches thick, instead of in the form of pigs. These slabs cool so quickly and so uniformly that the precious metals do not seem to have a chance to segregate. I strongly recommend this system of casting, although it is more expensive and disagreeable—from spattering and other causes. It removes from the sampling the element of gambling on results, which is considerable, unless the precautions which I shall enumerate later are uniformly adopted.

Eighteen Hole Method. When we find that the three bar or five bar diagonal sample also fails to give uniform results, we have adopted in many cases, after careful testing of the particular material in question what is becoming to be known as the "eighteen hole" system of sampling. This will be made plain by the following diagram:

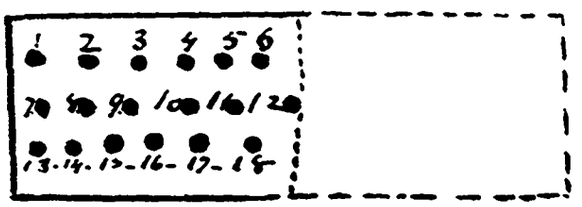


FIG. D.

A board which represents in shape half of the upper side of the pig, is bored with 18 holes equally distant from one another. This board is then laid upon the pigs to be sampled; The first pig is bored all the way through where hole No. 1 comes. The second pig is bored where hole No. 2 comes, etc. In this way every bar is bored once all the way through, and in every 18 no two are bored in the same relative positions. The borings, of course, must be thoroughly mixed.

One cause of the great difference in assays on argentiferous copper is due to the fact that some assayers are not careful to grind their material fine before weighing out the portion for assay. In fact, samples are sometimes sent to us which are supposed to have been divided equally as to quantity and quality between ourselves and other assayers, and the bottles contain "curles" sometimes two inches long, just as they came from the drill. After careful search we have found a mill which will grind samples quite fine, as you will note from the samples submitted herewith.

This then, in my opinion, represents the last word as to sampling by boring. It is the safest, whether the concentration of precious metals be in the centre or near the sides; whether the pigs be of the usual form, or whether the material be cast in slabs or plates.

We always urge upon both buyer and seller to agree in their contracts as to the method of sampling and assay to be employed, and this method we follow. This relieves the assayer of responsibility, but when he has to take this responsibility he should not shirk.

Sampling by Sawing. The difficulties in obtaining average samples by boring has led to a number of experiments to see whether or not the copper bars could not be sawed cold, and the sawings assayed with some expectation that they would represent the average of the material sampled. This, in my opinion, is the ideal method of sampling and will be adopted in future, but at present there are some difficulties in the way of the application of the saw in this busy commercial world of ours, because the results are slow. Some people, in fact, have told me that they believed it would be impossible to saw certain copper cold, but when we have urged upon them the experiment they have admitted that they were suprised that it could be done so rapidly.

This suggestion originated in England. At the works of a prominent refiner the sawing is done by a special machine designed for this purpose. The saw is circular, being two feet three inches in diameter and set up upon a powerful frame. The device for forcing the bar against the saw is a carriage operated by electric power. The saws do not wear out as rapidly as one would expect, and cut through a pig six inches in diameter, in about five minutes. The saw dust is all fine and in an ideal condition for assaying.

In some works where sawing has long been employed for trimming anode plates, it is now used for sampling.

The saw is forced up vertically against the pig, and does not cut all the way through, but cuts out a groove, say three inches deep, on the top of the pig, and the next pig which is sawed is placed bottom side up, so that an average of both top and bottom is obtained. In one works an ordinary band has been employed and is said to give satisfaction. These band saws wear out quite rapidly when pushed, but are not expensive and are readily replaced.

In all works in Europe and America where sawing has been adopted, the five-bar method is employed, which should be plain from the following diagram:

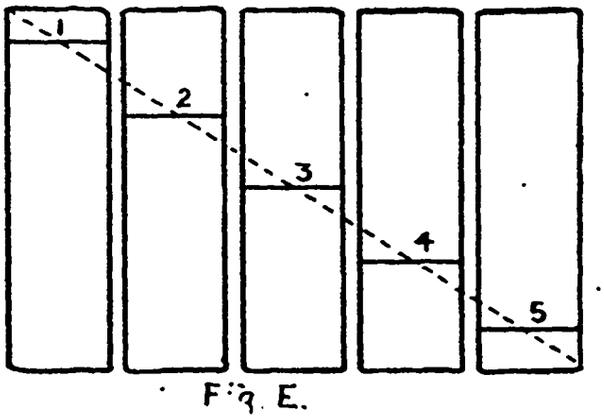


Fig. E.

In this case a diagonal line is drawn across the bars, but instead of boring a hole where this diagonal line crosses the centre line of each bar, the bars are sawed all the way through where these lines intersect. In this way we have an absolute average sample of each bar on a line different in its location from that of any other, and the sawings mixed together give us an accurate average for assay.

From what I have said the mechanical method of sampling as the art now exists to-day, may be stated again to be:

First, boring by the eighteen hole method, or sawing by the five bar method.

Dip Samples. A last word remains to be said under this head. Many works, both shippers and receivers of copper furnace material, contend that the only proper way of sampling is by dipping. The bars are melted up and samples are taken at stated intervals during the melt, which are granulated or cast into a sample ingot, which is then bored and the borings assayed. There are many difficulties in the way of this method of sampling and many precautions to be taken to insure accuracy. Both buyers and sellers are inclined to accept it if done at their own works. But it requires the independent sampler who is representing the interests of absent parties to be present during the entire melt; his men must be at the furnaces night and day to see that the dipping is properly done, and, after all, especially in comparatively low grade material, as far as copper contents are concerned, there is always an enrichment and concentration; so that the assay does not represent, in copper at least, the material which went in. In order, therefore, to arrive by calculation at an average assay of the lot as received, the weight of the material which entered the furnace must be taken; the weight of the anodes or plates which come out must be ascertained; the slag produced during the melt must be collected, weighed and assayed, and finally, there is always the suspicion on the part of sellers that the furnace bottoms have absorbed some of the values; or the fear on the part of the refiner that the furnaces may have given up some precious metal which may have been present as a residue from former charges.

Canada has added considerably to the anxiety of the refiners of the United States and to the burden of samplers, since the production of gold bearing copper mattes and bars from the British Columbia mines. If the receiver of furnace material was anxious on account of the variations in bars containing not over two ounces of gold per ton, imagine his mental state when he began receiving Rossland products in which the gold will average perhaps 18 ounces per ton, and the variation in parts of individual pigs is almost infinite! But even these 20 ounce mattes and the bars made from them are now safely sold and bought by the 18 hole method, or by sawing.

On the Gold Measures of Nova Scotia and Deep Mining.

By MR. E. R. FARIBAULT, B.A.Sc., Geological Survey of Canada.

The gold measures of Nova Scotia became known about the year 1860. The earliest discovery was followed by so many others, that it was believed that the whole of the Province was auriferous. Gradually, however, it became evident that the workable deposits of free gold were confined to the metamorphic rocks of the Atlantic coast, along which they form a continuous belt, from one end of the province to the other, a distance of some 260 miles, varying in width from ten to seventy-five miles.

They cover about half the superficies of the province, exclusive of Cape Breton Island, and their extent may be roughly estimated at 8,500 square miles. Of this area, probably 3,500 square miles are occupied by granitic masses, barren of gold, leaving an area of about 5,000 square miles of gold-measures.

The granite intersects the stratified gold-bearing rocks, in many places, in large masses or dykes, but for the most part it forms a prominent ridge, almost unbroken, from one end of the province to the other. Its intrusion took place at the close of the Silurian period, probably about Oriskany, and was accompanied and followed by disturbances, faults and much local metamorphism of the stratified rocks. It occurred after the folding of the gold-measures and the deposition of the quartz veins; for granite dykes and veins have been observed to always cut the interstratified quartz veins wherever they come in contact with them. The granite has thus no relation to the auriferous character of the veins, and need not again be referred to.

Although, no well defined fossils have so far been found in the sedimentary rocks constituting the gold-measures, most geologists agree to classify them, provisionally, as Lower Cambrian.

They certainly, in many respects, resemble the auriferous Cambrian of the Eastern Townships of Quebec, and knowledge gained in the Nova Scotia gold-fields may prove of the greatest practical importance in prospecting for veins below the alluvial deposits of Quebec.

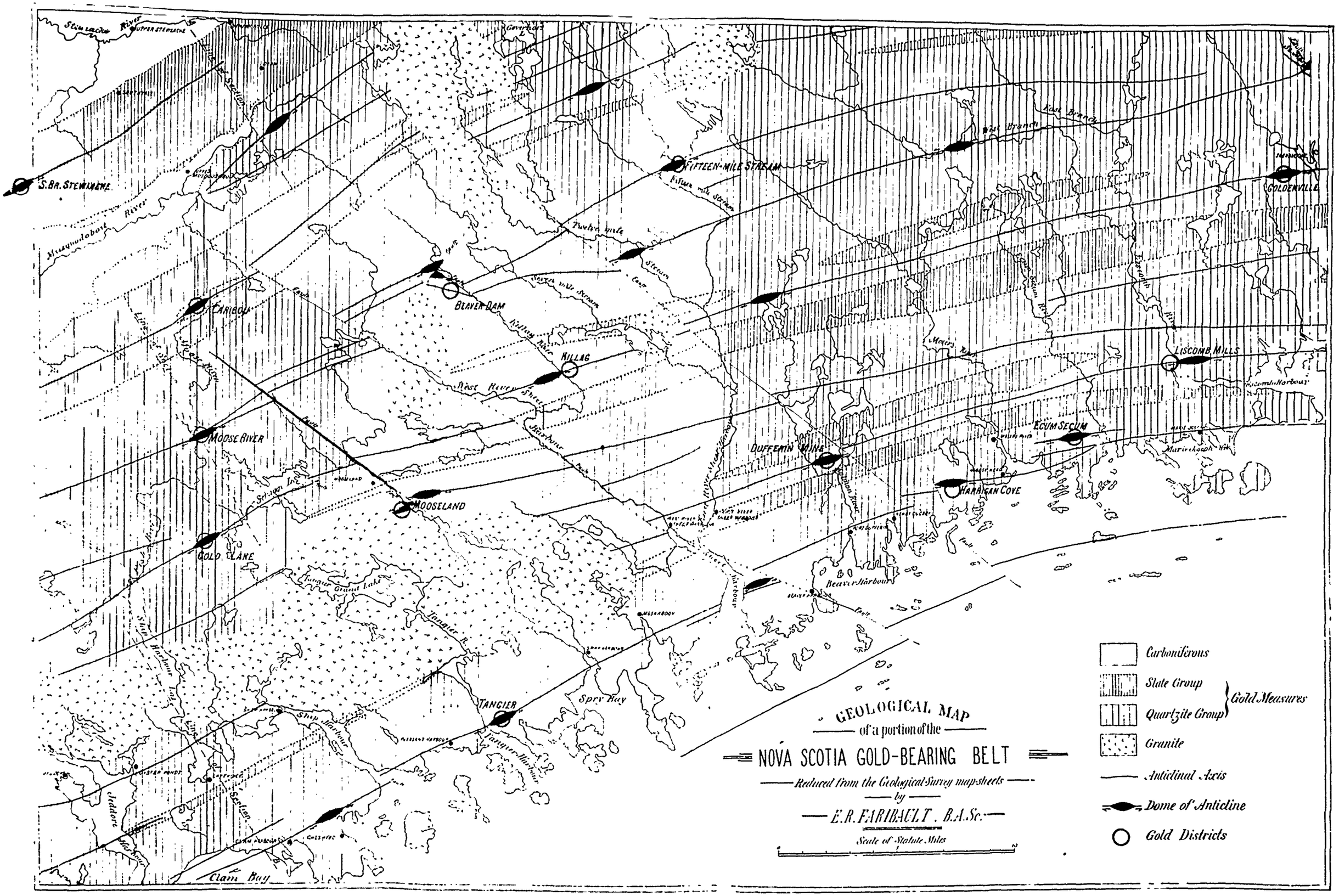
The gold-measures of Nova Scotia fall naturally into two well defined and distinct groups, viz., a lower or "quartzite group" and an upper or "slate group."

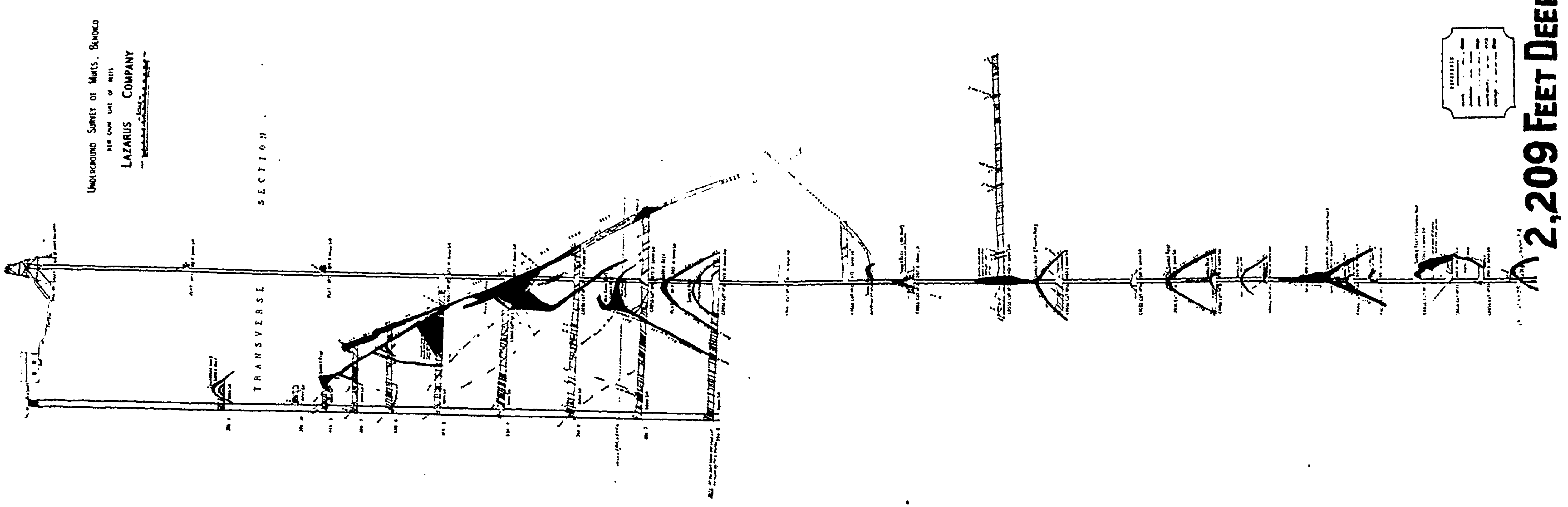
The mapping of the eastern part of the province, by the Geological Survey, places the thickness of the quartzite group, as far as denudation has exposed these rocks to view, at about three miles, and the thickness of the upper or slate group at about two miles, giving a total known thickness of strata of over five miles.

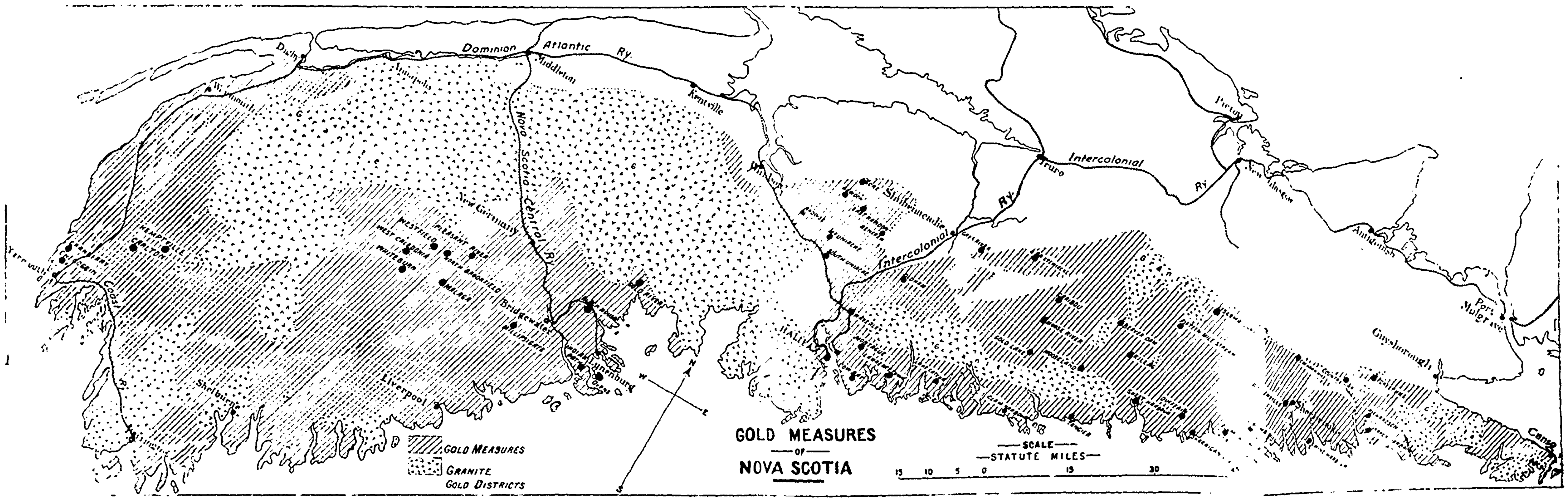
The lower division or quartzite group is mostly composed of thick-bedded, bluish and greenish grey felspathic quartzite, locally named by miners, "whin," a term used in Scotland for an igneous rock or greenstone. Interstratified with the quartzite are numerous bands of slates, of different varieties and colors, from a fraction of a foot to several feet in thickness. The upper division or slate group is mostly composed, east of Halifax, of bluish-black slate, often graphitic and pyritous, rusty-weathering, with occasional layers of flinty quartzose rock. The lower part of this group is characterized by greenish, argillaceous and chloritic, soft slate, of but little thickness at the east end of the province, but increasing to a great thickness at the west end. A few layers of magnesian, siliceous limestone have also been noticed at different places, at the base of the group, overlying conformably the quartzite of the lower division. The line of division between the two groups is thus well defined by characteristic bands, which form valuable data to work out the sequence and structure of these rocks, at any point, with certainty.

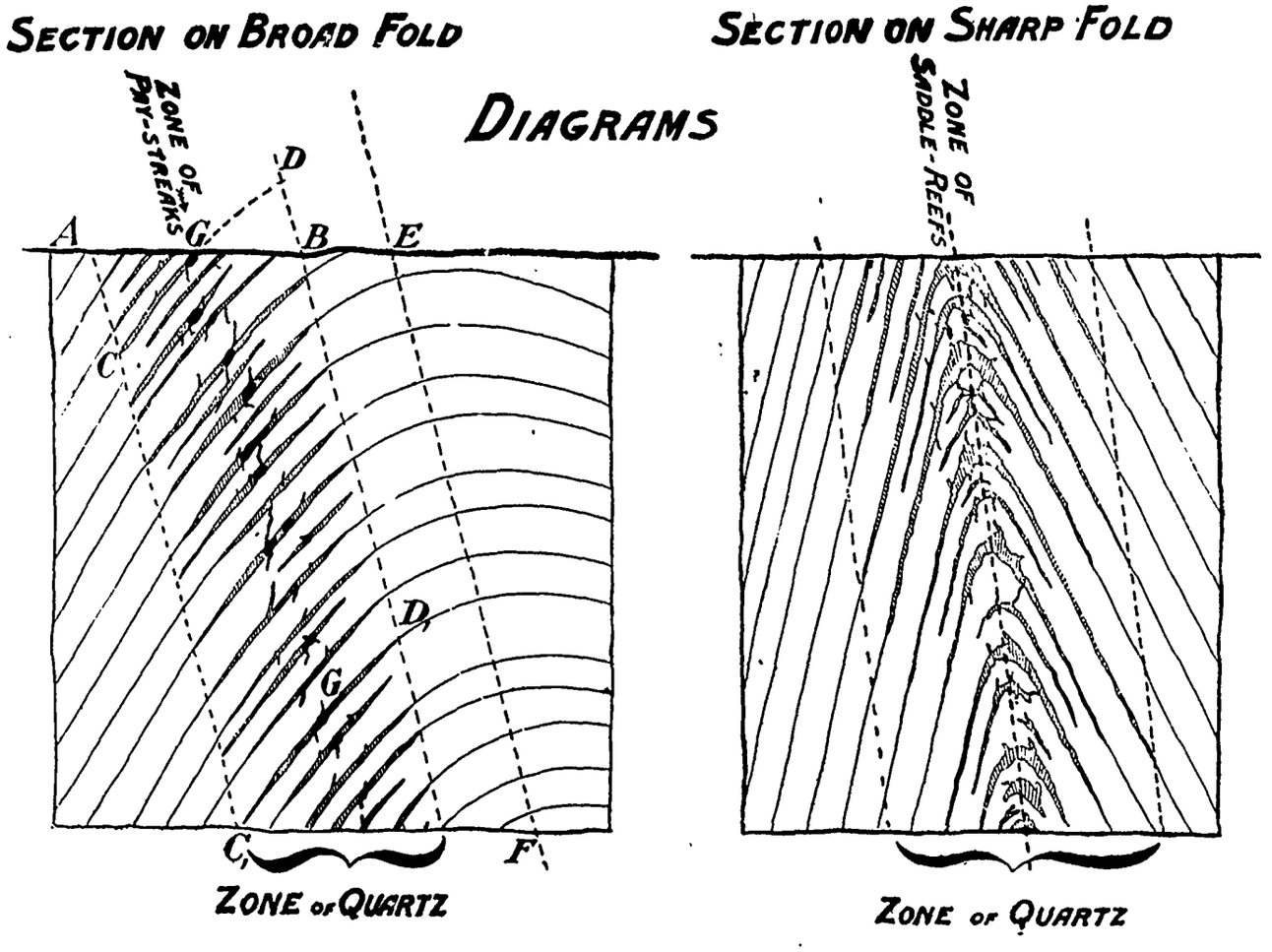
The beds of quartzite and slate, forming the gold-measures, were originally deposited in the sea, and therefore horizontally. These horizontal beds were then subjected, during a long period of time, to forces that have produced prodigious results. A close study of the present structure of these rocks shows that they have been slowly moved by a powerful and uniform pressure, which has folded them into a series of huge, sharp undulations, roughly parallel with the sea coast. They have indeed been buckled, bent and folded to such a degree that they occupy only one-half of their former width, measured at right angles to the strike.

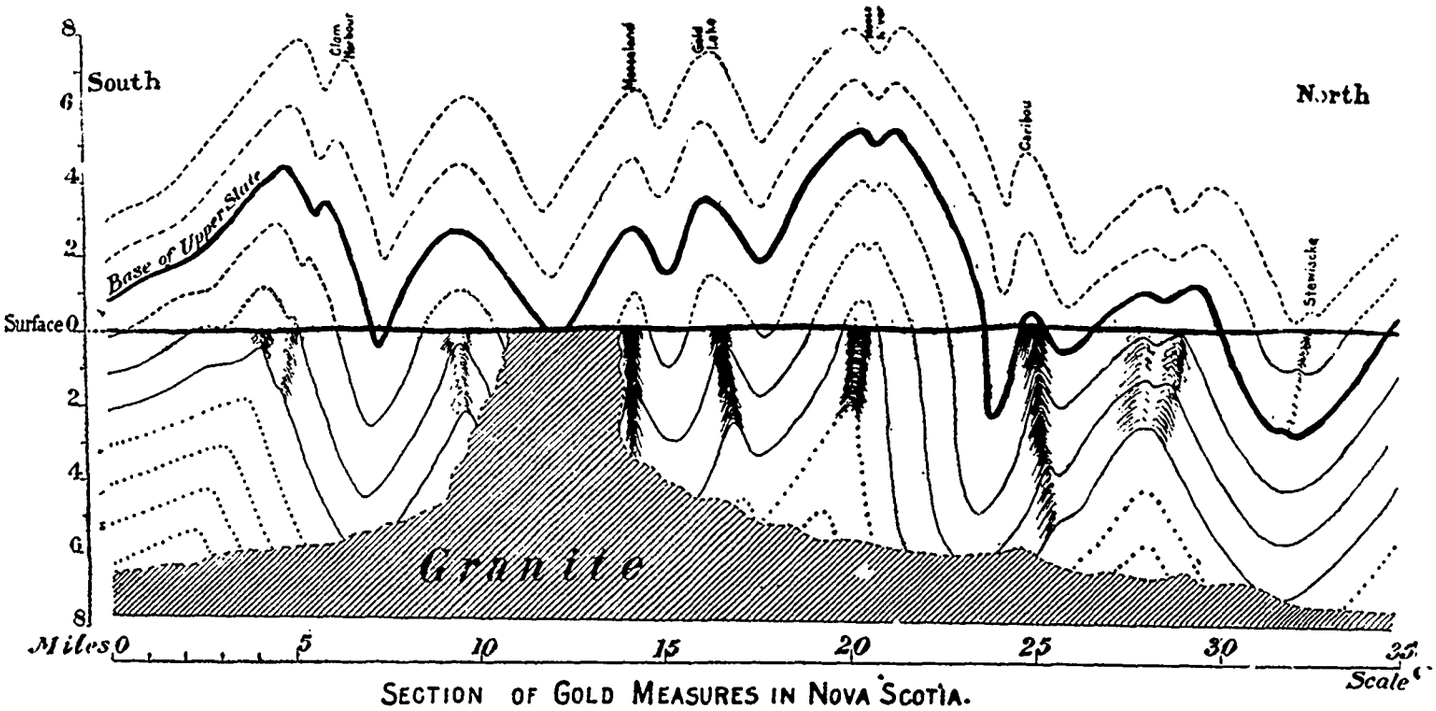
Since these rocks were deposited and folded they have been under the unceasing influences that tend to level the hills and fill up the valleys, and, at more recent date, the greater part of the surface was subject to glacial erosion. Extensive denudation has worn away the folded measures to the present level. Some of the sharpest and highest folds have been truncated to a depth, as far as we know, of over eight miles, exposing at the surface a section of gold measures of over five miles in thickness.


S. BR. STEWIACKE
Stewiacke River
Upper Stewiacke
Musquodoboit River
CARIBOU
MOOSE RIVER
MOOSELAND
GOLD LAKE
Tangier Grand Lake
Tangier R.
Tangier Harbour
Sheet Harbour
Salmon River
Indian Harbour
Clam Bay
BEAVER DAM
Killag River
KILLAG
Rose River
Twelve mile Stream
Fifteen mile Stream
FIFTEEN-MILE STREAM
Middle Branch
West Branch
East Branch
GOLDENVILLE
Tangier
Sheet Harbour
Musquodoboit Harbour
LISCOMB MILLS
Moser's River
ECUM SECUM
Marie Joseph
HARRIGAN COVE
DUFFERIN MINE
Dufferin Mine River
Beaver Harbour
Fault
GEOLOGICAL MAP
of a portion of the
NOVA SCOTIA GOLD-BEARING BELT
Reduced from the Geological Survey map-sheets
by
E. R. FARIBAULT, B.A.Sc.
Scale of Statute Miles
Carboniferous
Slate Group
Quartzite Group
Gold Measures
Granite
Anticlinal Axis
Dome of Anticline
Gold Districts

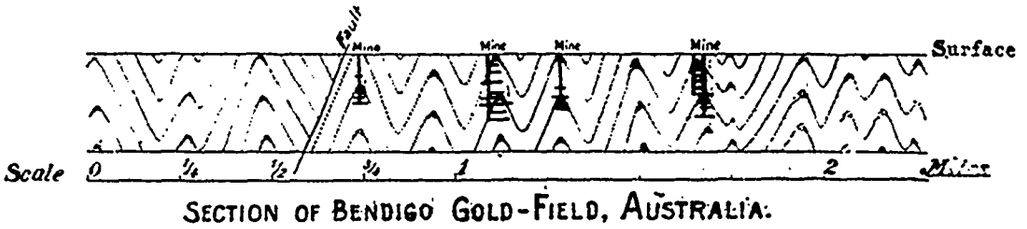

Underground Survey of Mines, Bendigo
LAZARUS COMPANY
TRANSVERSE SECTION
2,209 FEET DEEP


Dominion Atlantic Ry.
Nova Scotia Central Ry.
Intercolonial Ry.
Truro
Kentville
Pictou
Liverpool
Bridgewater
Halifax
Yarmouth
Guysborough
GOLD MEASURES
OF
NOVA SCOTIA
GOLD MEASURES
GRANITE
GOLD DISTRICTS
SCALE
STATUTE MILES
15 10 5 0 15 30





SECTION OF GOLD MEASURES IN NOVA SCOTIA.



SECTION OF BENDIGO GOLD-FIELD, AUSTRALIA.

The map (Fig. 2) is a reduction of map-sheets published by the Geological Survey on the scale of one mile to one inch. It represents a portion of the gold-measures, thirty-five miles wide and sixty miles long, east of Halifax, between Musquodoboit Harbour and Sherbrooke. The black lines show the anticlinal axes of eleven folds, into which the measures have been plicated; the narrow, dark shaded bands indicate remnants of the upper slate group, left undenuded along the deepest troughs or synclinal axes of the folds, the other areas indicate the granite masses.

A diagram (Fig. 3), gives a section of thirty-five miles in length, drawn across the whole belt of the gold-measures, along the line of section A B in the plan (Fig. 2).

Below (Fig. 3) is given, for comparison, a diagrammatic section of the Bendigo gold fields of Australia, on a scale ten times as large as the one above. The heavy black lines indicate gold mines on four different anticlinals, worked on the line of section.

The amplitude of the folds, or the distance between the different main anticlinal axes in these two gold fields respectively, varies considerably. The Nova Scotia section of thirty-five miles gives eleven anticlines, or an average distance of three miles between each anticline, and a maximum distance of nearly five miles; while in Bendigo gold district, it ranges from 300 to 1,300 feet. So that in Nova Scotia, the amplitude of the folds, is nearly twenty times greater than in Bendigo.

