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The Canadian Mining Review

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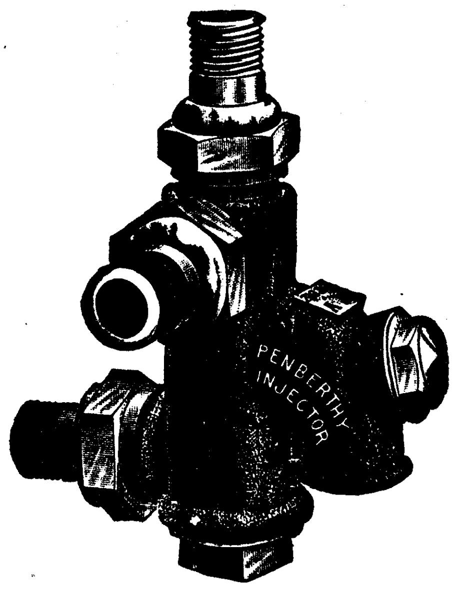

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