The mapping of the gold-measures by the Geological Survey during the last fifteen years, has been extended, under my charge, as far west as Lunenburg. The study of the structure of these rocks, over that region, has afforded an opportunity of acquiring many important facts and data by means of which gold mining may be carried on with more confidence, under more exact conditions, and with greater economy.

The most important feature disclosed, is that all the rich veins and the large bodies of low grade quartz worked in Nova Scotia, with few exceptions, follow the lines of stratification, and occur at well defined points along the anticlinal axes of the folds.

It was during the progress of the slow folding of the measures, that the rich quartz veins and large saddle-lodes of quartz were formed, at favourable places, along the planes of bedding on the anticlinal domes of the folds

Thus a thorough knowledge of the structure of the anticlinal folds becomes necessary, to locate the auriferous quartz deposits on the surface, and to develop them in depth.

In tracing the axes of the folds at the surface, the dip of the rocks is the chief guide. If the strata are found to dip towards each other, it is clear they form a synclinal axis or trough; while, if they dip in opposite directions they form an anticlinal axis or ridge.

The rocks, on opposite sides of anticlinal axes, generally dip at angles varying between forty-five and ninety degrees from the horizon, seldom lower than forty-five degrees, and overturned dips are frequently noted.

The deviation of any bed from the horizontal, in the direction of the axial line, is its "pitch." A longitudinal section, made east and west along the axis of an anticlinal fold, will show the strata and the fold to pitch either to the east or west, at low angles, seldom over thirty degrees from the horizon.

Owing to the pitch, the outcrop-edges of the beds, on each side of an anticlinal, are not parallel to the axial line; if they converge towards the east, the anticlinal fold dips east, and if to the west, it dips to the west.

When the pitch inclines both ways from a central point, that point is the centre of an elliptical "dome," and marks the position of one of the most favourable points on the main anticlines for the occurrence of quartz veins.

The average distance between one dome and the next, along the same anticlinal axis, varies from ten to twenty-five miles.

It has been thought by some, that these domes were caused by gentle north and south undulations, crossing the sharp east and west folds. Such does not, however, appear to be the case, generally, as it can clearly be seen by looking over the geological maps of the region, that the pitch at corresponding points on the various main anticlines is often quite different.

It will be seen that most, if not all, of the gold mining centres operated are situated on these domes.

Moreover, it has been observed that most of the anticlinal domes, upon which mines are not in operation, show indications of gold, and many will eventually prove to be important auriferous centres, only a few of them being without the structure necessary for the formation of quartz veins.

Of the twenty-one domes, in the region covered by this map (Fig. 2) fourteen have been worked more or less, six have shown auriferous quartz in situ or in float, and the remaining one has not yet been proved.

The gold districts operated to the east of Halifax are here given, together with their horizon or the vertical distance of their strata below (and in one case above) the base of the upper slate group.

Moose River	about	3¼ miles.
Tangier	"	2¾ "
Fifteen-mile Stream and Beaver Dam		2½ "
Lawrencetown		2 "
Goldenville, Harrigan Cove, Gold Lake and Forest Hill		1½ "
Waverley and Renfrew		1¼ "
Mooseland, Killag, Liscomb Mill, Richardson, Lower Isaac's Harbour, Wine Harbour and Montague		1 "
Ecum Secum, Middle Isaac's Harbour, Cochran Hill, Lake Catcha, and Oldham,		¾ "
Salmon River		½ "
Caribou at the base of the Slate group.		
Stewiacke about ¼ mile above the base of the Slate group.		

There is no doubt that certain kinds of slate are more favourable to the segregation of gold than others, and that the prevalence or absence of the former, at certain horizons, will necessarily give zones of different richness.

The fact that important mines have already been worked at different horizons, from the top of the series to the bottom, is sufficient proof, that strata favourable to the formation of auriferous veins are met with throughout the whole thickness of the lower quartzite group, and perhaps also in the upper slate group, though apparently less frequently. This is an important fact with regard to deep mining on the domes of anticlines.

The manner in which the strata are bent over the axial lines is worthy of note. The strata in folding do not bend round a centre, to form concentric circles, but their curves are more like parabolas, superimposed upon one another. This is due to the immense lateral pressure which has compressed these beds, especially the slate bands, on either side of the fold, producing a thickening of the strata and openings between them on the apex of the folds.

In a certain thickness of sheets of paper or cloth, bent into an anticlinal fold, a "slipping" of the several layers on each other will take place; the sides of the fold will be tightly compressed, while, on top, openings will be formed. In the same manner in the folding of this great thickness of strata, the beds separated along the planes of stratification, and moved along these planes, the upper bed sliding upward on the lower inclined bed.

This slipping is clearly proved by the striations and slickensides that are to be seen in most mines on opposite bedding planes, and by a certain thickness of crushed black slates or gouge between the walls.

Such movements naturally took place between strata, where the cohesion was slightest, and thus, we find quartz veins following layers of slate, especially when the state is intercalated between thick beds of hard quartzite.

These slips may be considered as fault-fissures along bedding planes, and it is along these fissures that the quartz began to be deposited, and as, usually, these movements were very slow and intermittent and extended over the whole period of folding, the quartz was also deposited very slowly, usually in thin coatings accumulating one over the other, as the fissures widened, until veins of different thickness and extent were formed. The quartz often holds minute scales of slate, peeled off the walls, and subsequently covered over by other layers of silica, giving a banded structure to the veins; while the gold also often occurs in streaks parallel with the banded structure.

The large-scale plans made during the last two summers by the Geological Survey, including the most important districts to the east of Halifax, have brought to light important facts bearing on the relations of the structure of the anticlinal domes to the thickness, extent and auriferous streaks of the quartz veins.

In the case of sharp anticlinal crowns, such as those of Salmon River, Mooseland, the Richardson mine, Fifteen-mile Stream and others, where the dip of both legs of the anticline forms an angle of less than forty or forty-five degrees, large bodies of quartz, called "saddle reefs" in Victoria, are found to occur along the anticlinal axes, and to bend conformably with the bedding.

On the course of the anticlinal axes, the saddle reefs generally keep their size for a great distance, pitching with the strata both ways from the centre of the dome, and eventually pinch out at a certain limit, which may be called the limit of the formation of quartz on the axia line.

They also curve sharply and follow the strata on the north and south dips, but generally thin out much more rapidly on the legs than on the pitch. Many legs have been mined in Nova Scotia to the depth of several hundred feet, and the quartz has still been found of a fair width. In Bendigo, where the folds are on an average, twenty times smaller than in Nova Scotia, the legs of quartz are said to very seldom extend to greater depth than one hundred feet below the cap of the saddle reefs; which would correspond proportionately to 2,000 feet in Nova Scotia.

These saddle reefs in Bendigo, are not only of great size and of remarkable persistence in length, but are also notable for recurring in depth, one below the other.

At the Lazarus mine, Bendigo, there are from the surface to the 2,200 foot level, no less than twenty-four of these saddle reefs, thirteen of which are auriferous to a payable degree, and some of great size.

At Bendigo, on the 31st Dec., 1897, six mines were worked over 3,000 feet in depth, and twelve over 2,700 feet; the deepest, the Landell's 180 mine, was down 3,352 feet, and these were all worked on anticlinal folds.

No operation has yet been carried to any depth, through the crown of the folds in Nova Scotia, but the important developments done along the crown of the anticlinal axes at Salmon River, the Richardson mine, Waverley, Oldham and Mooseland, should be sufficient to convince the most sceptical, that quartz saddle-reefs and legs may be found underneath one another, to even a greater depth than in Bendigo.

The Montreal-London Gold and Silver Development Co., largely composed of Montreal capitalists, which acquired lately the Dufferin mine at Salmon River, is at present sinking on the crown of the anticlinal fold a perpendicular shaft, with cross-cuts and levels, which has reached a depth of over 300 feet. I am glad to call the attention of the meeting to this development, which may be considered the first important step in the introduction of a new system of mining and will, no doubt, be the inauguration of a new era of extensive and permanent deep mining in Nova Scotia.

Few reliable data can be obtained regarding the relative richness of the different parts of the saddle reefs and legs on a sharp fold, but many veins, worked on the apex of the fold, such as the Richardson lead at Isaac's Harbor, the Dufferin lodes at Salmon River, and the Bismarck lead at Mooseland, show that the vein is richer or can be worked with more profit on the saddle than on the legs.

In the case of a broad fold, when the angle formed by the dips on both sides of the anticline is over forty-five degrees, the veins do not acquire any great development along the axial lines, and the enlargements are found rather at a certain distance from the axis.

The thickness of the strata denuded, chiefly since the folding, has already been shown to be very great, reaching on some anticlines eight miles. This superincumbent mass of rock exerted a powerful pressure which has to be taken into account in the folding process. It is evident, that in the sharp folds this pressure has been completely overcome by the lateral pressure, but it has had undoubtedly much influence on the shape of the broad folds and the development of quartz.

This pressure accounts, no doubt, for the fact that large veins are seldom found between strata dipping at lower angles than forty or fifty degrees.

Moreover, on a broad fold, at the surface, important veins are found only at a certain distance from the anticlinal axis, and within a limited zone of strata, AB varying between 200 and 1,000 feet. That is to say, quartz veins were formed on a part CD of the fold, where the combined forces of the lateral and of the downward pressure have determined the greatest strain and have produced most sliding and fissures. The outer limit of the zone A, corresponds generally to a point at which the strata begin to dip at an angle which remains constant for some distance.

Likewise, in depth, quartz veins were formed on that part of the fold which was subjected to the same conditions, and is similarly situated. As the structure of a fold will not change much for some distance in depth, the extreme limits C, D, of the zone of quartz veins will be found at about the same distances from the anticlinal axis of the fold, that is to say, parallel with the axial line EF.

If the fold gets sharper in depth, the zone of quartz veins will approach the axial lines EF downward, and if it gets broader, the zone will recede from the axial line. The distance B E of the zone of quartz veins varies considerably in the different districts according to the flatness of the fold. The axial line E F may also coincide with B D, in a sharper fold, and in a still sharper fold it may come half way between A and B, and we have then the typical saddle-reef fold.

Again, at the surface, in the same district, as at Goldenville, the fold may be sharper at one end and broader towards the other end, and in that case the zone of quartz veins will recede from the anticlinal axis, towards the broader end.

The quartz veins are sometimes very numerous on both sides of the anticlinal domes. On the Goldenville anticlinal domes, where developments have, perhaps, been more extensive than on any other districts in the province, some fifty-five different veins have been worked or uncovered, in a width of strata of 1,300 feet on the north side of the anticline, dipping north at forty-three degrees, and some fifty veins in a width of 500 feet on the south vertical dip of the anticline.

They extend in many cases on the surface for thousands of feet and they have been mined to depths of 700 feet in their vertical extension

The thickness of the veins varies considerably. The saddle reef deposits are by far the heaviest bodies; those worked at Salmon River, Richardson and Mooseland mines attaining fifteen to twenty-five feet in thickness, and others not operated, at Fifteen-mile Stream, Cameron dam, &c., are probably larger.

The veins along the legs of the folds are much smaller, averaging from four inches to one foot, but often larger.

Many quartz veins are also found cutting the stratification at various angles; some are of great thickness, many are auriferous, and a few have been operated with notable profits. They are of later origin generally, than the interstratified veins, and some of them may be roughly contemporaneous with the intrusion of granite. Their richness is generally influenced by the nature of the adjacent strata.

In the interstratified veins the gold is sometimes distributed uniformly over considerable areas; usually, however, it is more or less concentrated within certain limits, leaving spaces on each side, comparatively barren These enrichments are known as pay-streaks, and have hitherto been the principal source of the gold production.

Most pay streaks are well defined enrichments of twenty to sixty feet in breadth, often accompanied by enlargement in the size of the vein. They dip at low, constant angles, parallel generally with the well defined lines of schistosity of the rocks, and often with striations and corrugations on the walls, giving the veins a crumpled structure, locally called "barrel-quartz."

These corrugations and crumplings are more pronounced in the slate and quartz, and owe their origin to the sliding of thick beds of quartzite over one another, between which the softer bands curve and buckle in a wonderful manner. The pay-streaks lie at right angles to the sliding movement, that is to say, approximately parallel to the anticlinal axis.

Many of the pay-streaks have been proved very rich and some have been traced from the surface along a gentle incline for as much as 1,800 feet, with extraordinary uniformity. In many instances, two or three pay-streaks have been determined in the same vein lying parallel under one another for some distance. This mode of occurrence is necessarily limited to the portion of that vein situated in the pay-zone.

The laws governing the position and extent of the pay-ground or pay-streaks are intimately connected with the structure · the anticlinal folds and are similar to those already laid down for the position and extent of the zones of quartz veins. The data necessary to explain their many peculiarities in the different gold districts are difficult to obtain with any degree of precision, as few plans or records have been kept or are obtainable. As a general rule, the best pay-ground, in most districts, is situated at about the middle of the zone of quartz veins A B, where fissures with angular-veins are most numerous. These small angular-veins or "angulars" which run into the walls at different angles, and sometimes connect one vein with the next, play an important part in the concentration or segregation of gold from the adjacent auriferous rocks, and, causing an enrichment or impoverishment of the main veins, they are well called locally "feeders" or "robbers."

In depth also, the zone of pay-ground G G, should be situated at about the middle of the zone of quartz veins G, parallel with the axial line E F.

It will then be readily understood, that one individual vein, if it cannot hold gold in paying quantity to a great depth, may nevertheless, be sufficiently rich to be worked with profit for a great length along certain lines parallel with the anticlinal axis; that a vein barren at the surface B may be rich in depth in the pay zone, and that a vein which does not come to the surface B, may also be found payable on that pay zone G'.

The problem then consists of developing a zone of pay ground or portions of veins included within certain limits, along a plane G G, parallel with the axis E F, and that to depths practically unlimited.

This problem will, I am sure, prove interesting to mining engineers, and it only awaits their skill and knowledge to be put in practical operation and place the Nova Scotia gold-fields among the most productive in the world.

Test of a Two Stage Compressor.

By Mr. JOHN PRESTON, Montreal.

(Paper read before the March Meetings of the Canadian Mining Institute.)

This test was made at the Caledonia Colliery of the Dominion Coal Company, Cape Breton, on August 6th, 7th, 1898.

It was undertaken by the officers and members of the Summer School in Mining of McGill University, in return for the courtesy shown them by the Dominion Coal Company. Owing to the number of simultaneous observations necessary, some of the officials kindly gave their services.

The compressor is of the well known Rand construction of the horizontal type. It is one of the largest in Canada, and the one which the Rand Company exhibited at the Chicago Exposition of 1893.

The diameters of the steam cylinders are 40 and 22 inches, with a 48 inch stroke. The air cylinders are 34 and 22 inches, arranged in tandem with the steam cylinders. The clearance volume of the air cylinders is 0.53 per cent. of the volume swept through by the piston, which is for the Low Pressure Air cylinder 0.133 cubic feet, and for the High Pressure cylinder 0.055 cubic feet.

A very large intercooler consisting of a series of 6-inch pipes is submerged under the floor of the compressor house; through this the air passes on its way from the low pressure to the high pressure cylinder. The purpose of the intercooler is to absorb heat from the air leaving the low pressure cylinder, and to enable it to begin the second stage of compression at as low a temperature as possible.

The air for the compressor enters through an intake trunk 24 x 30 inches in section, passing under the floor to the low pressure cylinder, where it is compressed up to 40 lbs. absolute or 25 lbs. gauge. It then passes through the intercooler to the high pressure cylinder where it is compressed up to 95.5 lbs. absolute. It is then discharged through an 8-inch pipe to the fan shaft and is used for power underground.

The purposes of the test were:—

1st. To determine the number of pounds of air per min. compressed per effective horse-power in the air cylinders and hence the thermal efficiency of the compressor as compared with an ideal compressor.

2nd. To examine the action of the compressor valves.

3rd. To determine the mechanical efficiency, that is, the proportion between the work done in the air cylinders to that in the steam cylinders.

Also incidentally to determine the rate of transmission of heat through the cooling surface of the jackets and intercooler. For the purposes of this test a wooden box 14 x 13⅞ inches, and 12 feet long, was attached to the discharge pipe. All the air was allowed to pass a valve and then escaped to the atmosphere.

Near the end of the box next to the discharge pipe was fitted a fine wire screen to break the flow of the air and prevent eddies, which would otherwise have affected the accuracy of the anemometer observations. To determine the velocity of discharge, both Anemometers and Pitot tubes were used. The Anemometer was placed in the open end of the box and the Pitot tubes in the middle. Unfortunately during the progress of the first test the Pitot tubes were broken. The results of the observations taken with them agreed satisfactorily with those from the Anemometer.

For calculating the weight of the discharged air the humidity of the air had to be known. This was determined from the rapidity with which water evaporated in the air, which rapidity, is measured by the cooling of a thermometer the bulb of which is kept wet.

If then

t = temperature of the air (dry bulb reading).

t_1 = wet bulb reading.

e_1 = maximum pressure of water vapor at temperature t_1, as taken from table in Kholrauch Physical Measurements.

b = height of the reading in m. m.

The actual pressure $e = e_1 - 0.0008\ b\ (t - t_1)$.

The absolute humidity (f) which is the water contained in one cubic meter of air is

$$f = 1.06 \left(\frac{e}{1 + 0.003665\ t_1} \right)$$

= 8.9 gms. per cubic meter.

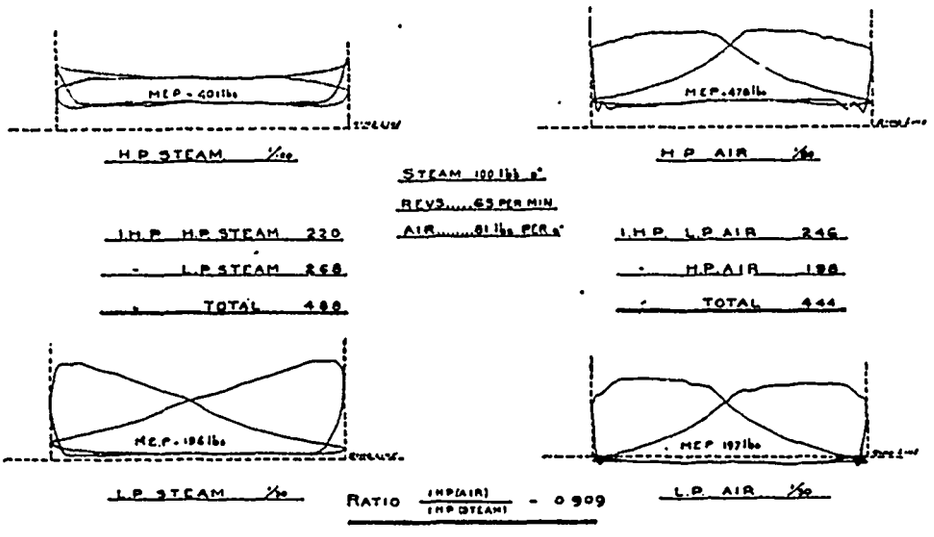
= 0.00538 lbs. per cubic ft.

Therefore at this pressure and temperature 1 cubic foot of air = 0.0651 × 0.00538 = 0.07048 lbs. Barometer readings were taken before and after the trial and the pressure 14.7 lbs. per square inch, was found to be practically constant. This method for calculating the humidity of air is taken from Kholrauch's Physical Measurements.

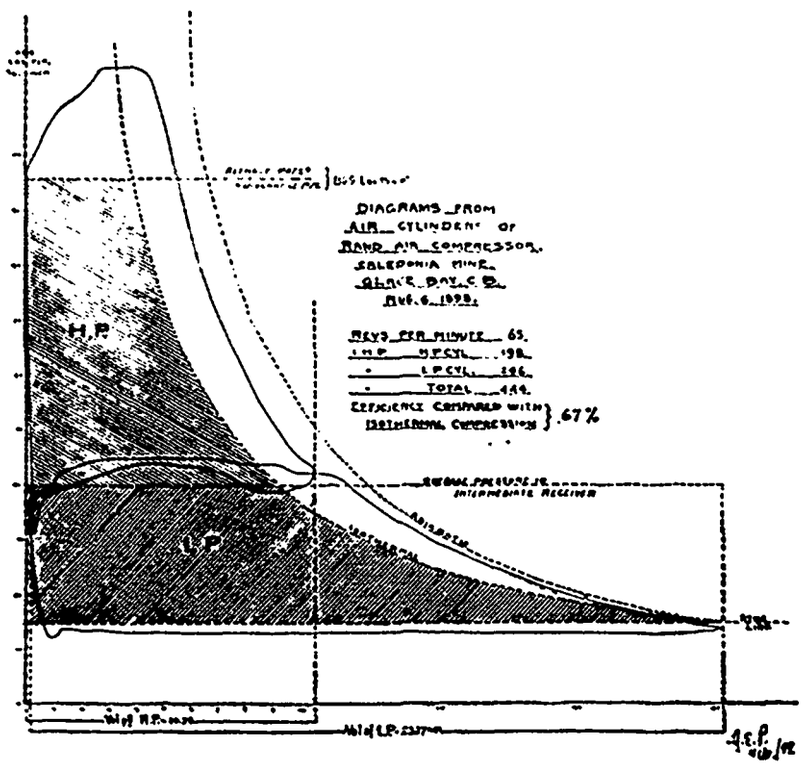
The velocity of the air was taken as 3,300 feet per minute, giving a discharge of 4,427 cubic feet per minute.

The circulating water from the jackets was allowed to run into barrels and weighed. The temperature of the inlet and outlet water being measured by thermometers placed in the flowing water.

The pressure of the air in the intermediate cooler and discharge pipe, and also the steam in the main steam pipe was taken with Crosby gauges, these gauges being afterwards checked with a standard test gauge. Accurate thermometers placed in copper tubes screwed



TWO STAGE
RAND AIR COMPRESSOR
CALEDONIA MINE
GLACE BAY C.B.
AIR CYLINDERS 22" & 34" DIA.
STEAM " 22" & 40" DIA.
STROKE 48"



into the intercooler near the low pressure air cylinder, and near the high pressure air cylinder were used for getting the temperature of the air entering and leaving the intercooler. A thermometer similarly arranged was placed in the discharge pipe close to the high pressure cylinder to get the temperature of the discharge air. Crosby indicators were used on each of the four cylinders. The indicator cards taken from them were measured by the system of ordinates, and a mean card sheet made from these results. In order to obtain mean diagrams representing as nearly as possible the average of those taken during the trial, each card from the air cylinders was measured, the height of the different ordinates tabulated, and the average value of each ordinate obtained. From these numbers a mean diagram was constructed for each cylinder. This mean card was then plotted for both cylinders as in the figure, the abscissae representing volumes, and the ordinates pounds per square inch absolute

In a perfect air compressor the air would be drawn in at atmospheric pressure and compressed isothermally, that is at constant temperature to the desired pressure and finally discharged at the pressure in the main. Under these conditions the work done in compressing a given amount of air would be the least practicably possible.

To get the thermal efficiency from the cards we have—

Area of H. P. Card = 24 Sq. in.
Area of L. P. Card = 24.25 "
Total area of Air Cards = 48.25 "
Area of Isothermal Card = 34.5 "

The corrected area of which is $\frac{13.7}{14.7} \times 34.5 = 32.2$.

So as to compare the two cards from the same pressure—

$$\text{Efficiency} = \frac{\text{Area of Isothermal Card}}{\text{Total area of Air Cards.}}$$

$$= \frac{32.2}{48.25} = 67\%$$

Nova Scotia Gold Yield.

The production of gold in Nova Scotia for the year ended 30th September, 1898, was increased from 26,570 ounces in 1897 to 31,704 during 1898. The following returns of individual operators have been reported for royalty up to 31st December, 1898:—

COMPANY OR OPERATOR	DISTRICT	Gold Yield			Rock Crushed		Months.
		oz.	dwts.	grs.	tons.	cwt.	
Oldham Gold Company (Hardman & Taylor Tributers)	Oldham	710	.....	8	591	10	10
Bluenose Gold Mining Co., Limited	Sherbrooke	3664	.....	.....	10445	.....	12
Stuart-Hardman areas (G. A. Hirschfield estate, sub-lessees)	do	839	18	23	3235	10	12
New Glasgow Gold Mining Co., Ltd.	do	255	.....	.....	1190	.....	4
Sutherland Development Co	do	230	7	17	427	10	11
Crow's Nest Mining Co.	do	161	16	.....	2294	17	7
Touquoy Gold Mining Co., Ltd	Moose River, Caribou	284	1	18	1764	.....	9
Moose River Gold Mining Co., Ltd.	do	254	14	10	2703	14	11
*Colonial Mining Co., Ltd.	do	35	8	12	1100	.....	2
Caribou Gold Mining Co., Ltd.	Old Caribou	94	1	14	302	.....	9
L. W. Getchell (formerly Elk Mining Co.)	do	34	15	.....	173	.....	4
Withrow Mining Associates.	South Uniacke	1622	16	.....	1672	.....	12
Thompson & Quirk	do	57	10	.....	81	.....	2
C. P. F. Mining Associates.	Mount Uniacke	130	14	.....	184	15	4
Sundry Tributers	do	15	19	18	31	.....	.....
Economy Mining Co. (prospectors)	Isaac's Harbor, Stormont	145	3	.....	229	.....	7
Hopewell Mining Co.	Country Harbor, Stormont	11	.....	12	48	.....	2
Richardson Gold Mining Co., Ltd.	Upper Seal Harbor, Stormont	2478	5	.....	24121	.....	12
Modstock Gold Mining Co., Ltd	Forest Hill, Stormont	2167	8	.....	3617	.....	12
McConnell Mining Associates	do	620	17	.....	984	.....	10
Griffin Gold Mining Co., Ltd. (Tests)	Isaac's Harbor	10	4	.....	190	.....	4
North Star Mine	do (west side)	8	11	.....	15	.....	1
Hurricane Point Gold Mining Co., Ltd.	Hurricane Point, Stormont	1932	11	.....	3025	.....	12
Tudor Gold Mining Co. (Tributers)	Waverley	357	2	23	902	.....	9
Old Provincial Gold Mining Co.	Killag	262	18	.....	202	.....	7
Brookfield Mining Co., Ltd.	Brookfield	2659	.....	.....	8020	....	9
Eben N. Higley (sub-lessee)	Renfrew	3	17	.....	37	.....	2
New Egerton Gold Mining Co., Ltd.	15-Mile Stream	588	12	.....	2470	.....	6
Mortared	do	4	5	.....	.....	20 lbs.	.....
Napier Mine.	Wine Harbor	207	8	17	963	.....	12
Essex Mine	Tangier	1108	12	.....	885	.....	5
Arlington Gold Mine Associates	Mooseland, Tangier	83	12	.....	75	.....	4
Townsend Mine (Tests)	Lawrencetown	91	19	12	91	10	.....
George J. Hiseler	Gold River	46	10	4	94	17	5
T. N. Baker	do	564	2	21	116	16	12
Sundry Tributers	Montagu	177	9	12	411	.....	10
Golden Group Mining Co.	do	177	14	.....	335	.....	2
Cashan-Hines Mine	Leipsigate	972	1	}	2869	.....	12
	Silver	91	3	}			
Cogswell Mine	Lake Catcha	239	9	7	232	10	8
John H. Anderson	do	238	8	.....	360	1	4
Walton & Britton (sub-lessees of Kemptville Gold Mining Co	Kemptville	65	19	.....	158	.....	7
A. P. McQuarrie.	Country Harbor, Stormont	26	12	14	140	.....	1
John Yorston	Ecum Secum	59	15	.....	176	.....	8
Parker Douglas Mine, Tributers	Malaga Barrens	1143	.....	.....	750	10	5
Owen Gold Mining Co	Leipsigate	547	10	}	757	4	5
	Silver	77	10	}			
Consolidated Gold Lake Mining Co.	Scraggy Lake	50	.....	.....	204	.....	2
Brignell, Bent & Rhodes (Tests)	Pleasant River Barrens	14	.....	}	99	....	3
	Silver	3	10	}			
Total fiscal year 31,104 oz.		25255	2	11	78743	12	.....
Total calendar year so far reported:—	Silver	172	3	.....	.....	.....	.....

To find the number of British thermal units lost on the cooling surface of the inter-cooler we may check the air delivered per minute through the low pressure cylinder.

The volume compressed is only 24.3 cu. ft. on account of the air left in the clearance space and therefore the weight =

$$24.3 \times 0.0807 \times \frac{13.5}{14.7} \times \frac{461}{541} = 1.53 \text{ lbs. per stroke.}$$

Or $1.53 \times 130 = 199$ lbs. per min.

We have then 199 lbs. of air cooled from 280° F. to 145° F. that is 135° F.

The B. T. U. per minute = $199 \times 0.2377 \times 135 = 6380$.

The number of square feet of cooling surface of inter-cooler is 542.

Therefore B. T. U. lost per minute per square foot of surface is

$$\frac{6380}{545} = 11.7$$

On analysis of the mean card it is seen that—

(1) By increasing the flow of water through the low pressure jacket, the compression curve may be made to come nearer the isothermal.

(2) That the cooling of the air in the inter-cooler is not enough to start the second stage of the compression at a point sufficiently near the isothermal curve to give good results.

(3) That the discharge valves stick, or do not open early enough, thus allowing the pressure in the cylinder to rise considerably above the reservoir pressure and increasing the amount of work to be done by the compressor.

(4) That the low pressure suction valses are not opening sufficiently, this is shown by the fact that the pressure in the low pressure cylinder during the suction stroke is more than two pounds below that of the atmosphere

AVERAGE RESULTS OF AIR COMPRESSOR TRIALS.

1. Date of trial	August 6th, 7th, 1898.
2. Compressor	Rand Two Stage.
Condition of test	Ordinary working.
Dia. and stroke of air cylinders	34" x 48" and 22" x 48".
" " of steam cylinders	40" x 48" and 22" x 48".
Dia. of air piston rods	H. P. = 3.86", L. P. 3.85.
" of steam " "	H. P. = 3.86", L. P. 3.87".
Steam pipe pressure by gauge	100 lbs.
M. E. P., H.P. steam cylinders	40.10 lbs. square inch.
M. E. P., L. P. " "	19.68 lbs. square inch.
Barometric pressure	29.94 = 14.7 lbs. per square inch.
Air pressure in intercooler	25 lbs. gauge.
" " in discharge pipe	80.9 lbs. reduced to atmospheric at end of pipe.
M. E. P., L. P. air cylinders	19.79 lbs. per square inch.
M. E. P., H. P. " "	47.87 " " " "
Mean revolutions per minute	65 " " " "
I. H. P., H. P. steam cylinder	220 " " " "
I. H. P., L. P. steam cylinder	268.4 " " " "
Total I. H. P. steam.	488.4 " " " "
I. H. P., L. P air cylinder	246.5 " " " "
I. H. P., H. P. air cylinder	197.6 " " " "
Total air I. H. P.	444. " " " "
Clearance Vol. L.P. air cylinder, fraction of piston displacement	=.0053=0.133 cubic feet.
Clearance Vol. H.P. air cylinder, fraction of piston displacement	=.0053=0.055 cubic feet.
Piston displacement L. P. air	25.14 cubic feet.
Piston displacement H. P. air	10.51 cubic feet.
Volume of Intercooler	73.6 cubic feet.
Cooling surface Intercooler	545 square feet.
Cooling surface of L. P. jacket	60.29 square feet.
Cooling surface of H. P. jacket	37.09 square feet.
Air leaving lbs. per minute	199.
Rise in temperature L.P. jacket water	4.96° F.
Flow in lbs. per minute	186.1.
Rise in temperature H. P. jacket water	5.3° F.
Flow in lbs. per minute	182.1.
Air temperature leaving L. P. cylinder	268.8° F.
Air temperature entering H. P. cylinder	145.4° F.
Air temperature leaving H. P. cylinder	65 8° F.
Temperature of air at suction	71.7° F.
Temperature of air at wet bulb	65.8° F.
Wt. actually expended per lb. of air compressed.	78 : 800 ft. lbs.
Wt. expended if comp. Isothermally	52,800 ft. lbs. per lb.
B. T. U. per sq. ft. per min. in L. P. jacket	15.
B. T. U. per sq. ft. per min. in Intercooler	11.7.
B. T. U. per sq. ft. per min. in H. P. jacket	25.47.
Ratio $\frac{\text{Air I. H. P.}}{\text{Steam I. H. P.}}$	0.9093.
Eff. compd. with Isothermal Exp.	67 per cent.

COMPANIES.

The Scottish Colonial Gold Fields, Limited.—The following is excerpted from the annual report of the Company under date of 22nd February, 1899:

While the Directors regret that the estimates furnished to them in regard to the profits to be expected from the Idaho mine during the past year have not been realized, they are glad to inform the shareholders that the latest returns received indicate that their confidence in the value of the property has not been misplaced. In the spring of 1898 it became evident that the estimated returns were not to be relied upon, and, in view of Mr. McPherson's return to this country on personal business, the Directors considered it expedient to appoint as their manager one who had a technical knowledge of silver-lead mining. Mr. J. D. Kendall was offered the appointment, which he accepted, and he at once proceeded to the mines, which were then being managed by Mr. Hughes, the owner of an interest in the Idaho, St. John, High Ore and Continental claims, during the absence in England of Mr. McPherson. Mr. Hughes declined to accept the Company's nominee as manager of the whole of the properties, and a dual management was thus constituted. Mr. Kendall advised the Directors that Mr. Hughes was within his legal rights, and suggested one of the three following courses: (1) That Mr. Hughes' interests should be acquired by the Company; (2) That Mr. Hughes should acquire the Company's interests in those properties in which he already owned a share; or, (3) the amalgamation of the properties by an exchange of interests. Mr. Kendall further advised that in the event of the third proposal being agreed on, Mr. Hughes should be appointed manager of the combined properties, and in that event he intimated his willingness to resign.

A deputation of Directors accordingly proceeded to British Columbia, and, after careful investigation of the whole circumstances which had conduced to the difficulties of the situation, negotiations were entered into with Mr. Hughes. The Directors are pleased to state that, as a result of these negotiations, Mr. Hughes consented to a consolidation of the properties on terms which they consider most favorable to the Company, and by this arrangement all questions as to the conflicting interests of parties were satisfactorily settled.

The Directors have pleasure in acknowledging the service of the members of the Board who successfully carried through a transaction which required careful and delicate handling.

Since the consolidation, Mr. Hughes has acted as manager, and has given evidence of his fitness for the post, both by the substantial and satisfactory returns he has made, and by the amount of development work he has carried out. Toward the end of December a snow slide carried away a section of the tramway, which temporarily suspended the shipment of ore, but later advices report that shipping has been resumed. By the erection of an aerial tramway, which is at present contemplated, all difficulties in this direction would be obviated, and the cost of handling the ore would be materially lessened. During last year the concentrator has been altered and improved, new ore-bins and additional camp buildings have been erected, and large sums have been expended on developments and permanent improvements, which have been paid out of the revenue. The properties, which now extend to 554.25 acres, are highly mineralised, and the Idaho Mine at present holds the position of the second largest producer in the Slocan district.

The names and measurements of the claims are as follows:

Idaho	50 24 acres	Victory	14.50 acres
St. John	51.29 "	Daisy	32.74 "
Cumberland	32.74 "	Eastern	24.40 "
Alamo	33.12 "	Hampton	19.46 "
Ivy Leaf	7.33 "	Thistle	8 00 "
Twin Lakes	36.23 "	High Ore	8.00 "
Continental	12.13 "	Tramway	
Edinburgh (formerly the Cedar			
Morning	35.00 "	Current	15c.00 "
Clarence	25.17 "	Detroit	
Total acreage			540.35

NOTE.—In addition, the Mazeppa claim (13.90 acres) adjoining the Idaho, has been recently purchased, as, in the course of development, Mr. Hughes discovered that one of the veins of ore was running in the direction of that claim, and would in all probability pass into it.

The recent satisfactory returns more than justify the expenditure on the properties, to the future success of which the Directors look forward with entire confidence.

The British Columbian books were closed on 30th September, when the consolidation of the properties took place, and the Company's auditors in Edinburgh have considered it incorrect to treat as profit the remittances received from British Columbia since Mr. Stein's audit. Accordingly the sum of £4272, 6s. 6d., which has come to hand since that date, does not appear in the Profit and Loss Account, the balance at the credit of which is £201, 18s. 2d.

As will be seen from the Balance Sheet, the contingent liability for calls on shares held in other companies has been lessened by £6701, 5s.

Sunshine, Limited.—The following is excerpted from the Report to the shareholders submitted on 2nd December, covering a period of 15 months from the date of the incorporation of the company:—"It will be seen that the revenue accounts showed profit balance of £673 9s. 0d. This profit is over and above the whole cost mining for 15 months, including all cost of the development of the mine, none of which has been charged to capital, and is substantially the result of eight month's production, ending on 28th April, 1898. At this date the Directors determined temporarily to confine themselves to pure development, leaving all ore in place pending the completion of the new tunnel. There would otherwise be no difficulty in producing during the last three months ore, the clear profit of which would have been ample to pay the 10 per cent. dividend on the preference shares issued. Smelter returns show that 650 tons, 1,385 lbs., gave a net yield of $68,134.57 from the 'Silver Cup' mine.

Lillooet, Fraser River and Cariboo Gold Fields, Limited.—Excerpt from Director's Report submitted on 15th December last:—"The statement of income and expenditure for the year shows a debit balance of £3,387 2s. 10d., of this sum £848 4s. 10d. represents abnormal expenditure in connection with the enquiry and reorganisation, leaving £2,538 18s. as the year's expenditure in excess of income. This sum of £2,538 18s. may be considered as being in reality still further reduced by the balance at the credit of income and expenditure account of the Sunshine,

Limited, in which your company holds a large interest. The invested funds of the company immediately realizable, together with cash in hand, amounts to about £50,000. No fresh claims or mining properties have been acquired during the year. During the past year some little work has been done on the company's properties in the Lillooet and Boundary Creek districts, and the necessary expenditure has been incurred to hold the claims retained in the Trail Creek and Kamloops District."

Smuggler Gold Mining and Milling Company, Limited.—At the last general meeting of shareholders it was decided to increase the capital of the company by an addition of 200,000 shares at a par value of $1.00, 100,000 shares of the new stock to be offered to the shareholders at 6 cents per share. The mine has been equipped with a 20 stamp battery and other plant.

British Columbia Gold Fields.—An extraordinary general meeting of the holders of the Deferred shares in the London and British Columbia Goldfields, Limited, was held at Cannon Street Hotel, E.C., Mr. Oliver Wethered presiding, for the purpose of considering and, if thought fit, passing the following resolution: "That the draft of an intended agreement proposed to be made between the London and British Columbia Goldfields, Limited, and its liquidator of the one part and a new company, intended to be incorporated and to be called the London and British Columbia Goldfields, Limited, of the other part, and the draft memorandum and articles of association of the said intended new company having been respectively submitted to the meeting, and identified by the signature of the chairman of the said meeting, this meeting hereby gives on behalf of all the holders of Deferred shares of the company its consent to the following variation or abrogation of the rights of the deferred shares in the winding-up of the company—namely, that in case the company be wound up and reconstructed upon the terms of the said intended agreement the holders of the shares of the company shall be entitled to the following rights in lieu of their present rights, that is to say: Every holder of deferred shares shall be entitled to 16 shares of £1 each, credited as fully paid in the capital of the new company, in respect of each deferred share held by him, and every holder of ordinary shares shall be entitled to one fully-paid share of £1, credited as fully paid in the capital of the said new company, in respect of each ordinary share held by him."

The Chairman said:—You will have gathered from the circulars--or, more particularly, the last circular—that it is necessary to hold three meetings to carry out the proposed arrangements, the first being that of the deferred shareholders. I should like very briefly to remind you that these meetings are called as a consequence of the unanimous expression of opinion made in this building when we held our ordinary meeting. I then asked for an informal vote, as some shareholders thought it would be very desirable to convert the deferred shares; and, that vote being unanimous, I, on behalf of the directors, gave a pledge that we would endeavour to carry out the wishes expressed, provided they could be carried out on what we considered to be equitable terms. To avoid unnecessary expense as a preliminary course, we invited representative shareholders of both classes—by representative I mean holders of large numbers of shares to attend meetings, at which we obtained expressions of opinion which justified us, and, in fact, compelled us, to call these meetings to-day. The basis agreed upon by the holders of the majority of the deferred shares is that sixteen shares in the new company should be given for each deferred share. Some of those who were present at the informal meeting I have mentioned thought the proportion of twenty to one would be a reasonable figure, while others thought twenty-five to one; but ultimately we got the holders of the great majority of the shares to agree, as I have said, to sixteen to one, and I hope we shall unanimously decide to-day, as deferred shareholders, to convert on that basis. I do not think I need trouble you with any more remarks on the subject, and therefore I will move the resolution which you have heard read; but before putting it to the meeting I shall be pleased to answer any question you may desire to ask.

Mr. Popkiss seconded the motion.

The Chairman added that the memorandum and articles of association of the new company, as well as the agreement referred to in the resolution, were on the table for the inspection of shareholders.

Mr. A. J. Shepherd asked whether it was really necessary to go into liquidation in order that the proposed arrangement should be carried out.

The Chairman: Yes, we were advised by our solicitor and, in addition, by Mr. Buckley, who, I suppose, is the greatest living authority on company law, that it is the only practicable way. There are other ways, but they are very cumbersome. The present arrangement involved a little expense, but it is very desirable that this course should be taken.

The motion was carried unanimously.

A meeting of the ordinary shareholders was then held.

The Chairman proposed a resolution in similar terms to that passed at the meeting of deferred shareholders.

Mr. Popkiss seconded the resolution.

The resolution was carried unanimously.

An extraordinary general meeting of the company was afterwards held, at which the Chairman proposed the following resolutions, viz.: (1) "That it is desirable to reconstruct the company, and, accordingly, that the company be wound up voluntarily, and that Mr. E. R. Tasman be, and he is hereby, appointed liquidator of the purposes of such winding up." (2) "That the said liquidator be, and he is hereby, authorised to consent to the registration with a memorandum and articles of association in the form of the draft submitted to this meeting, and identified by the signature of the chairman of the said meeting." (3) "That the draft agreement submitted to this meeting and expressed to be made between this company and its liquidator of the one part, and the new company of the other part, and identified by the signature of the chairman, be, and the same is hereby, approved, and that the said liquidator be, and he is hereby, authorised, pursuant to the powers conferred by Section 161 of the Companies Act, 1862, and the articles of the company, or some of such powers, to enter into an agreement with such new company when incorporated in the terms of the said draft, and to carry the same into effect, with such (if any) modifications as he may think expedient."

Mr. Popkiss also seconded these resolutions, which were agreed to.

The proceedings then terminated.

Payne Consolidated Mining Company, Limited.—Application is being made for new charter by this Company under B. C. Statutes. Under the reorganization each share will carry with it a bonus of one share, and the remaining 500,000, the capital being $2,500,000, will remain in the treasury. The directors of the reorganized company will be Messrs. W. L. Hoge, banker, of Anaconda, Montana; A. W. McCune, owner of the Salt Lake City Street Railway System; F. L. Sargent, also of Anaconda; James Ross, Hon. L. J. Forget, Wm. Hanson, Col. F. C. Henshaw and Clarence J. McCuaig, the last five being the Canadian members of the board. It appears likely that the presidency of the Payne will be offered to Mr. W. L. Hoge, who has hitherto managed the affairs of the mines with so much success. Recent advices show that the shipments from the Payne from the first of the year to March 14th, had reached 2,388 tons, with an average of $52 per ton, after deducting charges for freight and treatment as well as duty. This nets $125,000, or about $50,000 a month. Mr. C. H. Hand, the chief manager of the Payne Consolidated, also reports the showings in the different levels to be of the most satisfactory kind, and such as to warrant the belief that Montrealers now control one of the richets property in British Columbia.

Dominion Iron and Steel Company, Limited.—This is the new company which proposes to engage extensively in iron manufacture in Cape Breton and for the incorporation of which a Bill is now before the Legislature of Nova Scotia. The Provisional Directors are H. M. Whitney, Boston; Henry Dimock, New York, and Messrs. B. F. Pearson, A. Paget and W. B. Ross, Halifax. The capital stock of the Company is $10,000,000 in shares of $100.00 each, with power to increase to $20,000,000.

Mikado Gold Mining Co.—Result for February: Mill ran 22 days, crushed 893 tons, producing 316 ounces of gold. Cyanide treated, 387 tons, yielding 100 ounces of bullion.

Whitewater Mines, Limited.—Cable to head office under date March 9th, reports: "During February 2,445 tons have been milled, producing 276 tons concentrates; have shipped 285 tons. Returns from the smelter on 242 tons amount to $12,590. Appropriate profits on month's working is $4,250; does not include 15 tons of carbonates, $281.

Canadian Goldfields Syndicate.—The second annual meeting of the shareholders of the Canadian Goldfields Syndicate, Limited, was held recently at Queen's Hotel, Toronto. The President, Dr. R. J. Wilson, occupied the chair. The managing director, Mr. J. C. Drewry, of Rossland was also present, and a large number of shoreholders. Mr. J. C Drewry presented the directors' report for the year, giving a detailed account of the work which had been done on the company's properties during 1898. The most important feature of the report referred to the development which had taken place on the 350-ft. level of Sunset No. 2. A good pay ore chute has been opened up on this level for 200 ft.; and work was being pushed from a cross-cut from the 350-ft. level of No. 1 vein to a point under the discovery shaft on the discovery vein, which lies 320 ft. south of No. 1. A strong stringer of good ore had been disclosed on the surface just north of the discovery shaft. The stringer was intersected by a cross-cut last Sunday week at a depth of 400 ft., and there proved to be 3 ft. in width of solid ore, averaging $14 per ton in gold alone. This cross-cut has yet to be driven about 30 ft. to reach the discovery ledge. On the surface the discovery ledge carried very high-grade ore, the samples assaying from $50.90 to $91.30 per ton. It is expected that this ledge will show a large ore chute when intersected by the cross-cut. All of the company's properties are fully paid for and Crown granted. Development work is progressing day and night, with most encouraging results. Two trial shipments of ore were made to the Trail smelter for the purpose of finding out the actual value of the ore in commercial quantities. The smelter returns were $19 90 per ton, which shows, it was claimed, that Sunset ore is of equally good grade with that of any of the now famous dividend-paying properties in the Rossland camp. Under the company's charter three of the directors retire each year, but are again eligible for office. This year the retiring directors were Dr. R. J. Wilson, J. K. Kerr, Q.C., and Albert McGarvey. They were re-elected to the board, which now consists of these three and Thomas Wolson, Alex. Pridham, John W. Graham, Sidney P. Wilson, Robert Davidson, W. A. Charlton, M P.P., and J. C. Drewry. At a meeting of the board of directors, which was held subsequently to the meeting of shareholders, Dr. R. J. Wilson was re-elected president, Alex. Pridham vice-president, and J. C. Drewry managing director. The directors announced that ample funds have been provided to carry on active development work, not only on the 350 ft. level but also to continue the main shaft down to the 500 ft. level, and open up the rich ore shute, which is considered to be already proved in the upper workings.

Canada Mining and Metallurgical Co., Limited.—This is a new company which seeks incorporation by act of the Dominion Parliament with a capital of $5,000,000 in 50,000 shares of $100, to carry on operations, it is understood, principally in the Sudbury nickel and copper district, where work is now being carried on. The provisional directors are to be Robert M. Thompson, New York; John J. Thompson, Bayonne, N. J.; J. R. Wilson, Montreal; C. C. Colby, Stanstead, Que.; R. G. Leckie, Truro, N.S.

Hall Mines, Limited.—For the four weeks ending 6th March, 2,458 tons of ore were smelted, yielding 54 tons copper and 36,890 ozs. silver.

Standard Mining and Reduction Company.—This company has been incorporated under the laws of Maine, by Worcester, Mass., people to work the MacNaughton mine at East Rawdon, Nova Scotia. The capital stock is $500,000, and headquarters are in Worcester. Archibald G. MacDonald, a Nevada mining man, is president of the company; Wilber W. Hobbs, of Worcester, treasurer; John H. Johnson, vice-president; Matt. W. Alderson, the cyanide expert, is consulting engineer. The prospectus of the company states that the property consists of 371 mining areas, comprising 310 acres, situated about 40 miles north of Halifax. The buildings include a 25 stamp mill. Some of the ore is in arsenical pyrites, and part of the new equipment of the mine will be a cyanide or other plant to recover the values from the tailings remaining from former operations.

Nova Scotia Steel Company.—It is reported that an arrangement has been concluded with H. M. Whitney, of the Dominion Coal Company, by which the large iron ore areas owned by the Nova Scotia Company on Belle Isle, in Conception Bay, pass into his control. It is estimated that the total deposit of ore is 50,000,000. The property will be equipped with modern machinery, and according to report a large furnace will be erected near the mines of the Dominion Coal Company, at Cape Breton.

British Pacific Gold Property Company, Limited.—This company with $5,000,000 capital, has been organized to develop claims, amongst them the York Group, containing bodies of gold-bearing sulphide ores, near the mouth of Bear River on Vancouver Island. The company also owns claims in other parts of Vancouver Island and in Yale and East Kootenay Districts of British Columbia. Some of these claims carry bodies of pyritic copper-gold ores, while others carry galena, with silver and gold. The principal office is in Victoria. The officers are: President, Alex. J.

McLellan; vice-president, R. T. Williams; directors, T. R. McInnes Victoria; W. H. B. Aikins, Toronto; D. Lowrey, Brantford; B. M. Britton, Kingston; Geo. Gillies, Gananoque; Frank Dowler, Guelph; A. T. Watt, Esq., Frank Hall, Esq., Moses McGregor, Chas. Hayward, Lawrence Goodacre, James Muirhead, R. Erskine, E. A. Morris and Geo. Powell, of Victoria, and A. B. Erskine, of Vancouver; consulting mining engineer, Wm. M. Brewer, Victoria.

British Columbia Copper Company, Limited.—The officers of this company inform us that the company was incorporated in March, 1898, under the laws of the State of West Virginia, and registered in April, 1898, under the Companies' Act, 1897, of British Columbia, as required for foreign corporations doing business in that Province. The capital stock is $1,000,000, in 200,000 shares of $5 each, which have been issued, and are non-assessable. The property owned is the Mother Lode, Offspring Fractional and Primrose mineral claims, situated in Deadwood Camp, near the town of Greenwood, B.C., about 7 miles north of the boundary line. The directors are Paul Babcock, C. E. Laidlaw, H. L. Horton, F. L. Underwood and J. F. Tichenor. The board will organize in a few days. Messrs. Laidlaw & Co., No. 14 Wall street, New York, are registrars of the stock, and Frederic Keffer, of Anaconda, B.C., is manager of the property and the company's agent and attorney in that Province.

The development work consists of numerous shafts and cuts along the ledge for over 1,000 ft., and a tunnel across the ledge at a depth of about 100 ft., which shows the vein to be 185 ft. wide. From this tunnel a winze was sunk 100 ft in depth and a crosscut run from foot of same about 70 ft. to the hanging wall and 12 ft. toward the footwall, which shows over 60 ft. of pay ore. This work was all done for prospecting purposes and was stopped by water. It proved to the satisfaction of the managers, however, that they had a large mine, and they immediately installed a working plant, consisting of engines, boilers, hoist, 10-drill air compressors and electric machinery suitable for sinking to a depth of 1,000 ft. At a point 550 ft. distant from these workings they are now sinking a new working shaft 8 by 12 ft., which has reached a depth of 220 ft., the last 70 ft. being in pay ore, averaging from 5 to 6 per cent. copper and $6 to $8 in gold. At 200 ft. they are cutting out a station, preparatory to crosscutting. A drift run at this depth on the vein will be 170 ft. deeper than the old workings above described when it reaches a point under them. The company had in the treasury January 31st, $20,000 cash, after allowing for all unpaid accounts, and in addition a large amount of treasury stock for sale to meet the future development of the property and its equipment with a reduction and smelting plant. The Canadian Pacific Railway has surveyed its Crows' Nest Pass line to within 200 ft. of the property, and the vice-president of that company states that the road will be completed to Greenwood, about 3 miles from the mine, within 90 days.

Lightning Creek Gold Gravels and Drainage Company, Limited.—At the meeting at Ashcroft, on February 6th, James Reid, C. H. Unverzagt and H. W. Moore were elected trustees. Senator Reid, succeeding Dr. Reynolds, was elected president; Charles H. Unverzagt, vice-president; H. W. Moore, secretary and treasurer, and O. Harvey, auditor. The report of the work of constructing the drain tunnel on Lightning Creek shows some 1,600 ft. completed and that the work was being pushed with three shafts. In addition, a shaft is being sunk some distance ahead of and in line with the tunnel, which will drain the bench and assist in determining the depth of the old channel and its exact location. The report showed the company free from debt and in condition to complete the preliminary work of drainage and prospecting.

Gold Quartz Mining Company.—At the meeting of this company on Feb. 14th, the old board was unanimously re-elected, as follows: President, J. M. Staebler, ex-Mayor and President Board of Trade, Berlin; 1st vice-president, J. Tolmie, M.P., manager Ontario Peoples' Salt Co., Kincardine; 2nd vice-president, William Dynes, ex-M. L. A. Dufferin County, Shelbourne; treasurer, William Maguire, merchant, Toronto; manager and secretary, E. H. Hillborn, president Ontario Peoples' Salt Co., Toronto. Directors—J. Curry, financial broker, Toronto; S. M. Hay, M.D., surgeon Western Hospital, Toronto; W. P. Page, manager Sun Savings and Loan, Toronto; auditor, H. Parmly.

The report of the manager on the work on their Tache property was most satisfactory to the meeting.

Four assays have been made from the quartz at a depth of 14 feet, showing the following results: $64.20, $84, $93.60, and $100.80 per ton. The vein materials is a mixture of sugar quartz, blue schist and hornblend, all heavily charged with mineral, the mineral increasing with every sink that is taken out. The vein is seven feet in width at the surface with clearly defined walls, the north wall sinking perpendicularly, while the south wall dips at an angle of some 15 degrees, causing the vein to widen.

Since Mr. Hillborn returned to Toronto, the sale of the stock has increased rapidly, and since 31st of December has realised some $4,500, leaving the company with no liabilities, and a net surplus of about $5,000 to its credit, which, together with 40,000 shares set apart for the London market, and now practically closed, will raise the surplus to some $9,000.

According to the report the company is out of debt with valid assets of over $8,000, added to a cash surplus of $9,000, and an untouched reserve of one and a half millions of treasury stock.

Economy Gold Mining Company.—This Company is operating the Skunk's Den mine, Isaac's Harbor, N.S. Latest returns show yields of 106 and 160 ounces.

Dominion Coal Company, Limited.—The following are the shipments by months for the past three years:—

	1898.	1897.	1886.
March	26,900	24,000	9,171
April	23,500	32,000	30,315
May	124,930	105,000	112,544
June	158,500	145,000	152,409
July	175,400	173,100	168,839
August	165,800	159,000	149,532
September	163,200	161,600	149,367
October	140,000	150,100	131,541
November	67,900	70,000	63,089
December	37,398	50,000	47,001
January	37,300	22,800	29,758
February	37,000	14,900	24,200
Totals	1,157,827	1,107,500	1,068,029

Richardson Gold Mining Company.—This Company's mill at Isaac's Harbor, N.S., which has been shut down for repairs, started up again last month, the yield being reported at 307 ounces.

Cape Breton Copper Co., Limited—The management informs us the capital stock is in 200,000 shares of which 105,000 are in the treasury. It is proposed to underwrite this treasury stock for $10 per share, the par value, and offer it to the public on that basis, the proceeds to be used in developing the property and building a smelter, so that eventually 600 tons of 4½ per cent. copper ore can be made into matte daily. At present work at the mine is limited to repairs at the shaft and about the machinery. The company expects, when started, to handle 100 tons of ore daily at first.

Foley Gold Mining Company.—This Western Ontario company is being reorganized and work on the mine is expected to be resumed in May.

Golden Star Mining & Exploration Company of Ontario, Limited.—The first clean up of this Company was 49½ lbs. of bullion worth $9,300; the second clean up January 1st, 1899, was $6,794 in bullion and $3,000 (estimated in concentrates). Since January 1st, no clean-up has been shipped, but the superintendent reports a production of $3,000 per week in bullion. After some additions now being made to the plant have been put in, it is estimated the production will be at least $5,000. The present 10 stamp battery is to be increased to 30 stamps. At the general meeting of the company on 25th January last, Messrs Hall and Hughes and Associates, consented to permit a sufficient amount of the output of the mine to be set aside to declare a dividend of one per cent. on the par value of the stock and the management confidently expect that such dividend will be repeated at intervals of 60 days at least, until these gentlemen have been reimbursed on their contract, thereafter a monthly dividend will be paid for such an amount as will take up the entire amount of the earnings of the mine.

LAKE OF THE WOODS.

The past month has been marked by a renewed activity in mining matters, resulting of course in a more optimistic feeling on the part of those interested in mines and mining. This fluctuating condition of the estimation in which our mineral wealth is held appears to be chronic with us, and is largely due to our being dependent so much upon outside people for the development of our mining prospects. At present there appears to be strong feeling, supported by considerable evidence, that during the coming summer, our district in common with other parts of mineral Ontario, is to receive a large share of attention from outside capitalists interested in gold mining. In the meantime, I am able to report solid advancement, by the establishing of two new mining camps, one on mining location D 233, immediately adjoining the Mikado on the east, by the Bullion Mining Company, and the other on one of the Toronto and Western Cos. properties in the same neighbourhood. This move on the part of the Bullion Company is the result of Mr. Rogers, the manager's recent trip east. He reports the selling of all the stock he cared to dispose of for present purposes of development of their many properties. A steam hoist and a compressor plant has been ordered, and the work of sinking a shaft will be pushed as hard as possible.

There are numerous accounts of parties going out to examine mining properties, and altogether there is promise of this season being much better than last, especially in the important matter of actual mining.

Sultana.—It is reported that Mr. Caldwell, the owner, has under consideration the addition of thirty stamps to his present battery of thirty. The cost for mining and milling at present is said to be $1.82 per ton.

Regina.—Sinking is going steadily on; a drift is being run into the face of the bluff at the shore a few hundred feet east of the mill, on a quartz lead. Sir Henry Wilkinson has gone on a short business trip to England. The output of this mine for the month of January is reported as 615 tons, yielding $7.40 per ton.

Mikado.—There has been a change in the staff, by the resignation of Mr. Breidenbach, who it is said goes to the Toronto and Western, and the appointment of Mr. McMillan, formerly assistant manager to the vacated chief position. Mr. Pengilly has charge of the milling and cyniding. Work was recently stopped in No. 2 shaft and levels, and a number of miners and others discharged in consequence; it is said, however, that work will begin again shortly.

Scramble.—W. M. Strong, M.E., late manager of the Foley Mine, Mine Center, has been making an examination of this property for some parties, said to be an English Syndicate, but at the same time it is reported on good authority that a Toronto mining man largely interested in this New Ontario has secured a controlling interest in the stock of the old company or syndicate. At any rate this new move excites the hope that work may soon start up again at the Scramble.

Bad Mine.—The deal between the owners and Messrs. Armstrong *et al* fell through, technically, and since the date of expiration of the option no work has been done. Negotiations are however, in progress, from which it is hoped that a transfer of the property to the late optionees will be effected. The adit run into the side of the hill to strike the vein, cut it a few feet below the bottom of the old shaft, or about 70 feet from the top of the shaft. This adit or drift was 125 feet in when it met the vein, and it is 6 feet 6 inches high and 4 feet 6 inches wide, was driven by three shifts of single hand drillers, two on a shift, and the cost was about $8.00 per foot, the rock being a granite.

Stella.—This mine is being started up again under Neil Campbell's superintendence.

Triggs.—The balance of $5,000.00 lately paid on this property made the total amoudt $7,000, $2,000 being paid in the autumn of 1897. Work in the shaft has been resumed, and a large quantity of ore is to be hauled out to the head of Witch Bay, ready for shipment to some of our Reduction works in the spring.

The Beck.—Mr. Beck continues operations on this property, which is immediately south-west of the Triggs; he recently paid in an instalment of one-eighth of the bonded price, viz., $500.00, in consideration of having the option extended to June 1st.

The Lizzie Mine (Virginia Co.)—The shaft is down over 100 feet, and the present contract will take it to the 137th foot; the vein is good and strong, and the values are all right; they are getting out 1,000 cords of wood.

The Boulder.—The shaft is down 160 feet and the vein is showing up well. It will be remembered that this mine is equipped with a compressor plant.

The Sirdar.—They expect to be down 200 feet by the end of March, at this point drifting will commence. The vein is looking well.

The Echola.—Shaft down 40 feet, on a good strong lead.

The Sentinel.—The shaft is now down 135 feet, with a cross-cut to the foot wall at 130 feet, showing the fissure to be over ten feet wide. A very strong flow of water was encountered at the present depth, which it is difficult to cope with, without a steam pump. Mr. Eagen, manager of the company, is now at Rat Portage.

The Nora.—There is a strong probability that work will be resumed at this mine before long.

Hay Island The discovery of gold on this island in 1883, by Frank W. Moore, was the first discovery of the yellow metal on the Lake of the Woods. A company was organized, shaft sunk, and some good milling rock mined. From some cause work was discontinued, and from the low level at which the shaft was started and the rise of the lake level it appears that even the location of the old workings was lost. About two years ago the members of the James Cooper Manufacturing Co of Montreal, got control and began operations with a view to the recovery of the lost vein. They sank on high ground 100 feet deep and ran exploring levels, but failed to find the lead, and after spending about $15,000.00 it is said, gave up the quest, and retired in a frame which can be easily imagined, taking their plant with them. Mr. Rogers, of the Bullion Company, on his late visit to Montreal met Mr. James Cooper, and as a rejoinder to the pessimistic views put forth by that gentleman offered to find the vein for the sum of $500.00. It was a bargain and upon Mr. Rogers' return to Rat Portage, Mr T. E. Smith was set to work with his diamond drill; the machine was set up on the ice of the lake and in a few days, and at a cost of $275.00, the lost vein was located and proved to be 10 feet wide at that point, the gangue assaying about $12.00. The gentleman in Montreal was pleased of course, and he telegraphed his congratulations to Mr. Rogers What will be the sequel has not yet transpired, but there are no doubt several old and abandoned properties about the Lake of the Woods where a little judicious prospecting would be attended with almost if not quite as happy results.

Engledue Concessions.—The English syndicate exploiting these after two years axplaritory work at an expense of $45,000.00, have decided to discontinue operations it appears, and are now advertising their prospecting outfit for sale. The whole history of this venture is of much interest to our mining men, and a long and interesting article might be written on it, but these "notes" are not exactly the place for that. It is a great pity however, that Englishmen in general are not better informed about Canadian business affairs. If for instance the members of this syndicate had known that any one was free to explore anywhere for minerals in our mining districts and have his discoveries protected, they would not have paid for the privilege of prospecting on two limited areas, such as sections A and B. Since they began operations many rich finds have been made in the District, notably at Sturgeon and Deer Lakes, on the Pipestone, at the New Klondike and the Manitous, and amongst the properties owned by the Toronto and Western Co. That $41,000.00 would have kept twenty parties in the woods during the two seasons, who could have prospected a large part of the District, at any rate the most likely parts of it, and undoubtedly they would have secured their share of the good things that were being discovered.

J. M.

Rat Portage, March 18th, 1899.

MINING SOCIETY OF NOVA SCOTIA.—The annual general meeting of the members of this representative Society will be held in the Halifax Hotel, Halifax, on Wednesday, 12th April, commencing at 10.30 a.m. Among the papers to be presented we notice: "Notes on the Cumberland Coal Fields," by Mr. J. R. Cowans, Springhill; "On the Discovery, Uses, &c, of the rare mineral 'Wolfram' or 'Tungsten'" recently found at Margaree, Inverness County, N.S., by Mr. A. C. Ross, Sydney, C.B.; discussion on Mr. E. R. Faribault's paper "On the Gold Measures of Nova Scotia and Deep Mining," presented at the meeting of the Canadian Mining Institute. The annual dinner will be held in the Halifax Hotel in the evening.

CANADIAN SOCIETY OF CIVIL ENGINEERS' BILL.—The Bill was given a hearing before the Legal Committee of the Ontario Legislature, on Monday afternoon 27th March. Mr. Armour, Barrister, Toronto, presented the views of the Society, which was represented by a strong deputation. Mr. B. T. A. Bell, and Mr. Eugene Coste, appeared on behalf of the Canadian Mining Institute. Mr. Bell opposed the Bill as an invasion upon the rights and practice of the mining engineering profession in Ontario. The Bill was given the twelve months' hoist.

GENERAL MINING ASSOCIATION OF THE PROVINCE OF QUEBEC.—The annual meeting of the members was held in the Windsor Hotel, on Wednesday, 1st March. Officers were elected for the ensuing year, and the Report of the Council and financial statement adopted.

Chicago mica people are reported to have recently obtained extensive options on mica lands in Ottawa County, including the Nelles mine, Dr. Guay's mine in Wakefield and the Murphy lots in Templeton.

The total royalty on coal collected by the Government of Nova Scotia last year amounted to the snug sum of $227,000. This is $100,000 or so more than it was ten years ago Premier Murray estimates that there will be an additional increase of $100,000 in five years. The REVIEW is of opinion that within three years the increase will be more than the sum named by the premier. This year the increase over last should be between $55,000 and $60,000. If nothing goes wrong with the ovens at Everett the increase next year should be $50,000 over this year from the sales of the Dominion Coal Co. alone. The biggest contributor of royalty is of course the Dominion Coal Co., which tops the list with $129,530. The Cumberland Railway and Coal Co. comes second with $27,445; the General Mining Association third with $24,615; the Intercolonial Mining Co. fourth with $19,941; the Acadia Coal Co. fifth with $11,515, and then in order come Canada Coals & Railway Co., $6,680; Burchell Bros., $546; North Sydney M. & T. Co., $200; while the Broad Cove Coal Co. paid $100.

INCORPORATED BY ACT OF PARLIAMENT.

ANNUAL MEETINGS OF THE

CANADIAN MINING INSTITUTE

VALUABLE PAPERS AND INTERESTING DISCUSSIONS

British Columbia to be the Next Place of Meeting

The first annual meeting of the Canadian Mining Institute was held in the Club Room, Windsor Hotel, Montreal, on Wednesday, Thursday and Friday, 1st, 2nd and 3rd of March. The attendance, particularly of members from a distance, was distinctly good. Among others we noted:

Mr. John Hardman, S.B.M.E., Montreal, President; R. G. Edwards Leckie, M.E., Rossland, B.C.; Dr. G. M. Dawson, C.M.G., Director Geological Survey, Ottawa; Dr. Robert Bell, Assistant Director Geological Survey, Ottawa; John McLennan, Dominion Coal Co., Boston; H. M. Whitney, Dominion Coal Co., Boston; Charles Fergie, M.E., Intercolonial Coal Co., Westville, N.S.; George W. Stuart, M.E., Truro, N.S.; S. F. Andrews, Economy Gold Mining Co., Country Harbor, N.S.; Bernard MacDonald, M.E., Dufferin Mines, N.S.; James D. Sword, M.E., Rossland, B.C.; W. T. Smith, Greenwood, B.C.; Dr. A. R. Ledoux, New York; H. D. Lawrence, Sherbrooke, Que.; John J. Penhale, Black Lake, Que.; James F. Lewis, Rand Drill Co., Chicago; Mr. James Douglas, M.E., New York; Professor B. J. Harrington, McGill University, Montreal; Major R. G. Leckie, M.E., Sudbury, Ont.; J. W. Evans, C. & M.E., Sudbury, Ont.; G. F. McNaughton, 15 Mile Stream, N.S.; C. C. Hansen, Montreal; B. F. Peacock, Montreal; D. Smith, Kingston; George E. Drummond, Montreal; R. W. Brock, Geological Survey, Ottawa; Wm. Hamilton, Jr., Peterborough, Ont.; Dr. James Reed, Reedsdale, Que.; A. C. McCallum, Peterborough, Ont.; J. M. Jenckes, Sherbrooke, Que.; A. W Fraser, Ottawa; Lt.-Col. J. Wright, Ottawa; Geo. S. Davison, Ottawa; E. D. Ingall, A.R.S.M., Geological Survey, Ottawa; George MacDougall, Montreal; Frank Plummer, Montreal; Francis T. Peacock, Montreal; A. E. Hogue, Edmonton, N.W.T.; C. H. Bowen, Sherbrooke, Que.; Thos. J. Drummond, Montreal; C. E. Morgan, Toronto; E. Strachan Cox, Toronto; Robert Meredith, Montreal; J. F. Piggott, Montreal; J. Obalski, Inspector of Mines, Quebec; Eugene Coste, M.E., Toronto, Ont.; Jas. A. Macdonald, Greenwood, B.C.; J. F. Higginson, Buckingham, Que.; Hugh C. Baker, B.A.Sc., Perkins Mills, Que.; Russell Blackburn, Ottawa; W. J. Nelson, Intercolonial Coal Co. Montreal; F. T. Snyder, Peterborough, Ont.; Prof. W G. Millar, Kingston, Ont.; J W. Craig, School of Mining, Kingston; J. H. Walsh, Sherbrooke, Que.; George J. Ross, Rat Portage, Ont.; J. Burley Smith, M.E., Winnipeg; H. W. DeCourtenay, Montreal; F. Bacon, Montreal; A. W. Stevenson, C. A., Montreal; W. T. Bonner, Montreal; D. W. Robb, Amherst, N.S.; Dr. H. M. Ami Geological Survey, Ottawa; J. F. Latimer, Toronto; Alex McNeil, Halifax, N.S.; Dr. W. A. P. Tiernan, Halifax; B. T. A. Bell, *Secretary*, Ottawa; also parties of mining students from McGill University and the School of Mining, Kingston.

WEDNESDAY MORNING—BUSINESS SESSION.

The President took the chair at 10.30 a.m.

The Secretary having read the Minutes, the following were elected to membership.

NEW MEMBERS.

Russell Blackburn, Mine Owner, Ottawa.
Theo. C. Denis, Mining Engineer, Ottawa.
H. M. Whitney, Dominion Coal Co., Boston, Mass.
John S. McLennan, Dominion Coal Co., Boston, Mass.
George H. Campbell, Toronto, Ont.
S. F. Andrews, Mining Engineer, Country Harbour, N.S.
E. Strachan Cox, Toronto, Ont.
J. N. S. Williams, C. & M. E., Victoria, B.C.
C. B. K. Carpenter, Manager, Oil Wells, Gaspe, Que.
G. J. Ross, Rat Portage, Ont.
A. R. Ledoux, Ph. D., New York.
F. R. Mendenhall, Rossland, B.C.
W. A. Preston, Mine Manager, Mine Centre, Ont.
Herbert Paterson, C.E., Rat Portage, Ont.
Dr. Henry M. Ami, Palaeontologist, Ottawa.
Thomas Brown, Assayer, Nelson, B.C.
A. J. Colquhoun, C. & M. E., Savonas, B.C.
F. B. Gaylord, Iron Manufacturer, Deseronto, Ont.
J. B. McArthur, Mine Owner, Columbia, B.C.
William Mann, Montreal, Que.
Edwin E. LaBeree, Mining Broker, Ottawa.
George E. Townsend, Rossland, B.C.
Antoine Guilhault, Quebec.
John W. Bell, Demonstrator, Faculty of Mining Engineering, McGill University, Montreal, Que.
J. H. Tibbits, Mining Engineer, Forest Hill, N.S.
Lt Col. Joshua Wright, Mine Manager, Hull, Que.
Dr. Wm. H. Roughsedge, Mine Owner, South Edmonton, N.W.T.

E. T. Bartlett, Montreal, Que.
James C. Beebe, Mine Centre, Ont.
James Johnstone Riley, Montreal, Que.
Frank Plummer, Montreal, Que.
Frank Carrell, Quebec, Que.
W. H. Gallagher, Vancouver, B.C.
John H. Heal, Mining Engineer, Montreal, Que.
Chas. F. Smith, Montreal. Que.
Wm. Strachan, Montreal, Que.
Angus W. Fraser, Ottawa.
George T. Marks, Mine Owner, Port Arthur, Ont.
Col. S. W. Ray, Mine Owner, Port Arthur, Ont.
Victor E. Archambault, Sherbrooke, Que.
A. H. A. Robinson, Sudbury, Ont.
Edward Wallingford, Mine Owner, Perkins Mills, Que.
F. S. Wiley, Mine Owner, Port Arthur, Ont.
S. W. Jenckes, Sherbrooke, Que.
A. McNeil, Halifax.
Dr. J. Bonsall Porter, Prof. of Mining Engineering, McGill University, Montreal.

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STUDENT MEMBERS.

Philip W. K. Robertson, 32 McTavish St., Montreal, Que.
Stafford F. Kirkpatrick, 96 Barrie St., Kingston, Ont.
H. W. MacInnes, 5 North Park Street, Halifax, N.S.
N. M. Yuile, 133 Metcalfe St., Montreal, Que.
H. Stanley Atherton, Bolton, Lancashire, England.
John E. Preston, 196 Cowan Avenue, Toronto, Ont.
Selwyn G. Blaylock, Danville, Que.
George W. Waller, Bartonville, Ont.
Percy Butler, Guggenheim Smelting Works, Perth Amboy, N.J.

REPORT OF COUNCIL.

THE SECRETARY presented the report of council for the year (reproduced in our last issue) supplementing it with the statement that a number of the members noted by the Treasurer as in arrears with their subscription had since paid up, so that their actual membership in good standing would be slightly in excess of the number given in the report. The report was adopted.

BRITISH COLUMBIA MEETING.

THE PRESIDENT announced that the council had determined to hold the next meeting of the Institute in British Columbia, and arrangements were under consideration for an excursion to Rossland, Sandon, Trail, Ymir, Greenwood and other centres in that province.

After some discussion the following committee was appointed to make suitable arrangements: The President, Mr. George E. Drummond, Mr. Eugene Coste, Mr. A. W. Stevenson and the Secretary. Messrs. DeCourtenay, Peacock and Lewis having been appointed scrutineers for the election of officers, the meeting adjourned.

WEDNESDAY—AFTERNOON SESSION.

Mr. Hardman took the chair at three o'clock. The President intimated an invitation from Dr. Bovey of the Faculty of Applied Science and also from Dr. Porter of the Faculty of Mining Engineering, to visit and inspect the new mining laboratories at McGill University. It was agreed to visit these laboratories on Saturday morning.

PAPERS READ BY TITLE.

The following papers were read by title:

On Mine Costs, by the President.

Notes on the Development of the Iron Ore Industry, by Mr. John Birkinbine, Philadelphia.

Across the Pitch v. Up the Pitch, by Mr. O. E. S. Whiteside, Authracite.

On the Occurrence of Cinnabar in British Columbia, by Mr. A. J. Colquhoun, Savonas.

On the Establishment of Science Classes in Mining Centres, by Mr. A. H. Holdich, Nelson, B.C.

Electric Transmission and Electric Drills, by Mr. F. Hille, Port Arthur.

Smelting Conditions in British Columbia, by Mr. R. C. Campbell Johnstone, Nelson, B.C.

On the Occurrence of Free Milling Gold Veins in B.C., by Mr. W. Hamilton Merritt, Toronto.

On the Lillooet Gold District, by Mr. F. Cirkel, Vancouver, B.C.

On the Driving of the Simplon Tunnel, by Mr. Leopold Meyer, Ottawa.

A Notable Canadian Deposit of Chromite, by Mr. J. T. Donald, Montreal.

On the Petrographical Character of the Ore from the Republic Camp, by Dr. Frank D. Adams, Montreal.

ADJUSTMENT AND CONTROL OF THE STAMP MILL.

Prof. W. G. Millar, in the absence of the writer, Mr. Courteney DeKalb, of Kingston, presented a paper on this subject in which he dwelt upon the importance of minute details in milling practice and of treatment to the peculiarities of the ore. This, he said, may seem so obvious a necessity that the mere statement of it may strike some of you as superfluous. It was a comparatively rare thing to find a stamp mill, either in its design or management, exactly suited to the ore passing through it, except where a belt yielded (as sometimes happens) practically identical ores over large districts and where some millman of judiciously investigating habit has worked out his problem for the benefit of himself and his neighbors. But ores from mines in the same district, no matter how restricted, nor how similiar their appearance, and geological settling, are very seldom identical in character. They may even vary greatly at different points in the same mine, and the millman who ignores these variations, however slight, will find fluctuations in his extraction, for which in many cases there might be a simple remedy if he knew how to determine the right practice and apply it. The first error that is usually committed in faulty accommodation of the mill to the ore is chargeable to the recklessness of the mine owner in ordering "a stamp mill" from the manufacturer. He sometimes does specify the weight of stamps he desires, without as a rule having the remotest idea why he wants any particular weight, except that he frequently assumes that capacity is the great thing to strive for, and the reason that heavy stamps (if not too heavy on his purse), must necessarily be superior. Forgetful that in amalgamating mills there are two distinct capacities to be aimed at, viz: Crushing capacity and extracting capacity. The economical line between these two is the one that will be of the greatest importance to his company in the payment of dividends. But in ordering a stamp mill there are many considerations besides weight of stamps to be taken into account—such as width and depth of the mortar, length of feed hole and character of automatic feeder, number and positions of inside plates, shape of discharge lip, slope screens, etc. These are points which cannot be guessed at if the highest practicable efficiency is to be obtained. Obviously then a very considerable ore-body should be in sight, not simply as a surface out-crop, but well explored below ground, so that its character may be fully known. The next step should be to make practical mill tests on average lots of the ore, the *average* involving not only value but character of the ore One mill-test will commonly be insufficient to determine the design of mill required. If the extraction is well above 90 per cent. of the gold available by amalgamation the test may be regarded as ample so far as the mortar and stamps are concerned. The millman should then by careful attention to the finer adjustments reach a very high extraction. But if his test falls below 90 per cent. of the gold which should be saved by amalgamation, samples identical with those first tested should be experimented with in another mill of different design as to details of mortar, etc. If the difference in the design of the two mills was considerable, very useful deductions may be drawn from these tests. Manifestly such testing is expensive, and the outlay may amount to no insignificant percentage of the cost of the mill finally ordered, but the propriety of incurring such an expense should not be judged on that basis, but rather as compared with the loss in gold which would have gone irretrievably to the tailings dump had not these precautions been taken. Mr. DeKalb then proceeded to discuss the design of mortar, length of feed hole, slope of screen, rotation and height of stamp drop, quantity of water fed to battery, maintenance of same degree of crushing and other interesting features of milling practice, citing examples from his own experience. The stamp mill, he said, should be looked upon as primarily a combined crusher and amalgamator. As a crushing machine it is mechanically crude and wasteful of power. For simple crushing there are appliances far more efficient, particularly where large quantities of ore are to be treated. But in its proper sphere the stamp mill has no rival, and the exceeding delicacy of the adjustments possible for the production of specific results will be hard to attain by any other machine.

MR. HARDMAN—This paper is particularly interesting at the present time, in view of the rapid development of milling operations in Canada, owing to the discovery of free milling ores in British Columbia and to the expansion of gold milling in Ontario and in Nova Scotia. The members who are interested in the gold milling question will read Mr. DeKalb's paper with a great deal of interest, and will use it to check against their own notes. I have been doing that while Professor Millar has been reading the paper, and it struck me that Professor DeKalb has gone over the situation carefully. Of course, to old mill-men many of his remarks are well known, and I am not going to discuss it at the present time, when we have a number of gentlemen present who are past masters in gold milling.

MR. G. W. STUART - As the paper treats not only of the mortar as a crushing machine, but an amalgamating machine as well, it has struck me as singular that the important question of the quantity of mercury to be used has not been dealt with.

MR. F. T. SNYDER—In the matter of the weight of the stamps we find that the question of weight per square inch of area of shoes is more important than the question of total weight, and by changing that we have been able to modify the results in a manner that the total weight does not give us. With respect to the distribution of water and the old method of putting the water into the top of the mortar, it does not matter whether you put it in five times in the one place, it practically all seeks the same level. I had occasion to use a mortar where we had no screen. We adopted freely the principle of sizing the pulp and putting it out of the mortar by means of a water column within the mortar, and the result was that we could get any amount of pulp we wanted in clean distribution, but we could not get enough stuff through. As to the woven wire screens, the quartz breaks into tetrahedrons and the consequence is that while the screen originally has an open area, after it has been running a few hours it has an open area of much less than the bunch screen. It has been found of advantage to regulate the height of the discharge rather than the chuck box, by putting different heights of false bottoms in the mortar.

MR. OBALSKI—What is the meaning of "150 meshes"?

THE PRESIDENT—I fancy you will find most mill men will evade that question. In South Africa they have a much more preferable system by which they speak of a screen of "400 or 600," meaning the number of apertures in the square inch of surface. The 400 measurement is that which has 20 inches on one side of the screen and 20 on the other. I take it that the 150 meshes referred to by Mr. Obalski means 150 meshes to the lineal inch made out of this very fine bolting cloth. With regard to Prof. DeKalb's paper, he said that the width of the mortar and the depth of the mortar are fixed matters, that the depth is adjustable by means of the chuck box but the width cannot—possibly it cannot in one sense of the word, and in another it can. About fifteen years ago I got hold of one of the old vertical screen Nova Scotia mortars. I was disgusted with it and endeavored to convert it into a mortar which would be much narrower at the base and also where I could get a screen having an angle of about twelve degrees. It is true it was only a makeshift, but by putting in wooden blocks and covering it with sheet steel, I succeeded in getting a mortar which gave a test of about as much value as if I had a mortar of the modern style. I do not mean to say that would have been sufficient to crush a thousand tons, but it was sufficient to crush the sample lots of from ten to fifty tons and to give practically the same results as a modern mortar. In regard to the banking of the ore to which Professor DeKalb alludes, I think most men of large experience will say that that banking is due rather to the order of the drop, that to the matter of feeding through the central pressure or slot which extends across the whole width of the mortar. In 1891 I put up a ten stamp mill in which one mortar had a central feed of only about 17 or 18 inches. The other mortar standing alongside it had the whole width of the mortar as a feed slot, and I cannot say that there was the slightest particle of difference between the two as regards the banking or as regards the wear and tear on the shoes and dies. But there was a great trouble in starting that mill from the fact that the mill man had put his cams on in the accepted order of 1. 4. 2. 5. 3. We found there was a tendency for the ore to leave No. 1 and to accumulate in No. 5. The mill man attempted to remedy that by the very bad practice of giving his stamps different heights of drop; No. 1 was about 5 inches and No. 5 about 12 inches, so you can fancy the effect of that upon your cams and upon all the rubbing surface. When the order was changed to 1. 5. 2. 4. 3., the distribution of pulp was made even and the machine worked smoothly. In regard to the feeding by water, we have with us Mr. Bernard MacDonald who is contributing a paper on an improved method of feeding water to stamp mill mortars, and he possibly may contribute in that paper something of what I would like to say regarding Professor De-

Kalb's paper. I think a great deal may be done in that direction, to justify the remarks of Mr. Snyder, by eliminating a great portion of the wear and tear that occurs in ordinary screens, and as far as die cupping is concerned, in my experience, the cupping of the die has been due to improperly feeding too low or too high rather than to anything else.

Metallurgical Standards.

Mr. F. T. Snyder presented his paper on Metallurgical Standards (reported in the February number of the Review.

Mr. Hardman—Mr. Snyder has perhaps expressed himself differently from what some of us would do on this question, but still he has given expression to the need felt by everyone engaged in metallurgical work during the last decade. I do not feel myself competent to express any opinion regarding his sizing methods or his micrometer, but I can sympathize with him in the desirability of having a standard unit of weight which shall be fixed for all operations.

A New, or Hitherto Unrecognized, Geological Formation in the Gas and Oil Producing Regions of Ontario.

Dr. H. M. Ami in this paper described a geological horizon consisting of a series of fine-grained calcareo-argillaceous pyritiferous shales associated with bands of marine fossiliferous limestone which overlie the Portage and Genesee shales of Western Ontario. He said: "So far as I am aware, none of the oil-producing wells of Western Ontario have reached the Trenton formation of the Orodovinian (Lower Silurian) system. That the Trenton formation of the ~ ..tes of Ohio and Pennsylvania is well known as oil-producing strata need scarcely be mentioned before members of this Institute, nevertheless we venture to hope that, before long, wells sunk sufficiently deep to reach the Trenton formation, which underlies the Devonian and Silurian stata of the Huron-Erie peninsula of Ontario at a depth of some 3,000 feet (more or less, depending upon the points of departure), will reward the enterprising company which will make the venture. It will be clearly seen that every few hundred feet of strata which overlie the gas- or oil-producing strata which are eagerly sought by the drillers makes considerable difference in the calculations as to the relative position and exact geological horizon indicated. From a very complete series of drillings recently received at the Geological Survey, from the County of Bothwell, and placed in my hands by the Director for examination with a view to ascertain what geological formations had been transversed by the drill, I was able to ascertain very definitely just *where we were* owing to the presence of a large number of fossil organic remains detected in the drillings or small chips and fragments not crushed to powder by the pumping drill. And here let me make a suggestion which I hope will some day be carried out. In Western Ontario we need three or four good typical log-sections from a diamond drill. The amount of money invested in our oil, gas, salt, gypsum, and associated industries and resources of the Western peninsula fully justifies such an expenditure.

Mr. Coste—Dr. Ami mentioned in his paper that if the "Trenton" was ever reached by any of the prospectors, they would surely be rewarded by striking large quantities of oil. I regret to say that that has not been our experience. We have just reached the "Trenton" in one of the wells in Essex County, and I am sorry we have not been rewarded yet. We struck the "Trenton" near Lake Erie, about four miles south of the village of Harrow. We started on the lower Heldezberg limestone. We found considerable gypsum down to 910 feet. We had one bed of gypsum 10 feet thick at 865 feet, and another bed at 450 feet of about 5 feet thick. There is a great deal of gypsum all the way through from 110 feet where we struck the first rock down to 910 feet. At 910 feet we struck the "Guelph" and "Niagara" and found water in it. That is where we strike the gas in other parts of the same county between Leamington and Kingsville. It was thought by myself and by others until lately that it was in the "Clinton" where this gas was struck, but that is not so. We had never struck the shales before, and I could not tell exactly where we were until about a month ago, when we drilled down through this salt water and got to the "Medina" shales at 1,300 feet, about 400 feet below the first salt water. I am positive now that the "Guelph" is the stratum where we struck the gas at Kingsville and all through that district. At the Coste well No. 1 we struck the gas at 1,020 feet, or 50 feet below the gypsum bed, and we have the same gypsum bed in borings which I made in different parts of the county, some of them 20 miles distant from each other.

Dr. Ami—At what depth?

Mr. Coste—At 1020 feet in the first well is where the gas was struck, or about 50 feet below the gypsum bed. In this last well south of Harrow it was 910 feet where we struck the top of the "Guelph" and "Niagara" formation. We found the "Guelph" and "Niagara" formation to be a very open porous limestone with water in it. We found we had to go through in the wet hole from 910 to 1295 feet and finally we got the 6¼ casing in when we got to the Medina shale at 1298 feet. We struck the "Trenton" at 2,150 feet. I went about 300 feet in the "Trenton" and we got just a little gas and oil—enough for a sample. At Stratford, Ont., where the "Trenton" has also been reached at 2346 feet, they went 40 feet in the "Trenton" and got salt water at 2,384 feet. I have no doubt that other explorations in certain parts of Ontario will lead to the discovery of oil and gas in the "Trenton" formation. The negative result in the boring of two wells means nothing, but the fact of striking a little indicates that a good deal more should be found. I agree with Dr Ami as to the geology of this part of Western Ontario. A great deal of drilling has been done, but no correct logs of the wells have been kept, so that it is a difficult thing to know what formation would be obtained in different localities and at what depth. It is only lately, since we got more correct logs of the wells, that we can tell just what the series of strata are in Western Ontario. It is mostly covered with drift, and unless you drill and keep a correct account of it, there is no satisfaction to be obtained.

Dr. Ami—What do you think of diamond drill?

Mr. Coste—I do not think it is necessary to drill a well with a diamond drill to get a good log of it if you are on the spot and wash each screw of the drillings or cuttings as it comes up. You have to be there most of the time and wash the cuttings carefully every five feet, and if you do that, you can get a very correct log of what you are going through.

Mr. Ingall—Have you found any trouble in that respect by rock falling in from above?

Mr. Coste—We have no caving at all in these stratas, as they are very solid; too much so sometimes. In the coniferous limestone, for instance, there is a great deal of flint, and it is very hard rock, as well as the "Guelph" and "Niagara" and the "Clinton." Sometimes we could only make 10 feet in 24 hours. There would be some little chips falling in, but not enough to bother a geologist or paleontologist.

Mr Bell (Secretary)—Perhaps Mr. Obalski could give us some news about the Gaspesian oil wells.

Mr. Obalski—They are still drilling in Gaspé, but it must be remembered that Gaspe is a new country and that it has not developed to the same extent as Ontario. We expect some time to get oil at Gaspé.

Mr. Bell (Secretary)—Has the refinery been put up yet?

Mr. Obalski—No; they are putting in a pipe line, I understand.

Dr. Ami.—It would be a splendid thing if the records of the borings of these wells were systematically kept by the Government, and when a practical man like Mr. Coste reaches the "Trenton" he should let us know all about it at Ottawa. I was fishing for information when I ventured to put that clause in my paper, and I am delighted to know that the "Trenton" has been reached. I beg to tell Mr. Coste that I did not state absolutely that when the "Trenton" was reached the company would be rewarded by finding petroleum, but I ventured to hope that they would, and I suppose it comes to the same thing in the long run. I am delighted to think that Mr. Coste expressed the same hope as I did, that some day we will find petroleum in Ontario in the "Trenton" formation. We all know that in Ohio the "Trenton" formation has afforded large quantities of oil of great value indeed.

The President.—Do you not think it would be of great interest that the Government should keep these records?

Mr. Ingall.—It would decidedly be in the interest of the public and the Government, and a start has been made. Great assistance would be rendered if my friend Mr. Coste would collect these boring records and send them to us. This might be an opportune time to enter a plea on the part of the mining section of the Geological Survey that these gentlemen who have these records should extend to us a larger measure of co-operation in the future than in the past. Had we a large staff in the Survey we might be able to do that ourselves, and I think the mining community of this country should urge the Government to increase the Geological Survey appropriations instead of cutting them down. If we had a larger vote we would be able to put one man on to this work alone, who would keep track of the borings that are going on and persuade the borers to let us have their logs. I appeal to all gentlemen engaged in this business in Canada to voluntarily send us their logs so that we may have a useful record. Of course, sometimes people are not prepared to give away information, but they could use their own judgment on that. There is no doubt that the under-ground geology of the peninsula of Ontario is little known because of paucity of our records in that respect, and although we have a great many logs in the Geological Survey they do not represent a fraction of what has been done.

Mr. Coste.—They are no good.

Mr. Ingall.—You will agree with me that it would entirely take up the time of one man who would necessarily have to go on the ground and get correct samples. We have had a great many records sent in, but some of them are perfectly useless. It is a branch of the Geological Survey work which might be developed and would pay to have a man to devote his whole time to it.

Mr. Coste.—We did strike some gas in the "Trenton" limestone in Welland county at a depth of 2,940 feet. We struck a paying well which we have had connectected on the lines to Buffalo for several years. We struck the "Trenton" at 2,340 feet, and the find was made 600 feet in the "Trenton." We have tubed the well and closed it in, and it registered a rock pressure of exactly 1000 pounds to the square inch After several years use that well will yet register 800 or 900 pounds pressure. That was just about 100 feet from the archean rocks in strata in which I do not think paleontologists would expect to find many fossils; I would not. This brings up the question of the gas being generated from fossils, and I am quite prepared to say that it is not so generated.

Mr. Ingall.—You never got any gas or oil in the archean?

Mr. Coste.—That is the nearest I have come to it.

Dr. Ami. Applications are constantly made to the geological survey department for information regarding the lay of the formations in Western Ontario, and the only reliable section we have is the Attrell well which is a diamond bored well in the Goderich region In Europe and well as in the United States, three or four typical standard sections have been bored by the diamond drill, and it would be of great value if that done in Canada so that we could have an exact knowledge of the various kinds of strata that are traversed. This Wallaceburg log is a very good one and we have some excellant ones from Petrolia. Our bureau is supposed to be one of definite information and this is certainly a point on which we should have accurate and definite knowledge. The presence even of organic remains of fossils is of no value. The day before Mr. Coste struck his ten million cubic feet of flow well, he came to my office with samples, and in them we found a very pretty "leptocelia intermedia" from the "Niagara" group which showed just where we were, so the next day he struck the oil.

Mr. Ingall. Mr. Coste is a man of great experience and I would like to have his view on diamond drill boring. I take it that while such boring would be useful as fixing certain horizons, yet I would ask him if it has not been his experience that the question of gas and oil to a certain extent depends on the working of the local folds. Of course that would have to be supplemented by careful selections from other borings so as to get the local features of the under-ground geology. Does Mr Coste consider it has anything to do with the folds?

Mr. Coste.—It has all to do with the folds. I do not think it is necessary to use the diamond drill. Of course, the diamond drill would be altogether for experimental purposes, because the bore would be too small to use for a well. I may say that in our operatio boring in the ordinary way, we have never had any trouble in getting samples or a good log of the well.

Mr. Ingall.—May I take it that in the future your company would consent to send samples to us?

Mr. Coste.—Yes. Every five feet we clean the well and we take out samples of the ground we are in. Of course, sometimes a few chips fall in from above, but we can easily recognize them and take them out.

Mr. Ingall.—If you do that it will assist us in carrying out our work.

Mr. Coste.—You will have to send a man there to attend to it.

Mr. Ingall.—You could not send them in yourself?

Mr. Coste.—I would be very happy to go to the wells with your man, and I do not think it would be necessary to be watching the borings all the time. You could make arrangements with the contractor, but you certainly would have to send a man every day or every second day.

Mr. Ingall.—How many borings would be going on in Ontario during the season?

Mr. Coste.—More than twenty important ones as to records.

Mr. Ingall.—It would keep a man busy all the time for four or five months in the year?

Mr. Coste.—Yes; we are drilling in the winter too. I may say that ten years ago, at St. Catharines, Ontario, the "Trenton" was entirely drilled through at 2,185 feet and the gas was found under the Trenton. At that depth there were 15 feet of very clean sand. They stoped at 2,200 feet, and the last 15 feet was in clear white

sand and that is where they got the gas. I do not suppose that was 25 feet from the archean.

DR. AMI.—Almost everywhere in Ontario, underneath the limestone you find a white sand.

MR. COSTE.—The case at St. Catherines was a new one then; but large wells have since been struck in New York State, also, under the Trenton. It was in the calciferous about 20 feet from the archean that the gas was found, and where you got the fossils that produced that I do not see.

MR. DOUGLAS AND DR. LEDOUX.

MR. BELL (Secretary).—Before this session adjourns, I am quite sure I am only voicing the sentiments of every member of this Institute when I express to Dr. Ledoux, and to our brother-member Mr. James Douglas, the eminent president of the American Institute of Mining Engineers, who is so well known to us by reputation—I say I voice the sentiment of every member of the Institute in extending to these eminent gentlemen a very hearty welcome to our meetings. It is a great compliment to Canada to know that a Canadian is President of the largest, and strongest, and possibly most representative Institute of Mining Engineers in the world. It is a great pleasure to us, Mr. Douglas, to see you again in the Province of Quebec. Both Mr. Douglas and Dr. Ledoux will contribute subjects of great interest to our evening session, and we are very much indebted to them for their exceedingly kind co-operation towards the success of this the first meeting of our reorganized Institute. (Applause.)

The session then adjourned.

WEDNESDAY EVENING SESSION.

The President took the Chair at eight o'clock.

MINERAL PRODUCTION 1898.

MR. E. D. INGALL.—I am authorized by the Director of the Survey to place at the disposal of the members the Summary of the Mineral Production of the Dominion. The total showed (subject to revision):—

Non-metallic minerals	$15,884,596
Metallic	21,622,601
Products not returned	250,000
	$37,757,197

CHAUDIERE GOLD.

MR. J. OBALSKI, Inspector of Mines for Quebec, exhibited several bottles showing very handsome specimens of alluvial gold obtained from the Chaudiere district during the past year, and explained that satisfactory progress was being made in mining in that district.

SWEDISH IRON METALLURGY AND ITS APPLICATION TO CANADA.

THE PRESIDENT.—We are distinguished by having with us two gentlemen, Mr. James Douglas and Dr. A. R. Ledoux, officers of the American Institute of Mining Engineers. These gentlemen have not only been kind enough to come to our meetings, but they have consented to place their views before us on subjects which are certain to be of great interest to our members. (Applause.) I desire to re-echo some of the words which fell from the lips of our Secretary, that in the President of the American Institute, the largest body of Mining Engineers in the world, we have a representative Canadian; a Canadian by birth and one who remains a Canadian, because I believe Mr. Douglas has never become a naturalized American citizen. It is unnecessary to tell any Canadian mining man of the immense services Mr. Douglas has rendered to the profession, for as a mining engineer and metallurgist his record cannot be surpassed. (Applause.)

MR. DOUGLAS.—I feel abashed by such an encomium as has been passed upon me. I hope you will consider that the honour which has been shown me—and I consider it a great honour—by electing me president of the American Institute of Mining Engineers, is not only a recognition of my very humble services to the profession, but likewise an acknowledgment of that *entente cordiale* which has grown up between these two sections of the Anglo-Saxon race, and which certainly should grow from day to day between these two people, one in actuality, who divide almost the whole continent between them. There is nothing will so excite the admiration and esteem of my friends in the United States so much as downright honest rivalry between yourselves and them, and of course the most important branch of industrial activity in the United States is in the iron and steel industries. (Applause.) You will excuse me, gentlemen, if I say I think Canadians should be ashamed of themselves that these industries occupy such an extremely comparatively insignificant position in their commercial life here. I am quite well aware that one reason which will be given for this state of affairs is the absence of coal in Canada, and that is undoubtedly a cogent reason, but at the same time coal is not absent everywhere, nor iron either. The subject that I am merely going to suggest to you this evening is, the parallel between Canada and Sweden, and it may be taken as an answer to these Canadians who would excuse themselves, by referring to the absence of fuel, for the extremely impotent position which the iron industry occupies in Canada. In Sweden we have a country bearing many analogies to Canada, and yet, Sweden has always stood high in iron and steel production. (Hear, hear.) Some two centuries ago, Sweden ranked probably as the largest producer of the highest grades of iron and steel in the world. The question for you to solve is, whether in central Canada, or in other sections of Canada, you can become a competitor with Sweden in this valuable industry, of course the question can primarily be resolved only by determining whether you really have iron ores which will compete in purity with those of Sweden. In quantity you undoubtedly have, for in central Sweden, the quantity of iron ores is small; its purity is incomparably high. Whether you have ores as free from phosphorous and sulphur and as high in iron, it is not for me to say, when we look over the records of the Canadian Geological Survey, and the Iron and Steel Institute of Great Britain, we find analysis of extremely pure ore said to exist in considerable quantity, but whether it really exists in quantities and in that purity. I see no reason why in Central Canada an industry should not be built up that would compare with Sweden.

Mr. Douglas then reviewed at some length the main features of his paper. (reproduced in our last issue.) In concluding he said 'I believe, gentlemen, that every metallurgist on both sides of the line should work in direction of preventing this waste (timber and sawdust) and at the same time improving our iron industry. It is with this purpose I have put together these notes on Swedish metallurgy. I do say that you have waste lumber enough in Canada to make your iron and steel productions equal to at least one-tenth of the total iron and steel production of Sweden. You have the lumber and I believe you have the ore, and you can turn your attention to no more useful purpose than that. (Loud applause.)

THE PRESIDENT.—We are not only indebted to Mr. Douglas for his technical instruction, but also for the lesson he has given us in national economy.

THE SECRETARY then read a long letter from their member, Mr. E. A. Sjostedt, of Sault Ste. Marie, a Swedish mining engineer, well-known in Canada and the States for his connection with the iron industry, in which he endorsed the views presented by Mr. Douglas, in which he said: To what extent these precautions, sometimes, are taken, and to what expense the Swedish iron master is willing and ready to go, in order to gain in even the slightest degree in quality of product, you can get an idea from an instance that came to my personal knowledge only two years ago. While making a tour among the iron works of Sweden, when at Soderjors they were actually killing out their beechwood growth, and in its stead were planting pine and fir trees, solely on account of that shade of difference in the amount of phosphorous present in the hardwood, over and above that in the softwood.

MR. GEORGE DRUMMOND—I have listened with much interest to the eminently practical address of Mr. Douglas. For some years those of us who are interested in the manufacture of iron have been trying, by papers read at our meetings, to awaken an interest in the minds of the Canadian people in the vast natural resources possessed by this country for the manufacture of the most useful of all metals—iron. The great drawback in Canada hitherto in this enterprise, as in a good many others, has been want of confidence in ourselves and our resources, and it is certainly very gratifying to have one of the most eminent metallurgical authorities in the United States come here to-night to publicly recognize the value of these resources and to endorse in regard to the same what we, in this Institute, have so frequently brought to the notice of the Canadian public. Canada's natural fitness for the manufacture of charcoal iron is, I believe, quite as great as that of Sweden. We have vast forest stretches, from which the pine and other merchantable timber of like nature has been removed, and upon which exist a growth of hard and soft woods more extensive perhaps than that possessed by any other country, and just such wood as will make the finest class of charcoal fuel. In the matter of ore, the researches of the officers of our Geological Survey, and the practical work accomplished by the pioneer furnace-men of this country, although as yet amounting to little more than a "scratching of the earth's surface," have amply proved that we have ores within our borders at least equal to the average ores of Sweden, and in some cases possessed of qualities unrivalled by those of Sweden or any other country. We have in the past lacked confidence, and that necessarily meant also a lack of the "sinews of war," without which this or any other great industry cannot be made thoroughly successful. Mr. Douglas, at the commencement of his paper, states that in the matter of iron-making Canada is certainly "not conspicuous for energy," and he speaks very truly of our "backwardness," but we may be pardoned in reminding him that in Canada we have as yet only some five million people, and while we admit that we are not producing anything like the quantity of iron that we should, yet our exploits in that particular direction of national development compare very favorably with what the American people had accomplished at the same period in their existence. In the year 1810 the U.S. had a population of 7,239,903, and according to a statement of the "Arts and Manufactures of the U.S. of America," as they existed in 1810, prepared by Tenche Coxe, under the authority of Albert Gallatin, secretary of the treasury (a record of which will be found on page 509 of "Iron in All Ages," by Swank), with a population more than one third larger than that of Canada to-day, the U.S. only produced some 53,908 gross tons of pig metal, in addition to which she produced some 44,485 tons of finished, that is to say, wrought iron products. Canada with five million population produced in 1898 about 65,000 tons of pig iron, and in addition to this she produced in the rolling mills, steel works and wire nail factories of the country, a further 125,000 tons of material such as bar iron, wire nails, etc., the whole of which was made either from scrap metal or imported raw material, and not a ton of which was made from the pig iron produced in Canada. In addition to these finished goods about 24,000 tons of steel was made in Canada from the product of Canadian furnaces.

It will naturally be urged that iron was not consumed at the same rate per capita in 1810 as it is to-day, but on the other hand, the American iron producers had the natural protection of being separated by some 3,000 miles of ocean from their only possible competitors, viz, the iron masters of Great Britain, and it must be remembered that in those days ocean freight rates amounted to something, and afforded a splendid natural protection to American iron makers.

The best American authorities unite in agreeing that one great reason why their industry made such slow progress in the early days was that the iron masters were not protected by customs duties against the more fully developed industry of Great Britain. This same argument can be made in defence of Canada's tardy progress with ten times greater force when it is considered that our country lies along the borders of the U.S., the greatest iron producing country that the world has ever seen, and in this connection it might be well to remind Mr. Douglas that it was only in 1887 that the Government of this country saw fit to introduce a fair measure of protection to the native industry, and it is only some two years (or in 1897) since Canadian tariff questions were placed upon a settled basis that gave confidence to our iron producers and to capitalists generally. It can therefore be fairly said that we have just started upon our career of development. The present year will see at least two additional furnaces in blast in Canada, and within the next two years at least we will probably have four more furnaces in addition to those now in blast. The first stage in the progress of the native industry will have been passed, and the products of our furnaces will over-lap greatly for ordinary foundry practice, to which we are at present largely limited, and we will have to find a market for the over-plus stock in the manufacture of all forms of finished steel and iron. All that is wanted to accomplish this is that the Government shall maintain a steady settled policy for a few years, and give those now interested, and those who will join them, an opportunity to get the business on a solid modern foundation.

Mr. Douglas' most interesting description of the intelligent way in which the Swedish iron masters have "adjusted themselves to new conditions and new requirements," and have learned to utilize their own pig metal for the manufacture of finished iron and steel, thus securing to themselves and Sweden the maximum value of the labor required to bring the products to the highest stage, and to do it profitably, should be of great encouragement to Canadian charcoal iron producers, who will probably find a more permanent success in building up an industry where quality of product rather than the matter of price is paramount.

It would necessarily be a difficult thing for Canadians to seek to rival the established American producers in the matter of cost of production in coke irons, but in charcoal irons, possessed of unlimited raw matetial, the Canadian producer ought (once thoroughly established) to be able to compete with Sweden and the U.S. or any other country, and the history of the Swedish industry, as set forth in Mr.

Douglas' admirable paper, indicates a profitable course for Canadian producers to pursue.

Certainly the first requisite of charcoal iron should be quality, leaving to the coke iron producers the wider field afforded for cheap products.

The Swedes have certainly succeeded wonderfully in the building up of their iron industry, but a somewhat recent investigation of a few of even their larger plants, viz, in 1896, by a member of my own company, Mr. John J. Drummond, would indicate that the Swedes at that time, had not reached perfection in their methods of operation, and I will mention some of the impressions formed by him as a guide to Canadians generally.

Coal.—He says, speaking of a visit to one of the largest works. "In the making and handling of coal we have nothing to learn from them. I consider our ordinary kiln system (I do not refer to modern by-product plants) far ahead of their largely used Meiller system, but their coal is more uniform in size than ours, some of which is too large. Their system of storing coal for some months before using is, I think, a good one, and well worth following, as it tends to regularity of moisture throughout the whole, and would give steadier running of furnace."

Ore—In the matter of ore Mr. J. J. Drummond places the Swedish methods very high. He says: "They are much more careful than the usual American or Canadian furnace-men in the handling of their ore from the time it leaves the mine till it is used at the furnace. They handle only well known and thoroughly tested grades of ore, the properties of all of which are well known to them. They are particularly careful in the roasting, breaking to walnut size, and the proper and thorough mixing of their ores and flux as they are charged into the furnace. Nothing can be better looked after than this department."

Furnaces.—"Their furnaces, and furnace plants generally, are not so modern as ours, and their furnace work proper is poor. For instance, each of their furnaces has (according to the superintendent of the plant I refer to) 2,660 cubic feet working capacity, and the two combined 5,320 feet in which they make 28 gross tons per day, with roasted ores yielding 64 per cent., or a gross ton to every 190 cubic feet." This struck Mr. Drummond as peculiar in view of the fact that in his own practice, working on lean ores in a very moderate furnace, he was able to secure one gross ton on about 50 cubic feet.

A point that he was very much impressed with at nearly all the works visited was the large number of managers, superintendents and clerks employed about the different works, much more numerous than would be necessary about American or Canadian plants. He says: "I observed extremely large staffs at every plant visited."

Speaking of one of the large works he says: "Compared with American works this place is not run to advantage. There is a lack of system and push, and men take work easily as a rule. The whole place looks a trifle slovenly and generally out of shape. Furnaces are not "up to date" being built of brick from top to bottom, and banded with iron.

Labor.—He refers to the great advantage enjoyed by Swedish producers in point of cost of labor, and says: "I find good engineers and machinists are paid 2½ krona per day, or equal to from 65 to 70 of our money. Good miners also receive the same rate of wages, and ordinary laborers only 1½ krona per day, or 40 cents. The system of work is one shift of 8 hours, then one of 16, which seems to work well among the men. Evidently 12 hours constitutes a day's work."

Educated Labor.—In the matter of education, technical and ordinary, I think they have a great advantage over us, as nearly all their working men have the benefit of a fair education. The officials generally seem to have been specially educated in their various lines (the outcome of a long established business) special facilities being provided for their education. Sons follow their father in their special lines of work in old and well established concerns, and the Swedes will thus, for a time at least, enjoy a great advantage in this respect over Canadian iron producers establishing a new business in a new country.

Capitalization.—The larger of the Swedish works are heavily capitalized, a most important consideration in the successful building up of the iron industry.

On the whole there is no reason to doubt but that the Canadian iron industry can, in due time, be brought to such perfection that, in point of quality of product, it can compete in the European markets (as the product of at least one of its furnaces does now to some extent) with the first rank brands of Swedish charcoal iron.

With the introduction of more modern methods in our new plants, and with such splendid natural resources as Canada possesses, we should be able to compete most successfully with the Swedes in the matter of price, and gradually take our proper rank among the charcoal iron producers of the world, but the line indicated by Mr. Douglas, that we should first seek quality and then carry our product to the highest form of manufacture, is, in my estimation, the proper course to pursue.

MR. GEORGE DRUMMOND—Mr. Douglas spoke of the total export of Sweden being no greater than that of a single furnace of Mr. Carnegie in one week.

MR. DOUGLAS—I meant for one month. Carnegie's output is 1,000 tons a day.

MR. DWIGHT BRAINERD—I am beginning to think that in Canada we have depended too much on government protection and government assistance, and made too many excuses to ourselves for not being more advanced in many lines of industry. Mr. Douglas spoke about the waste lumber on the Ottawa, and without wishing to tread upon anybody's toes I may say that there is a waste in almost every manufacturing concern in Canada.

PROF. MILLAR—Perhaps Mr. Douglas will give us some idea of the details of the iron-producing industry in Sweden.

MR. DOUGLAS—I do not think that the Swedish works will in any way compare with our modern works. Sweden suffers, as they suffer in England, from low wages, and wherever wages are low people become extremely wasteful of labor. On the other hand, wherever wages are high, the people economise and try to supplant the labour by machinery, and that is one reason why the United States occupies her high position to-day. I am not an ironmaster, but I am working in the west where we have to pay $3.50 per day for certain kinds of skilled labour. Well, we cannot afford that, and therefore we reduce labor to the minimum and employ machinery to the maximum. That has been the case all through the United States, for we have been driven to do it and have done it. In Sweden labor is cheap; technical labor is cheap and good, and there is plenty of it. Sweden employs hand labor, and six men are working where one man is employed by us. You could adopt Swedish methods and make Swedish products, and yet not swallow Swedish practices. I do not mean to imply that we should select Sweden as an example and adopt all her methods, but we could adopt the best of her methods and improve upon them. Some of Mr. Drummond's remarks are very pregnant, but when he goes back to the revolutionary times and compares what the United States was without steam, to what you, in Canada, are doing with steam, he is not complimentary to Canada.

MR. GEORGE DRUMMOND—I made allowances. I gave the United States one-third more population and I cited the fact that you were 3000 miles from your nearest competitor. I wanted to emphasize the point that, competing as we do with the American people, the biggest iron producers in the world and the greatest hustlers in the world, the cases were analogous.

MR. DOUGLAS—So they are. I read a paper before the Society of Arts in London and I tried to stir up my English friends on this subject. If you go back to 1837, the commencement of Her Majesty's reign, you will find there were in the United States 800 blast furnaces, mostly scattered over the wild west, in Michigan and Wisconsin. There was good transportation even then in Canada. In fact there were more blast furnaces in Canada then than there are to-day, or in the United States either. For want of the transportation facilities we now have, whererer there was a little wood and iron they were obliged to have a little blast furnace and to make iron for their local consumption. Gradually these little furnaces were eliminated and we have to-day the iron production centered in favorable centres. At that time these 800 furnaces made about what one big furnace produces to-day. The conditions are entirely changed. In Sweden they are extremely primitive in their methods and their furnaces are extremely small, even the biggest of them only turning out 40 or 50 tons a day, which is a mere trifle. At the same time they set a very high aim before themselves to produce the very finest of iron and steel, and that is an object we also should aim at.

MR. BURLEY SMITH—Could the sawdust be used without being dried?

MR. DOUGLAS—If it smoulders at all it will do. I may say that I do not think peat would do to make a high grade iron. I think peat has one per cent. of phosphorous, and that would be fatal.

MR. BURLEY SMITH—Coniferous woods do not contain so much phosphorous as the hard woods.

MR. DOUGLAS—So it has been stated.

MR. INGALL—One feature that is encouraging in Mr. Douglas's paper is the fact that notwithstanding there may be a good deal of sulphur in our iron ores, yet by careful selection they can use these ores. That is important news for central Canada. The difficulty in the past has been that from that portion of Canada they have looked to selling their ore to American smelters, and I think they have devoted their attention to producing quantity instead of quality. Instead of selecting the best ore, they have produced a good deal of the unselected material, and the percentage of iron ran low and the percentage of sulphur high. Titanium was markedly absent except in a few cases. I think that these deposits were found to be somewhat similar to the Swedish deposits. The trouble we have had is that there has been so little information to be obtained as to the average analyses of our shipments of ores. In many cases we could not take the averages of large bodies of ore, and all we could do was to take the best ore we could get and see how it ran.

MR. COSTE—There is no doubt that some of our ores in the Madoc district are full of sulphur and would have to be roasted.

MR. INGALL—While that may be true, my experience is that in some deposits there would be a large body of good ore fairly free from sulphur, and in another part of the deposit it would be high in sulphur, so that it comes to a question of selection.

MR. DOUGLAS—When you get a less quantity but higher prices for your final product, it would pay to make a selection.

MR. GEORGE DRUMMOND—Everything rests on that. We can afford to roast our ores and to select them carefully if we get the price.

MR. INGALL—It appears to me that if we enter into competition with the Swedish ores, the market being limited, we would be more or less cutting our own throats.

MR. DRUMMOND—I do not think we should go away with the idea that all our ores require to be roasted, because as a matter of fact we have ore in Canada very free from phosphorous. Our mines have not yet reached that state of development to enable us to produce large quantities. We have been driven out of the American market and now we have to provide for our own market. I am engaged in the enterprise of erecting a new furnace commencing with the capacity of 80 tons a day, and I believe that we will be able to create a market for ourselves.

MR. INGALL—What is the average run of the mines in Kingston and Pembroke?

MR. GEORGE DRUMMOND—We are using little of the magnetite ores, but we have been able to get from Kingston and Pembroke district ores very free from sulphur. In Kingston and Pembroke and Madoc districts they suffer from sulphur, and the question is can we afford to roast that ore. If we build up an industry here such as they have in Sweden, we can afford to do so with a portion of the ore.

MR. DOUGLAS—I do not think that Mr. Ingall need worry about the limited market. The world is growing so large that there is no danger of your surfeiting the market.

MR. BURLEY SMITH—I should think there is sufficient of ore in this country to make it unnecessary to use magnetic ores.

THE PRESIDENT—I venture to think that Mr. Douglas deserves the hearty thanks of the Institute for his paper, which has been not only a lesson in political economy, but has been productive of a discussion which certainly enhances the knowledge of some of the members as to what their own native country is capable of. (Applause.) We have had occasion before to thank gentlemen who came from the other side of that invisible line which separates the two countries, and we are under obligation to them again to-night. We have with us Dr. Ledoux, also from New York, who has won for American sampling and American ore sellers a standing in the markets of the world which was not possessed before. Dr. Ledoux also occupies the position of a vice-president of the American Institute of Mining Engineers, and I beg to introduce him to the Canadian Institute. (Applause.)

ON THE SAMPLING OF ARGENTIFEROUS AND AURIFEROUS COPPER.

DR. LEDOUX, of New York, who was received with applause, then read a paper on "The Sampling of Argentiferous and Auriferous Copper" (reproduced elsewhere).

THE PRESIDENT—This paper of Dr. Ledoux's will be found of great importance to the people of British Columbia. Has Dr. Ledoux sampled the anodes coming from the Hall mines?

MR. LEDOUX—I think I have sampled all of them.

THE PRESIDENT—These anodes, as you know, carry a large amount of silver as well as gold.

DR. LEDOUX—Yes.

THE PRESIDENT—You said in your paper that the casting of this blistered copper into the anodes is of decided advantage.

DR. LEDOUX—It is.

MR. DOUGLAS—If you can say so without betraying professional secrets, would you give the range in gold and silver in copper as carried in anodes as compared with copper running in pigs?

DR. LEDOUX—Material of that kind certainly contains the five-hundredths of an ounce. We have bored 18 holes in the anodes and assayed every one separately and the extreme variation was less than three ounces

MR. DOUGLAS—I may say that the whole question of buying and selling furnace products in the United States has undergone a great deal of change. In the early days England was the arbiter and everything had to be sold in the United States and Canada to English sample and assayed by what they call the English method. From a certain point of view, that was a very sensible procedure. The English assayer put it through the same series of intricate operations that the English furnace man put it through, and he got some result, but what that result was the shipper had not the faintest anticipation of; it might be two, or three, or four per cent. under his assays. Long ago, the United States sellers kicked against that and at home everthing was sold on the arbitrary deduction of one and three tenths per cent. But for a long time England absolutely refused to take any of our furnace products unless we would allow them to sample and assay them their own way That went on until England could not do without them, and then, of course, we had our own way, and our way is to sell them subject to Dr. Ledoux's weights and assays. (Applause.) However reluctant, the English people have been obliged to submit to that. I do not think *they* suffered, and I know *we* have not. We sell a great many thousand tons of copper bar every year subject to Dr. Ledoux's weights and sizes, and so Dr. Ledoux has become a by-word and a proverb on both sides of the Atlantic. (Applause.)

THE PRESIDENT—I have great pleasure in conveying to Dr. Ledoux the thanks of the Canadian Mining Institute for the very valuable and interesting paper which he has just read.

The meeting conveyed its thanks to Mr. Ledoux amid applause.

ACETYLENE GAS AS A MINE ILLUMINANT.

MR. ANDREW HOLLAND, of Ottawa, addressed the Institute on the above subject as follows: When in the innocence of my heart I accepted your worthy Secretary's invitation to address this Institute on the subject of "Acetylene Gas as a Mine Illuminant," I had not calculated on the fact that I was to appear before an assembly of gentlemen eminent in their professions, well read on the scientific developments of the age in which we live, and no doubt more familiar with the technical and scientific questions involved in the production of calcium carbide and acetylene gas than I can possibly be. Having recklessly pledged my word, however, if you will bear with me a few minutes I may be able to say something of the practical application of acetylene that will be of interest to you as mining engineers. As you are aware, calcium carbide is a product of lime and coke, caused by their fusion in the intense heat of an electrial furnace. I am proud to say the invention or discovery of how to produce calcium carbide is the work of a Canadian, Professor Wilson, of St. Catherines. The discovery was brought about by an attempt, in 1892, by Professor Wilson to reduce lime to its metallic base by heating it with charcoal in the electric furnace. Instead of obtaining metallic calcium, as he had expected, he produced a hard crystalline substance now known as calcium carbide. This substance is infusable except in the electric arc. The gas is permanent in the calcium in a dry atmosphere, but carbide slacks like quick lime when exposed to moisture. Treated with water it decomposes violently and gives off acetylene, a gas having a strong odor and powerful illuminating qualities. The utilization of this gas as a mine illuminant is a subject of vast importance to the mining industries. More powerful than electric light, it is portable, requires no expensive plant or expert knowledge, and what is probably more important than all to the workmen in underground work, it removes less oxygen from the air and produces less carbon dioxide than any other known mine illumimant, the electric incandescent light excepted. Its heating effect is practically the same as that of coal gas burned with the incandescent mantle. Miners can readily see the importance of having a lighting element that is at once

Simple in operation,
Economical to use,
Powerful as an illuminant,
That does not rapidly consume oxygen, or vitiate the air with smoke or noxious gases, and at the same time is safe and portable, and requires no expert knowledge to operate it.

My first experience with acetylene as a mine illuminant was in the Grand Calumet Silver Lead Mine in the vicinity of Ottawa. A small generator containing a pound charge of carbide was used to light a shaft 10 x 12 at the 60 foot level. The burner was a Bray, consuming only half a foot of acetylene per hour. When the gas was lighted the shaft was so brilliantly illuminated that the smallest piece of rock could be distinctly seen from the top of the shaft. The manager of the mine, Mr. McC. Ritchie, reported as the result of the first week's experience with the new light, that his men had made an increase of three feet in sinking, over the best week's work that had been done in the shaft—a gain sufficient to pay for the lighting plant and carbide to run it for six months. He added that the health of the men was better than it was while mining with oil or candle light. Acetylene light is now in use in many mines as an illuminant. The carbide is packed in galvanized steel cans containing 100 lbs. fastened with screw covers. It is easily portable, and needs only to be kept dry to be perfectly safe. It does not leak and contaminate everything it comes in contact with as oil does, and it can be taken into the roughest mining country without difficulty. There are scores of generators on the market, adapted for all kinds of lighting. I am myself the inventor of, I believe, the only successful acetylene head-light for locomotives. It is now running on the Pontiac, Pacific, Gatineau Valley, and Canada Atlantic Railways. The engineers declare that acetylene gas has greater diffusive power than any other illuminant that they have ever used in a headlight. Engineer McFall of the Ottawa and Gatineau Railway says that he would rather buy carbide out of his own wages than go back to oil light for his locomotive.

The popular impression that acetylene is dangerously explosive is due principally to the terrific explosions which took place in the Jersey City Works, where ordinary low pressure acetylene gas was converted into liquid acetylene under high pressure. Of course anyone can readily understand that 400 cubic feet of gas subjected to a pressure that reduces it to one cubic foot, when it becomes a liquid, creates a dangerous element. Ordinary atmospheric air compressed in the same way under one temperature, when subjected to a rapid change in temperature would also develop a tremendously expansive force. It is believed by some authorities that the explosion of liquid acetylene at Jersey City was due more to impure carbide used in its production than anything else. Pure acetylene is not explosive. It requires a mixture of air to render it so. I have been unable to trace any explosion of acetylene gas generators to any cause but gross carelessness and ignorance, and in no case have I ever heard of a spontaneous explosion of acetylene or a destructive fire being caused by an acetylene explosion. Vested interests in coal gas, electric light and oil companies have made the most of the explosions that have taken place to create distrust in the public mind. They might as well, however, try to roll back the ocean tide or the flow of the St. Lawrence River as to prevent the developments of this progressive age. Acetylene has come to stay. We have only touched the edge of the market for it yet. I expect to live to see the day when locomotives and Atlantic liners will be propelled by steam generated from carbide. The possibilities of our immense water powers, the development of the electric furnace and by its means the conversion of what we have hitherto looked upon as waste products will, in the near future, create a wonderful industrial development in Canada, not the least of which will be the manufacture of Calcium Carbide. The industry is yet in its infancy. It stands to-day in the same relation to coal oil that coal oil did half a century ago to the tallow candle. I have probably followed the practical application of acetylene as an illuminant, more closely than many of you gentlemen have done, and my advice to mining engineers one and all, is to keep posted on its development, for the product of the electric furnace will as surely be in the 20th century the poor man's light as the product of the petroleum well has been in the latter half of the 19th century.

THE PRESIDENT—There are, no doubt, some members present who would like to ask Mr. Holland some questions.

Mr. HOLLAND—I shall be happy to answer any questions to the best of my ability

THE PRESIDENT—Might I ask you what is the danger, if any, in using acetylene?

Mr. HOLLAND—As far as my experience goes there is positively no more danger in the use of acetylene as an illuminant, when generated in small quantities in proper apparatus, than there is with any other illuminating element—in fact there is less danger with it than there is with coal oil.

THE PRESIDENT—I presume that carbide will be extensively manufactured in Canada?

Mr. HOLLAND—I am satisfied that the manufacture of carbide will within a very short time become one of the important industries of Canada. At present there is only one factory—that of the Willson Company, at St. Catherines, Ont. Its capacity is only 3½ tons per day. In a conversation with Prof. Willson to-day, at the Russell House, Ottawa, he gave me to understand that he had about concluded arrangements with a number of Ottawa capitalists, owners of large water powers there, to manufacture under a royalty to his company. In fact one factory has commenced operations and already has two furnaces in operation turning out carbide. Other furnaces will be installed as rapidly as possible. The demand for carbide during the past winter was so great that it could not be supplied, and two-thirds of the generators installed for house lighting had to be shut down. The carbide famine existed all over this continent.

Mr. LEWIS—Is it not a fact that in the United States there were several accidents reported as caused by acetylene explosions?

Mr. HOLLAND—Yes, that is a fact, but in every instance they were due to carelessness or the same sort of reckless ignorance that causes accidents with coal oil by filling lamps while lighted, pouring oil into a cook stove to hasten the getting of the breakfast, or with coal gas by prospesting for a leaking pipe in a cellar with a lighted candle. Such accidents will always occur with any lighting element that is explosive, where ordinary care is not exercised. As I said before, the explosions that caused such death and destruction of property in Jersey City, were not of liquefied acetylene, an element so dangerous under all circumstances in its present stage of development that Professor Willson will not sanction its manufacture in Canada under his patents.

THE PRESIDENT—Is not acetylene more explosive than oil or ordinary illuminating gas from coal?

Mr. HOLLAND—I have not found it so in practical use. Professor Lewis, of London, England, in his interesting experiments, finds that it requires a smaller quantity of acetylene in a given quantity of air to cause an explosion than it does of ordinary gas. But acetylene has this advantage. An ordinary Bray burner of 16 candle-power consumes 7 feet of ordinary illuminating gas per hour. An acetylene burner of 25 candle-power consumes only half-a-foot of gas per hour. Consequently if an acetylene gas burner were to remain open for ten hours in an ordinary room the proportion of gas to air would not make an explosive mixture. You must also bear in mind that there is no such thing as spontaneous explosion of low pressure gas. You must have an air mixture and fire or flame to produce it.

THE PRESIDENT—I would like to ask Mr. Holland what kind of lamps he used in the Calumet mine?

Mr. HOLLAND—It was a small generator made of galvanized iron, about the size of an ordinary water pail. It carries a charge of one pound of carbide, which is sufficient to run a 25 candle-power gas jet for five to seven hours, according to the purity of the carbide and the care used in preventing leaks. The generator is stationed in the most convenient place in the shaft and the gas is conveyed through a ⅜ rubber tube to a short bracket and ell cock and burner that can be suck anywhere in a crevice in the rock where it will throw the light to the best advantage. When the holes are drilled and loaded for a blast, the generator and bracket are taken up out of the shaft until the blasts have been made, and then taken down again and replaced.

THE PRESIDENT—Is that the only form in which it has been used underground?

Mr. HOLLAND—I have not heard of permanent plant being installed in a mine. Of course a large generator and regular piping could be put in where no blasting was being done. Acetylene must be burned as an open flame, and could not be used in coal mines or where explosive gases are developed.

THE PRESIDENT—I asked you that question because to be used successfully in a mine an acetylene light must be in such a practical form that it can be used in any part of the shaft or stopes.

Mr. HOLLAND—In that case you could use small hand lamps, such as you see in bicycle headlights.

THE PRESIDENT—And they are perfectly safe?

Mr. HOLLAND—Yes, perfectly safe. The quantity of acetylene generated in a lamp at one time is so small that if it did explode it would not be as dangerous as a fire cracker.

Mr. COSTE—How do you get your water pressure?

Mr. HOLLAND—In all these small generators there is a reservoir and regulating valve for the water feed.

Mr. COSTE—Not with the small lamp?

Mr. HOLLAND—Yes, the acetylene lamp is a generator and lamp combined, no matter in what form you get it. One fact about the acetylene light is its wonderful diffusive power. Mr. Murphy, engineer on the Pontiac Pacific Railway told me this winter that the acetylene headlight pierced through fog and falling snow in a way that no other headlight can.

Mr. ANDREWS—Is there any way of overcoming the disagreeable odor of acetylene?

Mr. HOLLAND—There is no odor from acetylene when it is burning; the odor is from escaping gas, and the gas itself is not injurious to health until it is in such quantity as to displace the air, and then it kills by asphyxiation.

Mr. ANDREWS—Is there any way of taking the refuse from the generator without gas escaping?

Mr. HOLLAND—No, a certain amount of gas will always escape when the generator is opened, but the smell soon disappears. In some generators the refuse carbide is drawn off from the bottom like milk of lime. It is called the wet process.

Mr. ANDREWS—In taking the ashes out is there not always some carbide in them that contains a certain amount of gas that would cause danger from fire?

Mr. HOLLAND—Not where ordinary precaution is used. Before cleaning out the refuse, if sufficient water is allowed to enter the generator to decompose the carbide the ashes will be damp and and will give up all its gas, and while they will throw off a strong odor of acetylene there is not sufficient gas left to light with a match.

Mr. ANDREWS—Mr. Holland has referred to the advantage of being able to carry carbide with provisions in taking supplies to a mining camp. Does he refer to carbide in sealed cans or loose?

Mr. HOLLAND—Carbide must always be carried in air tight cans or drums. Like quick lime it readily absorbs moisture from the air and slacks, giving off its gas. The safest place to keep carbide would be alongside a furnace, or in a furnace for that matter. It will keep for any length of time in a dry atmosphere.

Mr. ANDREWS—What do you calculate the cost to be of lighting with acetylene?

Mr. HOLLAND—At the present price of carbide, $76 per ton, a 25 c. p. light costs about half a cent per hour. Of course this varies with the quality of the carbide. If Prof. Emmerson's process of utilizing sawdust as a source of carbon supply is a success, carbide of a superior quality can be produced and sold at such a low price that coal oil cannot compete with it in any sense. It is calculated that at Ottawa from 700 to 800 tons of sawdust are thrown into the river daily from the sawmills. During the coming season Prof. Emmerson proposes to convert that vast quantity of waste material into marketable products, one of which is carbon. The carbon is rendered chemically pure in the process of producing it, and used in connection with a high-grade lime the carbide made from it is of a superior quality. Prof. Emmerson believes that he can make carbide with it that will yield from 8 to 9 cubic feet of gas per pound, as compared with 5 feet from carbide made with coke and lime.

THURSDAY MORNING SESSION.

THE PRESIDENT, who took the chair at 10.30 a.m., called upon Mr. Bernard Macdonald, M.E., to address the meeting on

AN IMPROVED METHOD OF FEEDING WATER TO THE STAMP MILL MORTAR.

(Address reported elsewhere in this issue.)

THE PRESIDENT—Those of you, gentlemen, who have had anything to do with milling, especially gold milling, will appreciate Mr. Macdonald's paper. I wish simply to say that the device in its present application may be new, but that so long ago as 1882, I saw practically the same thing in use in a stamp mill in South Carolina. It is not a new device in the sense of the introduction of water below the level of the pulp discharge, it having been tried in California according to Mr Hobson, in quite a number of places, but the details of it are certainly to my mind new, and I know that some of the gold men are anxious to say something about it.

Mr. ANDREWS—If the object is to facilitate rapid crushing I could understand the advantage of it, but if the objects were to be confined to thorough amalgamation in the battery, I can hardly understand where the advantage would come in. I tried it myself and I think a few improvements could be made with a view of getting a better rate of amalgamation. For rapid crushing I can understand why water entering as indicated would not carry the pulp to the ground through the discharge as quickly as it could be got through the screen, but at the same time, as was mentioned in the paper, it would clear away all the ore from around the base die, and consequently in my opinion the strong current would be likely to carry fine gold, especially very fine gold, through the discharge which otherwise would have time to remain in the mortar and become thoroughly amalgamated. I found that trouble to a certain extent myself. I examined in that line again, trying to see if I could overcome that difficulty, and I have done so to some extent at the cost of rapid crushing, but giving me a better result in the amalgamation. I placed a pipe in the wooden chuck box conveying the water from the hole down lower, and this pipe has been perforated over the small jet plugs that are screwed into the pipe. I have had the jets pointing in between the dies towards the bottom of the mortar, keeping the coarse sand clear. The current then had a chance to protect itself and it gave the gold a better chance to amalgamate. I found that specially advantageous in a place where we had no concentrators. You will notice bubbles of air flowing from the water, running into bubbles and raising to the water level. I think there is room for considerable doubt as to whether these bubbles of air will not pick up a certain amount of the very fine gold, causing it to float and pass away. It was pretty freely discussed in the American Institute some years ago, as to this air coming into contact with the particles of fine gold and causing it to float away with the water.

Mr. STUART (Truro)—I have had some expesience in this matter myself and I wish to say a few words as to this new system which we are indebted to Mr. MacDonald for bringing before us. One of the most important matters in connection with this has not been mentioned in Mr MacDonald's paper. As all practical mill men know, it is a very important thing to introduce just the required amount of mercury into the battery in order to give us good amalgam. If we take too little, the fine gold is allowed to escape for want of amalgamation, and if we feed too much it is thrown out of the battery and passes down over the plates. Some few years ago this method was introduced at one of the Waverley mills by Mr. O'Shaughnessy in rather a crude way compared with that now presented to us by Mr. MacDonald. On the whole I may say that the experience of Mr O'Shaughnessy of running two batteries side by side on the same material, one with this method and the other with the old method of introducing the water was eminently satisfactory. He got about 90 per cent. of his gold in the battery with the old method, and in the new he got 98 per cent. He obtained in the various tests he made at least 1 per cent. more gold.

Mr. MACDONALD—You do not believe, Mr. Stuart, that it destroys the effect of the mortar as an amalgamating machine to have the water injected from below?

Mr. STUART—There can be no question about it improving it.

Mr. MACDONALD—In that you do not agree with Mr. Andrews?

Mr. STUART—I cannot from the experience I have had.

Mr. MACDONALD—That is my experience, too. May I ask Mr. Andrews how the air got into the water?

Mr. ANDREWS—By various methods. Water contains a certain percentage of air and churning might liberate it. There is also a possibility of the water running low in your pipes.

Mr. MACDONALD—I should think, Mr. Andrews, that the water falling over the top at a distance of three feet would have a far better chance of being aerated than in flowing through a pipe under good pressure.

Mr. ANDREWS—I should think there should be some chance of that, but there would also be a possibility of the water liberating the air. I do not maintain that bottom feed was not as good for amalgamating as top feed. I stated that under these very same circumstances I have found that the pipe swept the fine gold through the water, and that by feeding in the back with the very same mortar gave me a larger percentage of amalgam on my plates that by feeding water in front and turning the jet down instead of turning it back. I found I got a large percentage of my gold in between the shoes and dies but on the opposite side. I had the same experience you speak of except that I found I did not get as large a percentage of fine gold and amalgam on my outer plates. Our mill is giving an extraction of 95 to 100 per cent. of the total value of the quartz, and consequently the method of feeding water below must be advantageous for amalgamation. I am speaking of the back method rather than the front.

Mr. MACDONALD—If the amalgam was got on the outside of the plates it would be equally as good?

Mr. ANDREWS—We prefer to have the amalgam in the mortar, if possible.

Mr. MACDONALD—Unless your assays prove to the contrary it really made no difference if it was far on the outside plates.

Mr. ANDREWS—It is always a chance when the amalgam gets on the outside of the plates that it may be swept away. It might be a small lot at a time, which might never show in the assays, and might not be swept away at the time the assays were taken.

Mr. MACDONALD—There would be danger of the inside plates scouring and the amalgam coming through the screens and being washed off the plates.

Mr. ANDREWS—Since I have been using the bottom feed I find I have less amalgam on the inside plates, and I get most of my amalgam now right down on the bottom.

GOLD MEDAL FOR STUDENTS.

Mr. BELL, the Secretary, announced, that as last year, a gold medal would be offered for competition among Canadian mining students for the best original paper contributed to the Transactions of the Institute during the current year.

The object of this competition was to encourage observation and original work, particularly during their summer vacation. Last year the award had been made to Mr. Percy Butler, a graduate of McGill, now with the Guggenheim Smelting Co. at Perth Amboy, N.J. (Applause.)

DESCRIPTION OF THE SULTANA QUARTZ LODE AND THE SINKING OF THE BURLEY SHAFT ON BALD INDIAN BAY.

Mr. J. BURLEY SMITH, of Winnipeg, presented his paper on the above subject (reproduced in this issue).

Dr. G. M. DAWSON (who occupied the Chair.)—We are all interested in the sinking of this shaft, under somewhat unusual circumstances, and I dare say there are several here who would like to ask questions about it.

Mr. ANDREWS.—Mr. Smith spoke of the borings there as testing the lead. Were these tests made to find out whether the lead continued there, or the value of the lead?

Mr. BURLEY SMITH.—To find whether the lode continued there.

Mr. ANDREWS.—Would that be of any value for assaying?

Mr. BURLEY SMITH.—They were all assayed.

Mr. ANDREWS.—I have no experience in that line and I was thinking of trying it myself. Would you consider it valuable at all as an indication of the value of the lead?

Mr. BURLEY SMITH.—If you get a sufficient number of borings, I should think it would be. The same applies to the sampling of these borings as to sampling in the pigs and copper. The greater number of borings you have the more likely you are to arrive at the correct estimate of the value of the ore.

Mr. ANDREWS.—Could you give any idea as to the cost of sinking these borings?

Mr. BURLEY SMITH.—The cost of most of these borings was a little increased on account of the ice there. They had to be put down from the surface of the ice and as the weather there often goes to forty degrees below zero we had trouble with the freezing of the motor. All through the ground is very hard there and it cost us about $3.55 per foot on the average.

Mr. ANDREWS.—There was no very deep boring.

Mr. BURLEY SMITH.—No; the deepest boring was a trial bore of 300 feet to test the ground generally.

Mr. COSTE.—I have heard that my name was mentioned in connection with this matter, and that a remark was made about a report I made on that district in 1883, and I understand Mr. Smith has stated that I condemned the district.

Mr. BURLEY SMITH.—Oh no.

Mr. COSTE.—As I understand it, you stated in this paper that I said in my report there was no gold in that particular mine.

Mr. BURLEY SMITH.—Your report so stated with regard to the quartz as not being auriferous.

Mr. COSTE.—Well I have the report here and it will speak for itself as regards that. I may say that the report was written before we had the result of the assays and before they were made, but I will now quote from the report in order that there may be no misunderstanding about it:—

"This vein, called the Sultana lead, is about 30 feet wide. Its strike is 70°, and its dip south at an angle of 72°; the quartz is yellowish, hard, and devoid of minerals. I do not think it is auriferous. It reappears 500 or 600 feet to the east on another bay of Indian Bay; and also a quarter of a mile to the west, on the Island directly west of Quarry Island. In the foot wall of this quartz vein at 12 feet or thereabouts is another little vein with softer and whiter quartz, which is auriferous and contains mispickel, iron—pyrites and galena—probably argentiferous. The thickness of this little vein varies from 6 in. to 1 ft. The gneiss at the foot wall of this second vein, and between the two veins, is also changed into hornblende schist.

"'Pine Portage Mine' (shaft vein), ten miles south-east of Rat Portage, Lake of the Woods.

"A dark greenish schistose rock, intersected by numerous seams of calcite and containing a good deal of iron pyrites. The sample which consisted of a single fragment weighed two pounds nine ounces. Assays showed it to contain:—

"Gold .... Trace.
"Silver.... ..... 0·117 ounces to the ton of 2,000 lbs.

"'Pine Portage Mine' (shaft vein), one mile from the bottom of Pine Portage Bay, Lake of the Woods.

A greyish translucent quartz, associated with a little coarse crystalline calcite and containing, in parts, a trifling amount of iron-pyrites, weight of sample, a single fragment, one pound one ounce. It was found to contain :—

"Gold ..... 9.916 ounces to the ton of 2,000 lbs.
"Silver ..... 15.371 " " " "

"Maiden Island—small island three quarters of a mile east of Heenan Point, Lake of the Woods.

"The sample consisted of three fragments—the first a greyish, translucent quartz, associated with a small quantity of greyish green chloritic mineral, in parts coated ferric hydrate and containing here and there a little copper pyrites—the second a fragment of quartz much stained with ferric hydrate, contained in parts a little copper pyrites—the third, a soft greyish-green schistose rock, associated with a little quartz, it was in parts coated with ferric hydrate, and contained here and there a little copper pyrites, weight of sample two pounds fifteen ounces. It was found to contain :—

"Gold ..... 1.225 ounces to the ton of 2,000 lbs.
"Silver..... 0.175 " " " "

"Sultana lead (little vein), east shore of Indian Bay, eight to ten miles south-east of Rat Portage, Lake of the Woods.

"A very fine greyish white quartzite, holding here and there, a few specks of pyrrhotite and iron pyrites. The sample, a single fragment, weighed two pounds nine ounces. It was found to contain :—

"Gold ..... 0.992 ounce to the ton of 2,000 lbs.
"Silver ..... 0.467 " " " "

"Sultana lead (big vein), east shore of Indian Bay, eight to ten miles south-east of Rat Portage, Lake of the Woods.

A greyish sub translucent quartz, in parts coated with ferric hydrate. The sample, a single fragment, weighed two pounds one ounce.

"'Keewatin mine,' west vein, eight to ten miles south-east of Rat Portage, Lake of the Woods.

"A white quartz, in parts very much honeycombed, the cavities at one time most likely contained iron pyrites, which has been removed by weathering ; it was, here and there, stained with ferric hydrate, and contained a little iron pyrites ; minute specks of native gold were observed adhering to the walls of some of the cavities. The sample, a single fragment, weighed one pound three ounces. Assays showed it to contain :—

Gold..... 9.917 ounces to the ton of 2,000 lbs.
Silver .. .. 0.525 " " "

Mr. Smith will therefore see that I only mentioned one as not being auriferous, and that was proven afterwards by the assay.

Mr. BURLEY SMITH—I qualified that in my paper. I stated that the actual boring tests made lately at this particular place had shown that the quartz is not auriferous or contains the smallest trace of gold. Opposite the Crown reef there is a vein of about 14 feet wide which yielded a splendid mass of quartz and has really fine walls. I imagine you alluded to that, because it is patent you must have seen it. I must say at the same time that I feel myself very much indebted to Mr. Coste's report because it was owing to that report I first got the idea of following that lode up. It was pointed out to me by a man named Jake Hennessy. I trust Mr. Coste does not think that I cast any reflection on his report, because, on the contrary, I am much indebted to it.

Mr. COSTE—Far from this district not being rich in gold, I think it is quite the contrary. Although in 1883 there was very little work done, still there was enough to show, and the assays proved, that some of the veins were very rich in gold. For instance, one of the places that was open about a mile or so on the other side of the little peninsula—the Pine Portage mine—the vein was about 70 feet wide, with very little iron pyrites or any other mineral, and you could not see any gold in it, yet when it came to taking samples of the white quartz the assay has proved by analyses 12.77; another one assayed 9.68; another assayed 9.91 ; showing that some of the veins in the Pine Portage mine were very rich. Also in the Keewatin mine, one assay gave 4 95 ounces, another 9.91 ounces. My report cannot be said to condemn that district, but on the contrary it shows that some of the veins are very rich.

Mr. BURLEY SMITH—Your report was the best I read on the subject, and it led me to further exploration on that lode. With regard to that position, where the quartz re-appeared on the island, we got assays there quite 6 ounces. We have sunk a shaft slightly beyond that place and the lode was 25 feet wide, and there is gold visible.

Mr. COSTE—I think it is a most promising district. Some of the veins are very strong, well defined, and quite rich.

Mr. INGALL—I am glad Mr. Coste is here today, because I know that on several occasions allusion has been made to this report. People do not seem to have read it carefully or understood about the assays being published in another part of the volume separate from the report. It is well that Mr. Coste has made an explanation so as to clear up mistakes. I have heard it said that Mr. Coste stated there was no gold in the Sultana veins, whereas is was another vein altogether to which he alluded.

Mr. BURLEY SMITH—Anyone who reads the whole of Mr. Coste's report will see that he states that very clearly. There was not sufficient work done at that time to show up, but he mentioned many veins where there was gold. At that time it would be impossible for any one to judge by appearances.

Mr. COSTE—Even then my report went to show that the district was rich, and the assays proved it afterwards.

Mr. MACDONALD—I would like to ask whether that large body of auriferous quartz occurs at a vein paralleling the auriferous vein or as an isolated body.

Mr. SMITH—It is a vein parallel with it and over it. They are really lenses.

Mr. MACDONALD—Vertical?

Mr. BURLEY SMITH—They have the general dip of the other lenses.

Dr. DAWSON—It seems to me the most singular thing about that whole district is that it should have been opened up more than 15 years ago and reported on and known to be auriferous, and a good deal of excitement started about that time and it dropped through for years and years and has only been taken up again quite lately. It appears to have arisen entirely from the work having fallen in the first instance into the nands of people who are not versed in that sort of business and who made it purely a speculative matter. As far as I can make out that was the whole trouble at first, and only for that these mines might have been producing for the last fifteen years.

Mr. INGALL—It must be remembered, however, that there was difficulty as to the title of these lands and a dispute as to whether they belonged to Manitoba or Ontario.

Mr. BURLEY SMITH—That had an important influence in delaying their development. For instance, it was not known who could give the title to the Sultana Island, and it was only recently that the owner obtained his patent from the Ontario Government. The Ophir mine was opened by the John Taylor Company, and it was partly because of a disputed ownership, and also the prior timber limit rights of Mr. John Mather, and others, which caused the mine to be closed down. That mine will open some day and will, I believe, be one of the richest mines in the world.

Mr. INGALL—Was there not some difficulty also with the Indian Department?

Mr. BURLEY SMITH—The Indian Department at that time gave only such a patent as they were able to give. They did not guarantee it was a valid patent, but it was taken as being the best we could get.

Mr. LATIMER—Sixteen years ago I spent some time in the neighborhood and examined the locations and I can say that the great difficulty in connection with the development of that country was that a sufficient satisfactory title could not be obtained. The Sultana vein showed little gold, except on one side, at that time ; we could get only from $1.00 to $3.00, except on one side, where it was very rich. I recommended it at the time, and when they commenced to develop it they found the title was not satisfactory and they were afraid to make an investment. The title was a great difficulty, and then there was also a little want of confidence and want of capital.

Mr. BURLEY SMITH—Mr. A. W. Fraser, of Ottawa, who is present, is fully cognizant of all the legal difficulties of this case, and as the question has a strong bearing on the development of that district, I trust he will state the facts to the meeting.

Mr. A. W. FRASER—A difficulty regarding the title arose in the first instance because this was disputed territory. The Dominion issued patents to a portion of the island for the Sultana mine and also for three locations called the "Ophir Property." When the litigation between the Province of Ontario and the Dominion was decided in favor of the Province, it was then claimed that the Indian Reserve on the main land included Sultana Island, and that the Dominion had power to deal with the island as forming part of the reserve. In the precious metals case the Privy Council decided that the precious metals are vested in the Province. There are a number of cases dealing with these questions which are fully summarized in the very able judgment of Mr. Justice Rose, in the case of "Caldwell *v.* Fraser," and the judgment of Mr. Justice Rose was confirmed by the divisional court. This case sustained the title granted by the Province to the defendant, and from this time forward I expect there will be no further difficulty about titles. Regarding the Indian reserves, as I understand it, the Province has to confirm the reserves set apart by the Dominion before they become actual reserves, but this has not yet been done. So far as the precious metals are concerned, the authorities have decided that the Province only has the power to deal with them, and if the patents are granted of the mining rights it carries with it the right to work the mines. Even should it be held that Sultana Island formed part of the Indian Reserve, the Indians having surrendered their title the Province has full power to deal with the minerals.

THE PRESIDENT—With all due respect to the men from Ontario who may be here, I have never seen so many examples of bad management in the same territory as I have seen in the Province of Ontario. How much that has to do with retarding the progress of the country, perhaps I am not posted enough to say, but I can say that when you put men who are accustomed to hew timber, to hew rock, you make a mistake. The great trouble that has been in Ontario that they seem to think that a blacksmith can make boots and shoes for people to wear. They have had a class of management there which has been, to put it very mildly, thoroughly ignorant of the subject of mines. Of course there are exceptions, and I make exceptions in the case of several men. In June or July last I was in the Rat Portage country and I was informed that of all the number of stamps in the Lake of the Woods district, only three were running, viz : Regina, Mikado and Sultana. I know from my own experience of twenty years, in several districts, that for every one property that is intrinsically poor, and is a failure, there are at least a dozen good ones that are turned down simply because of incompetent management. I think the failure of the Lake of the Woods country to produce more bullion than has been produced during the last three or four years is due chiefly to the bad management which has prevailed, and not to the poverty of the country.

Mr. INGALL—Apart from the question of mismanagement that question of disputed title is very important it seems to me. No matter what representations may be made about a property, the first question asked you in New York or London when you go for capital is why have you not worked the district? It is all very fine to tell us about the district, but why was it not worked? Consequently it is of great importance that it should be known that this district was not worked because of the disputed title. The gold district of Beauce, in Quebec, has not been worked so well as it ought to have been for the reasons that the titles were not perfect and the people gave up in despair.

Mr. BURLEY SMITH—It is undoubtedly true that there has been mismanagement of mines, but it must be remembered that mismanagement always occurs in developing new fields of industry, and it occurs especially in mining because of the class of men who go into prospecting. Men who prospect are not supposed to be good mine managers, and it is only after the mines become developed that really good management is necessary.

Mr. B. T. A. BELL, Secretary—While admitting that the question of title had been a great factor in keeping back the development of the Lake of the Woods, that was a thing of the past, and hardly explained why the whole gold production of Ontario did not, so far, exceed $300,000 per annum. Hundreds of companies had been incorporated in Ontario during the past three years ostensibly to carry on mining, but I am afraid the disposition has been to speculate in undeveloped lands and to gamble in ten cent stocks rather than to produce bullion. In that new country there naturally had been ignorance in mining practice and costly mistakes had been made, but it was gratifying to observe of late substantial indications of progress and the gold output, not only of the Lake of the Woods, but of the Seine, and other sections of the Province would be considerably increased this year. The curse of gold mining in Ontario, and for that matter of other portions of the Dominion nearer home, was that our people had yet to realize that mining was a business, requiring skill and experience and economy, and to be successful must be managed on the same lines as other industrial undertakings.

A NEW DEVICE FOQ THAWING DYNAMITE.

Mr. DANIEL SMITH, Kingston, exhibited a patented device for thawing dynamite which his company, the Ontario Powder Works, has recently had on the market. The idea is that of a miniature boiler, and consists of a series of horizontal tubes of galvanized iron, fixed in a square water tight box of similar material ; so that, when the dynamite cartridges (fifty at a time) are placed in the tubes, horizontally, and not on end, and the box filled with water at about 115 to 125 degrees Fah. each cartridge is completely surrounded by the water, being thus warmed safely, uniformly and quickly to the temperature most suitable for use with the best

results. This method of thawing dynamite, laying on the flat in tubes surrounded by water, and not on their end, is safe, and much more effective than any other and I advise its use. Some may think I attach too much importance to thawing dynamite. I would say, thus far you have escaped damage by thawing before a fire, around a blacksmith's forge, or in the leg of your boot. You may the very next time pass over the danger line and be torn to atoms. Dynamite freezes ten or eleven degrees sooner than water, and is practically unexplodable by ordinary means, and every winter in this country brings a fresh crop of accidents while attempting to thaw it in an improper way. A very safe plan outside of our thawing box, on large work, is to have a frost proof room with means of keeping it heated to 70 or 80 degrees and have the dynamite placed around on shelves laying down flat, and not standing on end where it can thaw slowly through and through and about summer heat maintained.

The session thereafter adjourned.

THURSDAY AFTERNOON SESSION.

The President took the Chair at three o'clock.

Mr. J. W. EVANS presented his paper describing some work done on "The Gold Bearing Lands of the Vermillion River" (reproduced in this issue).

THE GOLD MEASURES OF NOVA SCOTIA AND DEEP MINING.

Mr. E. R. FARIBAULT, C.E., of the Geological Survey, next presented a paper on this subject (reproduced in this issue).

THE PRESIDENT—Mr. Faribault is well and favorably known to most of the members of the Institute, and especially to the gentlemen from Nova Scotia, in which Province he has spent eighteen years in mapping out the gold fields. You will agree with me gentlemen, that this paper is one of the most valuable which will be recorded in our transactions. I may say further, that considering that the Geological Survey of Canada is primarily an economic Survery, there is no department of its work which will give better results to the tax payers of Canada than that which is being done by its agents in the Province of Nova Scotia. I have a desire to discuss this paper as I spent ten years in the development of some of Nova Scotia's gold properties, but I give place to the many gentlemen who are present and who have equal or better experience than I have in that Province. I first of all would like to hear from the distinguished Director of the Geological Survey who, although he has earned more fame in calling Western Canada to the attention of the public, has of late years done the Eastern part of the Dominion no little service in proclaiming its similarity with the very famous Bendigo fields of Australia.

Dr. G. M DAWSON—I have great pleasure in endorsing what the President has said, particularly with regard to the work of the author of this paper on that very complex subject which he has been studying in connection with the gold fields of Nova Scotia. It is most pleasing to find that his calculations are all coming out in a clear and easily understood way; you might almost say with mathematical precision. I dare say some day some one will attempt to work out equations with regard to the relation of the folds and domes I will leave practical mining men to deal with this question. I appreciate the remarks of the President on this particular phase of the work of the Geological Survey, and I will leave him to call upon those who are practically familiar with the region

THE PRESIDENT—I shall call upon a gentleman who has had experience in the gold fields of Nova Scotia second to no man. I mean Mr. G. W. Stuart, the Mayor of the town of Truro, who is with us to-day, and who may be said to be one of the pioneers of the Nova Scotia gold mining industry.

Mr. STUART—Mr. Chairman and Gentlemen,—I am a practical man and I regret very much I have not the ability to place these questions before you with that eloquence for which your worthy President is noted. I must first say that Nova Scotia owes the Geological Department of the Dominion of Canada a debt of gratitude for sending a gentleman like Mr. Faribault to that Province, and Nova Scotia will never be able to repay Mr. Faribault for the work he has accomplished. I trust that the Government will see their way clear to have Mr. Faribault remain in Nova Scotia, so as to bring to a completion the work he has commenced. In order to appreciate Mr. Faribault's work and the manner in which he does it you have to be with him and follow him in the field: a more indefatigable worker I have never seen. It would, perhaps be useless for me to go over the whole ground of the gold industry in Nova Scotia with you this afternoon, and it will no doubt, be more interesting if I read to you a few excepts from an article which I contributed to the last number of the CANADIAN MINING REVIEW

[After reading the article in question and dwelling on the marked progress in mining and milling practice, notable of recent years in Nova Scotia, and the satisfactory increase in its gold production, Mr. Stuart said:]

You will see, gentlemen, from these statistics, that we are beginning to learn something about mining in Nova Scotia, although I am bound to say we are yet far behind the methods adopted in some other countries. For instance, in the last report of John Hayes Hammond on South Africa, he reports an average sinking in what they call their deeps between three and four thousand feet. The average sinking per month for each shaft is from 150 to 260 feet, whereas, we have never yet succeeded in getting a depth of over 80 feet per month in Nova Scotia. I do not know what you have been able to do in Quebec and Ontario, but I fancy you have not beaten the Nova Scotians very much. When you come to contrast the difference between 80 feet per month and that of from 150 to 260 feet per month in South Africa and that chiefly done by native labor, you will see that we have yet a good deal to learn.

THE PRESIDENT—The excitement of recent years, so far as mining in Canada is concerned, has been confined to British Columbia and portions of Western Ontario and as Mr. Stuart has said Nova Scotia has suffered somewhat by reason of that. Mr Faribault made reference to the Dufferin mine or the Salmon River mine and we have with us to-day the manager of that mine, Mr. Bernard Macdonald, an American citizen whose experience has been, not in Canada, but Montana and the Western States, where they are supposed to be very active and abreast of the times. We should be obliged to Mr Macdonald if he would give us his experience in Nova Scotia.

Mr. MACDONALD My experience in Nova Scotia has extended over a period of only about a year and I am perhaps not competent to pass judgment after such a short acquaintance with the Province; As to the rapidity in mining I know that the Nova Scotians cannot compete in speed with the people of the West. My experience goes to show that there is no means of making that speed and progress which Mr. Stuart has stated they make in South Africa. I assume that South Africa is like Australia and all the western places, British Columbia included, where they work Sunday as well as Monday in mining work, and that is not so in Nova Scotia so far as I am aware. For my part I would as soon stop a ship in mid ocean to rest her over Sunday as to stop a mine or mill. I think this will answer to some extent for the slowness of the progress in Nova Scotia, but it certainly does not give the full reason.

THE PRESIDENT—We have with us our youngest, but not least experienced, member, Mr. Andrews, and we would like to hear from him. He was formerly manager of the Richardson mine of which you have heard Mr. Faribault speak.

Mr. ANDREWS—I was quite interested in Mr. Faribault's comparison between the leads in Bendigo and the leads in Nova Scotia, especially with regard to their development in depth, and it was rather surprising to me to find that our leads compare so favorably with them. My limited experience has principally been in connection with some of the large bodies of ore in Nova Scotia, and particularly with those coming in close proximity to the anticlinal formation. I have watched Mr. Faribault explain all these formations and I find that his conclusions coincides almost exactly with my own experience. For instance at the Richardson mine, at the time of the discovery of that reef, the anticlinal formation was not much of an accepted theory. The lead was first discovered on the south dip, and it was developed by tunnelling eastward. The tunnel following the lead curved gradually northward, and then to the westward, forming a horseshoe, proving that the vein was on the eastern pitch of a dome. One reason why at that place we were enabled to obtain our quartz so cheaply was on account of the location of our shaft house, which was eventually located at the turn, there already being a shaft dipping to the southeast; and, after some expensive work, there were three shafts sunk on the turn of the anticlinal, all of which came to the surface at one big shaft house, so that all the rock was handled at the one place. The proper way to develop such a district, would be, as Mr. Faribault suggests, to sink a perpendicular shaft on the anticline through the lead or belt and carry it deeper to other saddle reefs lying one beneath the other in the same fold. I know there are a great many people who are under the impression that mining operations in Australia are confined to one lead, whereas, as a matter of fact, the larger mines have extended their operations in depth to a number of leads; but after all then, the large and numerous saddle-reefs and veins, which have been worked to such great depths in Australia, would not be as extensive by one-twentieth as those likely to be met with in depth in the Nova Scotia formation. This fact in regard to mining in Nova Scotia is a matter of great encouragement. I for one, though not born a Nova Scotian, but one who has spent a great deal of time there, believe that Mr. Faribault is deserving of a great deal of thanks for the work he has done in that Province.

Mr. FARIBAULT—Mr. Andrews has just brought out a very interesting fact. In Bendigo the saddle-reef veins seldom extend more than 50 or 100 feet below the cap, while in Nova Scotia veins have been worked 700 feet in depth, and theoretically they should be about twenty times as extensive as in Bendigo, giving an extreme limit of 1,000 or 2,000 feet. There has been a tendency in Nova Scotia, on account of the great extent of the veins, to confine the developments to individual veins, while in Bendigo the limited extent of the veins has led to development by means of perpendicular shafts and cross-cuts, new saddle veins being thus opened up one under another to depths of over 3,000 feet.

Mr. STUART—In proof of what Mr. Faribault has said I may mention that in the district of Goldenville there has not been over 400 feet of cross-cutting done in the whole district.

Mr. FARIBAULT—That is a noteworthy statement. Nova Scotia has had too few mining engineers capable of understanding the complex nature of the quartz deposits, and to this cause may be attributed most of the failures and the slow progress made by gold mining in the province.

Dr. LEDOUX—If there are very few good mining engineers in Nova Scotia, it occurs to me that the most of the good ones must be here to-day, for I have listened with the greatest of interest to these papers and I have been specially interested in the paper of Mr. Faribault. I am one of those who took occasion to complain of the fact the United States geological survey is constantly publishing very learned geological treatises and nothing very practical for the miner. I have recently been in Montana on which the United States survey has recently published a pamphlet, but that pamphlet is full of technical and geological terms, and it contains nothing as practical for the miner as this paper of Mr. Faribault. There is nothing in the United States work which the practical mining engineer could take hold of with a view of prospecting and getting a good return. I believe that Mr. Faribault's paper is going to make a record, and that it will be of immense value not only to this particular district, but to many others where, in all probability, the same vein formation occurs. Might I ask whether the granites ever show in gold at all—or in other words, were the veins which have followed these fissures segregated close to the granites?

Mr. FARIBAULT—Some of the districts, like Forest Hill, Moeseland, Country Harbour and Cochran Hill, are in close proximity to granite masses, but most of them are at some distance from them. At Forest Hill and Country Harbour I have observed granite dykes and veins cutting quartz veins which were worked, showing conclusively that the granite intrusion is later than the segregation of the auriferous quartz veins, and has not affected the richness of the veins in any way whatever.

Mr. STUART—At Forest Hill, near the shore of a lake, granite dykes were found to run parallel with and cut quartz veins and in several places it is shown very clearly and conclusively that the granite is of later origin than the gold formation. In another place the granite has shot out and has taken a section of the gold formation with it, and the leads will be found broken off and starting again running parallel with the granite, showing very clearly that this section was driven out of place by the intrusion of the granite.

Dr. F. D. ADAMS Mr. Faribault's paper embodies one of the best pieces of work which the geological survey of Canada has ever produced, and the survey is to be congratulated in having upon its staff men, who like Mr. Faribault, possesses the ability and perseverance required to unravel such complicated geological problems as those presented by the region under discussion. The director of the survey is also to be congratulated in that notwithstanding the various calls made upon the time of his staff, he has been able to keep Mr. Faribault at work in this region for several years, and has thus made it possible for him to carry out the work in the detail necessary to achieve such valuable results. Studies such as this show the enormous and direct practical value of accurate and detailed geological work in any ore-bearing region, as indicating in the first place where the ore is to be found, and in the second place how it may be most economically mined. The resemblance of the Nova Scotia gold field to that of Bendigo, as described by Rickard and others, is most remarkable In both fields we have an ancient series of sandstone and shales in both cases the same anticlinal folds with the transverse pitches, and in both cases an association of the ore-bearing rocks with granite intrusions. The fact, pointed out by Mr. Faribault, that the structure of the Nova Scotian field is on a larger scale than that of Bendigo, the anticlinal axes being further apart, the saddles larger and the "legs" longer, is a fact which must be a source of satisfaction to the fortunate possessors of claims situated on the domes of the Nova Scotian folds. The origin of the gold is in both cases a question of much interest, and the presence of great masses of intrusive granite

in each case, would seem to point to the heated waters which always accompany or are given off by such masses on cooling as the source of the precious metal. It is evident from Mr. Faribault's map that the whole gold field in Nova Scotia is underlain at no very great depth by granite, so that if this rock be the ultimate source of the gold, there should be an abundance of the latter. The question, however, is one which can only be decided by close observation and study of the veins and their relation to the surrounding rocks and it is hoped that with the progress of deep mining in the district, additional light may be thrown upon this very interesting and important subject.

Mr. B. T. A. BELL—This very excellent paper of Mr. Faribault's reminds me of the splendid service, he and other members of the Staff of our Canadian Geological Survey are rendering the country, and that the occasion is appropriate to express our appreciation as mine owners and mining engineers of their work. It is deplorable to think that gentlemen who possess their skill and ability and high technical training and whose investigations and reports are so valuable to the development of the mineral wealth of the country are so poorly and inadequately recognized by the Government. The appropriation made by the Dominion Government annually to this work is altogether insufficient to meet the growing necessities of the country and it is not surprising, therefore, to find, from year to year, many of the best men leaving the service for more remunerative professional work. Going no further than this room, I notice my old friend, Mr. Coste, at one time in charge of the Division of Mineral Statistics, who has since become rich in practical work done in our natural gas territory. Dr. Lawson, Mr. J. B. Tyrrell, Mr. W. A. Carlyle and many others have resigned and now occupy positions yielding them salaries more in keeping with their high professional attainments. We ought, as an Institute, to impress upon the Government not only the necessity of maintaining the Survey in a proper state of efficiency by paying its officers better salaries, but the imperative need of more suitable quarters to house the magnificent collections of the Survey, worth many millions of dollars. The present building, besides being altogether too small, is unsafe and may tumble about the ears of the staff at any time. With respect to the gold mining industry of Nova Scotia my views are too well known to require repetition. I can only reiterate what I have said many times before at these meetings, that the gold measures of that Province will amply repay investigation. The returns last year showing a gold production of over $600,000 on an invested capital of about half a million dollars must be considered distinctly creditable. One can readily realize what results may be expected when adequate capital is invested under competent and skilful administration. Until last year, when the Montreal-London Company started work on the Dufferin, comparatively little foreign capital has found its way into the Province, but the results from that enterprise under the skilful administration of my friend Mr. Macdonald, may be relied upon to give a fillip to mining enterprises in the Province.

Mr. INGALL—It seems to me that Nova Scotia gold mining can stand a very large investment of capital which will develop it into a much larger industry. If it does so, it will be very gratifying to me to have the statistics put together so as not to have B. C. have the heavy end of the log.

THE PRESIDENT—We should like to hear from Mr. Jas. Douglas, for, if I am not very much mistaken, he has seen one or more gold districts in Nova Scotia.

Mr. DOUGLAS—My knowledge of gold mining in Nova Scotia is so perfunctory that I cannot form a conclusion with regard to it. This paper of Mr. Faribault's puts a new face upon the whole question. It will encourage those who have invested money in Nova Scotia and who have been discouraged by the work they have done to extend their operations. It has determined me to point out to my friends the high and better hopes they ought to have, if they would only put back a little of the money they have already taken out.

THE PRESIDENT—We have still to hear from Mr. Coste, who was formerly connected with the Geological Survey, and who is now a distinguished mining engineer.

Mr. COSTE—I have listened to the paper of my friend Mr. Faribault with the greatest interest, especially as it points out a condition in Nova Scotia, which is somewhat different from the general conditions that exist in the districts of British Columbia and Western Ontario. In these districts you have veins and you follow your veins always the same between the two walls. It was only by very careful work that it could be brought out in such a clear manner as it has been brought out by Mr. Faribault. I believe, like Dr. Ledoux that this will be a record paper, that it will tend not only to the fame of the Geological Survey, but to the reputation of our Institute to have such papers in our Transactions.

THE PRESIDENT—I shall allude to one point which Mr. Faribault made and I think it is an important one. Mr. Faribault alluded to the similarity between the Silurian rocks in Nova Scotia and those of Quebec which underly the alluvial gravels of Beauce County. After experience in both sections of the Dominion, I think that the effect of the geological work which Mr. Faribault has been doing in Nova Scotia will very materially aid that search for the gold veins in Quebec which has been illusive hitherto. We know there is gold in the gravels, but we do not know there is paying gold in the quartz which occurs under precisely similar conditions. This part of the paper ought to be very valuable to those in Quebec. Reference has been made to sinking to determine whether these saddles really do occur in Nova Scotia. In 1891 I was in charge of a property in Nova Scotia in which I had an opportunity given me by my directors of sinking an experimental shaft to determine the question. Unfortunately I was only allowed to go 253 feet. We commenced on the anticlinal axes, but in sinking that shaft we opened nine different veins which never came to the surface. As to their auriferous qualities each of them showed a value, but out of the nine there were only two considered sufficiently rich to constitute milling ores. This is apart from the question; but there has been for the last eight years a decisive conviction that what I did in 250 feet could be done in 2,530 feet in proportion. Another feature which must be remembered is the very high quality of the Nova Scotian gold. Mr. Stuart gave you some figures as to the number of tons crushed and the number of ounces of gold, but I fancy many in the audience do not know that an ounce of Nova Scotia smelted gold rarely runs below $19.50, while an ounce of Yukon gold averages from $14 00 to $16.00, and in Grass Valley, Cal., $16.00 is a high price for an ounce of gold. When you have an ounce of Nova Scotia gold you have an article that is worth two dollars more than an ounce of any other gold in the world, except that of Victoria, Australia. The session then adjourned.

THURSDAY EVENING.

The evening session was entirely taken up by lantern projections, Dr. George M. Dawson exhibiting a large number of slides showing prominent mining works in Canada, from Nova Scotia in the East to British Columbia in the West. He was followed by Mr. A. C. McCallum, who exhibited a number of diagrams illustrating his paper on the Designing of Metallurgical Machinery. Mr. James F. Lewis, the popular vice-president of the Rand Drill Co., terminated the session by exhibiting a magnificent series of views showing the work done in constructing the celebrated Chicago Drainage Canal.

FRIDAY MORNING SESSION.

The President took the Chair at 10 a.m. After a number of new members had been elected, the Secretary read a petition respecting the Yukon Mining Regulations which had been forwarded by the Incorporated London Chamber of Mines and after having been considered by the Council of the Institute, had been referred to this meeting for action.

THE SECRETARY—I do not think any action we may take respecting this question of royalty will affect in any way the decision of the government in the matter. The Hon. Minister of the Interior, had emphatically stated that he would not make any rebate of the royalty. Every mining man in the country would sympathise with the efforts of the Yukon miners to have the royalty reduced or repealed, but nothing would be done by the Government at present.

Mr. STEVENSON—It is a question of policy with the Government.

Mr. FERGIE—It is a question that we should not interfere with at all.

THE PRESIDENT—In view of what the Secretary has stated as to the expression of sentiment on the part of Hon. Clifford H. Sifton, perhaps it is as well that this communication should be laid on the table.

Mr. Stevenson moved, seconded by Mr. Fergie that the resolution be laid on the table.

ELECTION OF OFFICERS AND COUNCIL, 1899.

Mr. Jas. F. Lewis, on behalf of the scrutineers, reported that 83 votes had been cast, two ballots being rejected, with the following results:

President:

Mr. John Hardman, S.B., Consulting Mining Engineer, Montreal, Que.

Vice-Presidents:

Dr. George M. Dawson, C.M.G., Director Geological Survey of Canada, Ottawa.

Mr. W. A. Carlyle, M.E., General Manager British-America Corporation, Limited, Rossland, B.C.

Mr. Hiram Donkin, C.E., General Manager Dominion Coal Company, Glace Bay, C.B.

Mr. George E. Drummond, Canada Iron Furnace Co., Montreal, Que.

Secretary:

Mr. B. T. A. Bell, Editor CANADIAN MINING REVIEW, Ottawa.

Treasurer:

Mr. A. W. Stevenson, C.A., Montreal, Que.

Council:

Mr. S. S. Fowler, S.B., M.E., London & B.C. Gold Fields, Limited, Nelson.

Mr. John B. Hobson, M.E., Consolidated Cariboo Hydraulic Mining Co., Quesnelle Forks, B.C.

Mr. Elliot T. Galt, Alberta Railway & Coal Co., Lethbridge, N.W.T.

Mr. Robert R. Hebley, Metallurgist, Hall Mines Limited, Nelson, B.C.

Mr. Archibald Blue, Director of Mines, Toronto, Ont.

Mr. James McArthur, Metallurgist Canadian Copper Co., Ltd., Sudbury, Ont.

Mr. Eugene Coste, M. E., Provincial Natural Gas & Fuel Co., Limited, Toronto, Ont.

Mr. Charles Brent, M.E., Rat Portage, Ont.

Mr. George R. Smith, M. L. A., Bell's Asbestos Co., Limited, Thetford Mines, Que.

Mr. J. Obalski, M.E., Inspector of Mines for Quebec, Quebec.

Dr. Frank D. Adams, McGill University, Montreal.

Mr. R. T. Hooper, Anglo-Canadian Asbestos Co., Montreal.

Mr. Wilbur L. Libbey, Brookfield Mining Co., North Brookfield, N.S.

Mr. Clarence Dimock, Wentworth Gypsum Co., Windsor, N.S.

Mr. C. A. Meissner, Londonderry, N.S.

Mr. J. R. Cowans, Cumberland Railway & Coal Co., Springhill, N.S.

GOVERNOR-GENERAL AND PREMIER BECOME PATRONS.

THE SECRETARY intimated that His Excellency Lord Minto, Governor-General, and the Right Hon. Sir Wilfred Laurier, M.P., had graciously consented to become patrons of the Institute.

AN EXECUTIVE COMMITTEE.

Mr. GEORGE E. DRUMMOND suggested the addition of two names to the Library Committee to work in conjunction with the Council. It has been found difficult sometimes to get a quorum of the Council together. He therefore moved that such an Executive Committee be appointed, to consist of Mr. H. A. Budden, Mr. H. E. DeCourtenay, Mr. Stevenson Brown and Mr. Meredith, together with the officers and Council *ex officio*.

Mr. LEWIS seconded and the committee was appointed.

Messrs. S. J. SIMPSON and J. J. Riley were elected auditors.

CANADIAN MINING AND METALLURGICAL EXHIBITION.

Mr. B. T. A. BELL suggested that it would be desirable at an early date to consider the advisability of holding a first class Canadian Mining and Metallurgical Exhibition in Canada, preferably in Montreal, where suitable accommodation could now be obtained. Such an exhibition would be a laborious undertaking and could only be successfully carried into effect by the co-operation of the Federal and and Provincial Governments. Other countries are showing the world what they produce and are advertising their natural wealth and in another year or two Canada would be in a position to make an exhibition that would be an eye-opener to outside capitalists. The year succeeding the Paris Exhibition would be a favorable time to hold it.

Mr. SNYDER—I thoroughly approve of the suggestion made by Mr. Bell and I believe the Canadian Mining Institute should take the matter up enthusiastically.

Mr. BELL—I would move that this meeting endorse my suggestion and recommend to refer it to the Council for future consideration. Carried.

THE GEOLOGICAL SURVEY.

Mr. B. T. A. BELL again referred to the small grant given to the Geological Survey by the Government and the wholly inadequate remuneration paid to its officers.

Mr. A. W. STEVENSON—I am sure that we all heartily approve of the suggestion made by Mr. Bell and in order to put it in practical shape I move, seconded by J. Burley Smith, the following resolution: "That the Canadian Mining Institute herewith places on record its appreciation of the services rendered to the mining interests of Canada by the work of the Geological Survey, and would urge on the Government the necessity of giving further financial support to that Department, with a view to the increase of its work in the mining districts.

"The Institute views with regret the various losses sustained by the Geological Survey of late years, in the resignation of so many of the experienced members of its technical staff, and would urge that steps be taken to give remuneration more in keeping with the professional standing and valuable services rendered by these gentlemen, so that it may be possible for the future to permanently retain their services and thus ensure a continuance of the valuable work already done."

The motion was adopted unanimously.

AFTERNOON SESSION.

The afternoon session was entirely taken up by the reading of papers by Mr. R. W. Brock, "On the West Kootenay Ore Bodies"; by Mr. James D. Sword, on the "Variety of Rocks and Ore Deposits of the Kootenay"; and by Mr. John Preston, "On a Test of the large Rand Compressor at the Caledonia Colliery, C.B."

Mr. W. H. GALLAGHER, seconded by Mr. SWORD, moved a Resolution in favor of the establishment of a Canadian Mint, but after some discussion the Resolution was not put to the meeting, it being resolved to give the matter further consideration later.

The meeting then adjourned after having passed a vote of thanks to the President, Secretary and Treasurer for their services.

ANNUAL DINNER.

At eight o'clock over 100 members and their friends sat down to dinner in the Ladies Ordinary, Windsor Hotel, Mr. John Hardman, S.B., presiding. The Hon. W. S. Fielding, M.P., Finance Minister, who is an Honorary Member, and Mr. H. M. Whitney, President of the Dominion Coal Company, occupied seats at the head of the table. The dinner was an unqualified success in every sense.

The toast list was a short one, idcluding "The Queen," "The President of the United States," "Our Mineral Interests" and "Our Guests," all the speeches being conspicuous by their brevity, no one exceeding the time limit of five minutes. Songs and recitations, of which an exceedingly generous programme had been arranged by the committee, were then in order, the members enjoying themselves hughly until midnigh. Dr. Drummond, the well known author of "The Habitant," contributed a number of selections from his writings which were greatly enjoyed. All the vocal and instrumental numbers were above the average, and the chorases were joined in very heartily, Mr. James D. Sword, as usual, adding greatly to the enjoyment with his songs and banjo accompaniments.

COMPANIES.

B. C. Mineral Properties, Limited.—An extraordinary general meeting of the British Columbian Mineral Properties, Limited, was held this month for the purpose of considering and, if thought fit, passing the following resolutions passed on February 27th, which were duly confirmed:

"1. That it is desirable that the company be reconstructed and amalgamated with the Klondyke and North-West Territories Exploration Company, Limited, by the transfer of the undertakings and assets of both companies to a new company." "2. That for the purpose of such reconstruction and amalgamation the company be wound up voluntarily, and that Mr. Herman Hendricks be and he is hereby appointed liquidator for the purpose of such winding-up, at such remuneration as the company at this meeting shall determine." "3. That pursuant to Section 161 of the Companies Act, 1863, the agreement dated Feb. 9th, 1899, and made between the Klondyke and North-West Territories Exploration Company, Limited, of the first part, this company of the second part and Francis John Stephens on behalf of a new company intended to be incorporated with the names of the Klondyke and North-West Territories Exploration Company, Limited, of the third part, be, and the same is hereby approved and sanctioned, and the liquidator is hereby authorised to carry the same into effect with such modifications (if any) as he may consider expedient."

Mr. Hugh Stanton (Chairman) presided and explained the object of the amalgamation. We have a twofold object in thus naming the new company. The first is that the shares, which have been largely dealt in in the past, shall not lose their distinctive name on the market, and the next is that the title of the company appears to us to be all-sufficient to cover the objects of the combined companies. I may confidently say that the project which we have in view has met with practically the unanimous approval of all the shareholders. From what I stated to you at our general meeting, which was held in May last, you are aware that ever since the incorporation of this company we have been working in close connection, and, I may say, upon the most friendly terms with the board of the Klondyke and N. W. Territories Exploration Company, Limited, and we have been taken into the confidence of the directors of that company, so that we are perfectly *au courant* with the locations and properties which have been acquired by its exploration party in the goldfields of the Klondyke and Yukon territories. It was our intention to join hands with the Klondyke Company in developing these properties with a view to their resale to subsidiary companies to be jointly issued by us, and towards these objects we should, of course, have had to provide a substantial amount of capital. I may therefore, tell you that it was in these circumstances that the directors of the Klondyke Co. and ourselves came to the conclusion that the best thing to do was to amalgamate the two companies, and to consolidate the interests we have in our mining properties in British Columbia with those gold-bearing claims owned by the Klondike Company in the Yukon territory. Mr. Ritchie is under an arrangement with the Klondyke and N. W. Territories Exploration Company, Limited, and we shall, therefore, if you adopt the suggestion made, participate fully as shareholders in the joint company in what we venture to believe is an immense advantage to any company, viz., the services of Mr. P. R. Ritchie as a general manager and adviser. The results obtained by Mr. Ritchie in the Klondyke serve amply to prove the excellent judgment and the untiring energy of that gentleman in the interests of his company, and I feel sure that it will be manifest to you, without further remarks from me, that this company must of necessity gain a considerable advantage by having him associated with the working of the properties which we have, or may hereafter acquire, in the most promising gold-bearing regions of British Columbia.

We have now a thorough organization on the other side. We have the means of seeing that our properties are properly tested and developed, and upon results obtained we shall be able to determine whether we shall work these properties for ourselves or dispose of them to satisfactory companies. You will get par value in exchange for your shares, and you are not called upon to incur the slightest liability, and therefore it seems to me that the proposed amalgamation must needs be in every way beneficial to yourselves. There are many of you who are shareholders in both companies, so that the amalgamation which you are called upon to authorize will most undoubtedly serve to consolidate the interests and benefit the shareholders. Our own shareholders will have the first opportunity of securing allotments of the capital, and it is our intention to extend this privilege to any friend or friends of any of our shareholders whom they may wish to nominate for allotment or allotments. The policy of the newly constituted company will be that of active development. We shall possess many valuable properties, which, we feel sure, will amply repay for the funds which we shall ask to be expended upon them, and we trust that by vigorous development, the provision of the best machinery, and the assistance of a thoroughly capable technical management, to be able to earn for our shareholders dividends which cannot fail to be regarded as very satisfactory.

The Chairman here invited the fullest discussion, after which the resolutions were carried unanimously.

The meeting terminated with a cordial vote of thanks to the chairman.

Hall Mines (British Columbia).—The directors of this company are applying to their shareholders for a subscription to an issue of £50,000 6 per cent. first mortgage debentures upon the terms that they may be converted into ordinary fully-paid shares within a period of three years. In order to do this it will be necessary to increase the ordinary share capital, and in the event of a sufficient number of applications being received a general meeting will be called for the purpose. The board does not appear to put forward a strong case, but rather seems to invite a vote of want of confidence. It has apparently, by a previous circular to the shareholders, attempted to raise these debentures, and now states that unless an adequate amount of the debentures are taken up by March 20th, they see no alternative but to call the shareholders together and take steps to obtain such necessary capital through the reconstruction of the company, and this, although the directors state they will take their proportion of the debentures, amounting to abont £10,000. It certainly seems very remarkable that the company which was formed only in 1893 to acquire the Silver King Mine and the Kootenay Bonanza Mine with some others, and has since paid, in 1897, a dividend of 10 per cent., in 1898 one of 5 per cent., and whose profits to September 30th, 1898, were over £28,000, should be in such a state. In the schedule to the circular a list of the properties are given, and the mines and minerals claims are valued at their cost price, £207,306; plant and machinery at the mine, £22,011; an aerial tramway, £18,729; a smelter with refining furnaces, £42,398; and lands and timber, £2,938; with the addition of the cost of development work in the Silver King Mine during the year ending September 30th, 1898, of £10,277. What has this board been doing if the only addition in development is this £10,000, while plant, buildings, smelter, &c., reach a total of over £80,000? The directors answer this, in a way, thus in their circular:—"The board would point out that besides the mine, plant, and timber lands mentioned in the schedule the company is possessed of smelting and refining plant, which cost £42,000, capable of earning profits apart altogether from the mine." This looks very much as though, instead of spending money in developing the property which was paid for at the starting of the company, and for which the shareholders gave the somewhat handsome price of £175,000 in fully-paid shares and £40,000 in cash for the privilege of developing, they have spent the money which might have been so employed in the way which has brought so many companies to an untimely end, in erecting expensive plant and machinery before such was required, and which can only be used, until the property is developed, in earning profits apart from the property for which the company was formed. Of the board we only have to say that they are certainly sufficiently numerous, numbering no less than than seven. When they have to meet the what would appear inevitabie reconstruction meeting, they, doubtless, may have some explanation how it is that after paying £28,000 in profits they have no money to develop property which is undoubtedly valuable.

The Estate, Finance and Mines Corporation.—The following cable has been received from the manager of the Fairfield Exploration Syndicate, Limited, in Vancouver: "Output for the month ending 28th February, 1216 oz. bullion—gold, 367 oz., value $7,530 (£1553); silver, 621 oz., value $406 (£84); total, £1637. 808 tons treated, value: gold, $12.43; silver, $1.02. Calculated extraction: Gold, 83 per cent.; silver, 58 per cent. Five stamps ran eight days nine hours, ten stamps ran eleven days two hours; crushed 737 tons. Main tunnel (11th February) in 428 ft.; still in the ledge." Office note—The value of the output for January was $6,251 (£1288). The manager reports that he has been much hindered by heavy snows followed by rapid thaws.

ENGINEERING NOTES.

Mica Substitutes Glass in Miner's Lamps.—In order to guard against accidental breakage of glass in an ordinary miner's lamp, Mr. Max Raphael, of Breslau, Silesia, has constructed a cylinder of double plates of mica, each of which have their vertical edges united in metal to form a secure joint. The smaller of the two cylinders is enclosed within the larger, and thus leaves a small annular air space of about $\frac{3}{4}$ of an inch wide between. The two vertical joints coincide so as to intercept as little light as possible, although this may be a disadvantage as regards strength of construction. The two cylinders are kept in position, top and bottom, by being inserted into two brass rings, having annular rims, the edges of which are turned towards one another. The grooves thus formed contain some red lead cement, in which the edges of the mica cylinders are embedded, thus ensuring air-tightness. When thus formed, the double cylinder is let into the lamp cage to replace the usual cylinder of glass. Lightness is one of the advantages claimed for this arrangement, and less liability to breakage, which, in the case of glass lamps, is a serious matter in the presence of inflammable gas and coal-dust. For, even if the outer cylinder should by any chance be fractured by a knock, the inner one would, in all probability, remain intact. It must be allowed that these advantages are not gained without a slight diminution of light as compared with glass, for mica is not quite so transparent; but this objection will not weigh seriously where increased security against explosion is considered.

Automatic Doors for Collieries.—Any arrangement that will tend to reduce the risk of accident in the coal mines and underground workings is of the utmost importance to all who are connected in any way with mine operations. One of these safeguards is fully described and illustrated in the "Colliery Guardian" of January 13th. It has recently been introduced, and an additional point in its favor is that it will save manual labor. Pressure on the rails on either side of the door is the principle upon which the action of the apparatus depends. The doors open automatically on the approach of the wagons under any circumstances (even in the case of a runaway wagon), and immediately close when clear through. The doors are of sheet iron stiffened with angle iron and are in two parts, opening right and left, being suspended on an overhead racer which is secured to the top beam of a stout timber frame, constructed to exactly fit the heading. Attached to each half door is a small link which is connected to a long lever called the opening lever, which latter is attached to a short shaft passing through the bottom timber of the frame, to which shaft is keyed a cog-wheel. The action of opening and closing the doors is controlled by the sinking slightly of the rails. These are cut into two pairs on each side of the door and placed in a tilted position, rising about 4 inches from the usual height and sloping down again towards the door. They are kept up by a carriage spring underneath at the tilted ends. Attached to the chair holding the tilted ends is a small lever, keyed to the end of a long shaft on either side of the rails, which shafts pass through the bottom timber of the frame. Keyed to these shafts and flush with the bottom timber are two cog-wheels which gear with the two which actuate the opening levers. The opening spaces in the frame, on right and left of the air door, can be fitted with doors for the passage of the workmen. The rails are in their normal position when tilted, the air doors consequently being closed. On the approach of a train of wagons from either side of the door, the rails are instantly depressed down to the sleepers, and the small levers on the long shafts cause the shafts to slightly revolve; this motion, acting on the wheels of the opening levers, the doors rapidly slide open and remain so until the last wagon of the train has entirely passed over the down-pressed rails on the far side. As soon as the weight is off the rails the springs underneath force them up again and the doors are closed as easily as they opened. The weight of a single empty wagon is sufficient to open and close the doors. When the air doors are open it is impossible for anyone to pass through the side doors, for these openings are covered over, so no one can tamper with the working of the doors in any way. The side door only opens one way, and that is against the air currents, so that when both doors are closed the ventilation is perfect.

Temperature of Battery Water.—"The temperature of battery water" is receiving attention of many mill men, and from the variety of opinions published, based on personal experiment, it would appear that other conditions than the temperature of the water are important factors in amalgamation of gold ores in batteries and on plates. At the Homestake mills, Lead City, S. D., the superintendent after a series of careful experiments lasting a considerable period determined to his own satisfaction that the best results were accomplished at a temperature of 52°. The temperature is obtained during winter by heating the water and in summer by pumping it to a tank located in a tower from which it was allowed to fall through screens, and exposed to the draft of revolving fans which reduced the temperature to the desired point. It may be that although 52° is the proper temperature at the Homestake mine, that this temperature would not be found to give the best results in Arizona or in California or Colorado.

That the character of the ore is an important factor there is little doubt, and there is reason to believe that the size of the gold particles may also have an important influence on the behavior of the quicksilver. In some ores the gold is in an extremely fine state of division; in others it is comparatively coarse and it is not to be expected that two such widely different ores would act similarly even were the temperature of battery water the same in each case. Many mill foremen take careful note of the result of the operations in their mills under varying conditions; some are satisfied to let well enough alone and often claim they are accomplishing the best possible results, when they really do not know such to be the case.

Treatment of Zinc Ores.—Recent advance has been made in the treatment of zinc ore containing iron by magnetic separation. The separation of the two metals had hitherto only been possible in cases where the particles were of comparatively large size so as to allow of their treatment by a process of concentration by gravity, the iron being the heavier. The impurities which affect the value of zinc are iron and lead. The former, which is the most frequent, renders the metal much harder and causes it to heat and crack during the rolling of zinc plates. Lead is generally present to a small degree, being introduced from the galena which so often accompanies the ore. Zinc is extracted by a process of distillation, which is rendered easy, as the metal volatilizes at a bright red heat. When the sulphide is used for this purpose it is first roasted to get rid of the sulphur. Lead is separated from the zinc during the treatment by heating the pigs of zinc on the sloping bed of a furnace. As they melt and run down to the bottom the lead, being the heavier, collects in the bottom of the hollow and the upper layer of zinc can be run off. The deposits in which the ore is usually found are, like most deposits in limestone, irregular fissures and pockets connected by stringers. The ores which occur are the sulphide of zinc (blende) and the carbonate (calamine). The former carries 60 per cent. zinc when pure, but averages 40 to 60 per cent. in practice. Calamine is a white, pearly ore containing up to 52 per cent. zinc, and was for a long time the principal ore worked. The red oxide of zinc is found in some places. When heated before the blowpipe it gives a characteristic incrustion on the charcoal which turns green when moistened

with cobalt solution and re-heated. Various other metals in combination prejudice this test. Galena has a specific gravity of 7.5, blende 4.2 only, so that the one ore is nearly twice as heavy as the other. Galena is also much softer than blende.

Nickel Steel for Boilers.—Nickel steel forgings are used to a limited extent in engine building, but we think few engineers have ever thought seriously of using nickel steel for boiler plates. Commodore Melville, of the United States Navy, is so pleased with nickel steel engine forgings, that he regrets so few companies have taken up this class of work, and he is prepared to use nickel steel exclusively in the construction of boilers. He tells how he found it necessary to find a way of reducing the thickness of the shell-plates of cylindrical boilers. The shell-plates in the *Alabama* class had reached a thickness of $1\frac{7}{8}$ in., in material, having a tensile strength of over 65,000 lbs., and elastic limit of over 35,000 lbs., with an elongation of 24 per cent. in 8 ins. for longitudinal specimens. Experiments were made on a higher carbon steel, oil tempered and annealed, having a tensile strength of over 74,000 lbs., and an elastic limit of over 40,000 lbs., with an elongation of 21 per cent., and a very satisfactory transverse cold bending test. Such material allowed a slight reduction in thickness from that used formerly, although the boilers were designed for the higher pressure called for in the new battleships. Nickel-steel bracing and rivets were made and tested and found suitable for use with this high-grade compound boiler plate, easily reaching the Bureau's specifications. Experiments have also been made with nickel steel to fill the high-grade shell-plate requirements; and these gave very satisfactory results, with a surface much better than that furnished for other boilers, but not as perfect as that of the high-grade carbon steel just described.

We should think that steel with a slightly increased percentage of carbon can be alloyed with nickel to meet the highest requirements; and we believe that in a very short time nickel steel will be in demand for all descriptions of boilers.

A Montana Miner's Tools.—In Anaconda, Jas. Bray has seven tools made by himself, three being pole picks of the kind used to break off samples of rock and four candlesticks. The eyes and straps of two of the picks are forged from one piece of steel, the wood of the handles worked into the straps. One of the candlesticks is made so that it can be taken apart and fits into the end of the handle of one of the picks. Another has a pistol grip in place of the ordinary loop or ring, and can be closed up somethiug after the manner of a clasp knife. A cover working with a spring fits over the socket into which the candle is inserted, and is so arranged that as soon as the candle is consumed even with the top of the socket the cover flies forward and extinguishes the candle. In addition, Mr. Bray has still another folding candlestick, made to be carried in the pocket. It is so arranged that either the hook or spike can be used, or both can be folded back and the stick carried in the hand. Another stick has a knife attachment connected with the hook for cutting fuse, an arrangement for splitting the fuse and ripping open the paper that covers giant powder in case it is found necessary to crowd it into a small hole, and also an appliance for crimping the cap. This stick is also provided with the automatic extinguisher.

Ramsay Caging Apparatus.—The Ramsay caging apparatus consists essentially of two steam rams placed back of the shaft, and two transfer trucks running on a track across the tipple in the rear of the head-frame, which are operated by a steam cylinder. Its operation is as follows:—After a car has been dumped it runs back by gravity past one side of the head-frame on to one of the transfer trucks, which is then moved by means of the steam cylinder to the rear of the compartment, where the next loaded car is coming up. When the cage with the loaded car is at the landing the empty car is pushed by means of one of the steam rams against the loaded car, which is then taken off the cage and the empty car left on the cage ready to descend, so that the loaded car is shoved from the cage and the empty pushed on all at one operation, thus saving considerable time in the caging. When one transfer truck is back of the head-frame with the empty car, the other truck is in position to receive the empty car as its comes from the dump. As to the capacity of the apparatus, there has been handled 3,021 tons of coal in 8½ hours, or for 275 days an average of 2,143 tons a day. While this apparatus has thus far been used at the coke-works mines, it would seem that its combination with automatic cross-over dumps, at a tripple with two dumps, would form an advisable combination at a mine.

The Advance in Copper.—The doubling of value of stock in the big copper producing companies is only a surface indication of the tremendous activity in copper mining everywhere. A product selling in open market for 18 cents and costing 6 cents per pound to produce is in active demand, and the world is being ransacked for this metal that electrical development has made so permanently valuable. Nothing but excessive production can check the present demand, and nothing (except prohibitory and extortionate figures) can quickly check the advance in price. For nearly seven years increasing foreign consumption has sustained the American copper market; now that domestic requirements have been augmented, the price mounts still higher. Since '94 the American copper production increased from 160,000 tons to 234,000 tons; in the same time foreign production decreased from 90,000 tons in '94 to 85,000 tons in '98. Meanwhile exports of American copper have risen from 77,000 tons in '94, and 65,000 tons in '95, to 145,000 tons in '98, thus leaving for domestic consumption 83,000 tons in '94 and 106,000 tons in '95, and in '98 but 89,000 tons. In addition it is to be noted that when the big French syndicate went to pieces just ten years ago, it left 170,000 tons in the hands of the sub-syndicates of bankers. Lake copper then fell to below 10 cents, and the bankers called for a conference with the leading American producers. The Calumet and Hecla people told them that if they wished to market their copper the price would be about 5 cents per pound, and they would be found willing to meet the market at that figure, with the Anaconda also in competition for the market. This was bitter, but resulted in an agreement that there be no restriction as to the price of copper, but the Calumet and Hecla and the Anaconda agreed not to increase their output in consideration of the bankers agreeing to market only a limited amount per annum for their accumulated supply. That visible supply of copper in March, '89, has come down from 170,000 tons in the hands of the bankers' syndicate to a total world's visible to-day of 26,000

tons, and the world through a dull industrial period the past ten years has been absorbing 15,000 tons of copper per annum more than the world has been producing. Now on both sides of the Atlantic there is increased consumption, the smallest visible supply ever known, and little probability of new copper fields now being opened becoming immediate important factors in production. Meanwhile those who are trying to corner the market are taking a lesson from the dear-bought experience of the French syndicate, and, instead of trying to control the product, are attempting control or ownership of the mines themselves.

United States Will Give No Concessions on Lead Duty.—A Washington special says: "The lead interest will not suffer by reason of the negotiation of the treaty between Canada and the United States. Republican friends of the lead interest in this country have been especially active, and Senator Shoup of Idaho says that, after careful investigation, he believed there was no fear whatever of the incorporation in the treaty of any clause which would unfavorably affect the lead mining industry of this country. The knowledge of strenuous opposition in the Senate to any such proposition will, it is believed, be sufficient to prevent its incorporation in the treaty, which must subsequently be ratified by the Senate. Senator Shoup has been actively engaged during the past week in running down the rumors of action adverse to the lead-mining interests, and is satisfied that, if they ever had any basis, they have no standing before the joint commission."

Canadian and American Asbestos.—Manufacturers of asbestos textiles in the United States obtain their supply of crude material almost exclusively from the Canadian deposits of chrysotile at Black Lake and Thetford, as is shown by the reports of the Bureau of Statistics of the Treasury department of the United States. The total value of the asbestos imports for the fiscal year ending June 30th, 1897, was $191,097, of which the imports from Canada were worth $190,971, the difference ($126) being made up by two small shipments from Germany. Canadian asbestos, or chrysotile, possesses greater strength and elasticity of fiber than the American product, and is consequently much preferred for the manufacture of woven fabrics. Occurrences of chrysotile similar to that of the Canadian product have been noted in the United States in Loudoun County, Virginia, and near Casper, Wyoming, but conditions have not been favorable to their successful development, and, except for specimens and the necessary assessment work to maintain title, they have not been exploited. Fibrous hornblende, or true asbestos, which is produced commercially in the United States, is not so well adapted for the manufacture of textiles as the Canadian chrysotile, owing to the brittleness of fiber, but for such purposes as fireproofing, paints, boiler and safe packing, etc., where strength of fiber is not essential its heat-resisting qualities make it valuable. The use of the American product is, therefore, confined to these lines.

The Mica Industry of the United States.—Dr. D. T. Day, in his recently issued volume of "The Mineral Resources of the U. S., 1896-7, says:—"While the domestic product in 1897 was larger than for several years, it was not much more than 25 per cent. of the value of the mica produced in the United States in 1884. The importation of India mica began in 1884, and its effect upon the domestic production was immediately appareut. Mica was on the free list prior to 1891, and the inability of our mines to compete with it is shown in the decrease from $368,525, the value of the domestic product in 1884, to $161,000 in 1895. In the fifteen years preceding

1884, the value of imported mica had not exceeded $14,000, in any one year, and the average for the period was only $4,658 per annum. In 1884 and 1885 the value of the importations was not large, being something over $28,000 in each year. This was, however, for rough mica, and no estimate can be made as to the value of the cut mica obtained from it. The same may be said of the years succeeding 1885. The demoralization of the mica-mining industry in the United States since 1884 is the best indication that the value of the imported mica has not been overstated. In the five years 1880 to 1884, inclusive, the value of our domestic product averaged $256,000 annually. In the next twelve years, ending with 1896, the average annual value of the product was $86,000. During the same period the imports averaged nearly $120,000. That is to say, the average value of the domestic product in the two periods shows a decline of 66⅔ per cent., while the value of the imports in the second period was more than 25 times that of the first. The average value of the domestic product in the first period was more than 50 times that of the imported. In the second period the value of the imported mica has been nearly 1½ times that of the domestic, and as stated before, the values given for the imported product particularly during the years 1891 to July, 1897, when an *ad valorem* duty was imposed, have not been excessive. The value of the domestic product in 1897 was about one-half that of the imported.

The Portland Mining Company, of Cripple Creek, has decided to fit out its main shaft with steel, the supports and sets to be of that material, with timber for lagging, on the ground that a shaft constructed of steel will be stronger, more durable, and cheaper than the ordinary timber shaft, with a saving in the time of construction. According to *Modern Machinery* for December, the corner posts are to be of structural steel one inch thick, cast at right angles with the angles inside, the several lengths solidly bolted together. The square sets are of the same style of iron, to be firmly bolted to the uprights at intervals of six feet. The lagging is to be of 4 inch plank, set in endwise, with broken joints, so that the pressure will in no place come against more than six feet of plank. The cost of the steel structure with the heavy lagging is just the same as if the shaft lining was composed entirely of wood, but the saving is in the rapidity of construction, the greater durability of the steel, and the saving in excavation. A timber shaft requires timbers of from 10 to 12 inches square, while the steel is but three inches thick, and on account of its shape, presenting a sharp edge to the rock, can be readily fitted with a few blows of the pick. The saving in excavation in a three-compartment shaft, such as that in use in Portland, amounts to nearly a yard and a half of rock to every foot of depth gained—an important matter in such a shaft as the Portland, with its 1,000 feet of depth.

The Ruhr district of Westphalia has lately shown great enterprise in making provision for dealing with an increased output from the colleries. A great many new and powerful winding engines with spiraloid drums have recently been erected there. The Gutchoffmurgshutte Co., of Oberhausen, has made four engines for a net load of 3-3 tons, one for a lift of 273 fathoms for the Neumuhle Colliery, and the others for lifts of 382 fathoms, one for the Rhein-Preussen, and the other two engines for the Zollverein Calliery. The Friedrich Wilhelm Hutte Co. at Mulheim has built an engine even more powerful for raising a load of 4-4 tons from a depth of 437 fathoms for the Wilhelmine Viktoria Colliery, and two engines, each capable of raising 2-2 tons of coal from the depth of 382 fathoms, for the Mathias Stinnes Colliery. The diameters of the spiraloid drums are 21 ft. 7 in. and 33 ft. 10 in., and the width 6 ft. 10 in., while the diameter of the shaft, which is 32½ ft. between the centre lines of cranks, is 26½ in. in the middle and 18¾ in. in the bearings. With these engines the angle made by the rope with the vertical plane passing through the headgear pulley becomes considerable in the extreme positions, causing oblique strains on the pulleys very unfavorable to their preservation, and also to that on the winding ropes which rub against the groove edges. For counteracting this difficulty, it was found necessary to erect the engine at a considerable distance from the shaft; but in such case, owing to the great distance between the drums and the pulleys, the ropes are subjected to so considerable a sagging as might occasion a fall of the cages in the event of a sudden stoppage.

An alloy of iron and nickel containing 45 per cent. of nickel is said to have the same coefficient of expansion as platinum. The latter possesses the same expansive and contractive qualities as glass, rendering its use for the manufacture of the leading-in wires of incandescent electric lamps hitherto universal. Possibly the nickel iron alloy may become a competitor in this kind of work.

Wonderful improvements are said to have been made in certain coal mines in Pennsylvania by the introduction of electric power for pumping and coal-getting. The Cumberland and Elk Lick company has put in an electric generator. An insulated trolley cable traverses the variaus headings. The squatty, odd-looking motor, which supplants the mule, weighs eight tons and pulls 20 or more loaded mine cars on a trip. The mine has also in successful operation an electric pump, which keeps the wet portion clear of water. The electric plant of the Merchant Coal Company is utilized in undermining the coal. The digger consists of a motor stationed on a sliding carriage and propels an endless chain upon which are a number of steel claws, not unlike the teeth of a large circular saw. The machine is staunchly braced up against the breast of the coal and the current turned on. The chain begins to revolve rapidly and the claws are forced into the coal, cutting clear and clean 42 inches wide to a depth of seven feet under the coal in a few minutes. This operation is repeated until the full width of the breast is undermined. The machine is then loaded upon a truck, requiring but a few minutes, and is removed to another room. The miners of the room that has been undermined "put in a shot" and discharge it, knocking down the entire breast of coal. As high as eleven cars of coal have been loaded from one shot. In a short time two machines in each of the three mines will be at work.

All nitro-glycerine compounds freeze and become hard at about 42 degrees Fahrenheit. In this condition they will not readily explode. When large quantities of powder are to be used a separate building for that purpose should be fitted with a small steam radiator. Use only exhaust steam for heating the same if possible, keeping the temperature of the room at about 80 deg. Fahr. In the part of the room at the greatest distance from the radiator, place the powder on racks to thaw. When but small quantities are required to be thawed, a thawing kettle may be used, being two watertight kettles (one smaller than the other), the cartridges to be placed in the smaller kettle, and the space between the two kettles filled with hot water at from 120 to 130 deg. Fahr., the kettle being fitted with a cover to retain the heat. Under no circumstances, however, should the kettle be placed over the fire. When more hot water is required, empty out the cold water and fill again with hot water.

Advertising Pays

Montreal, 21st February, 1899.

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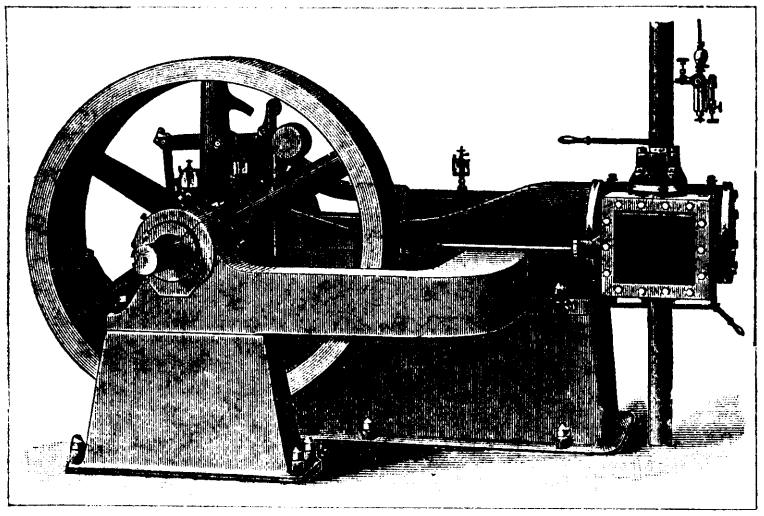

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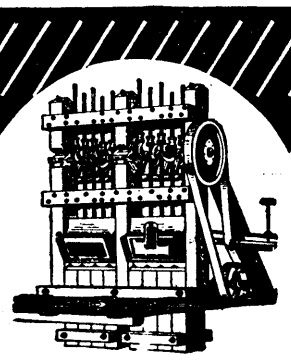

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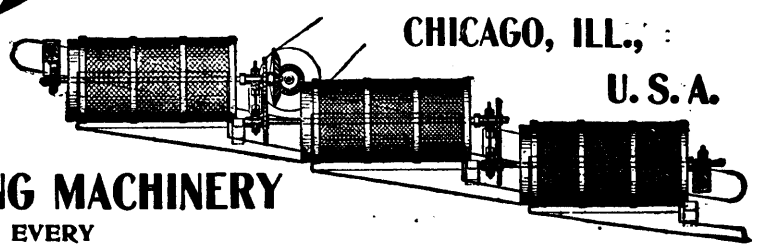

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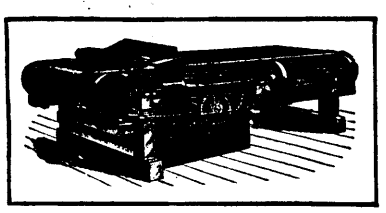

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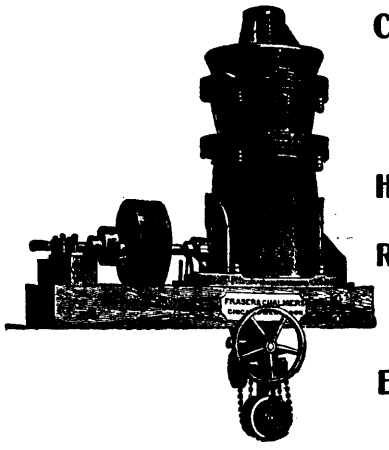

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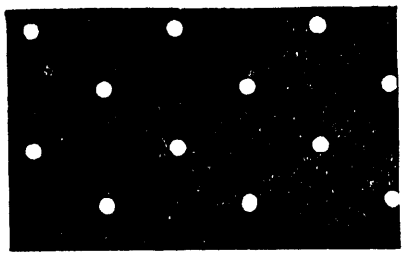

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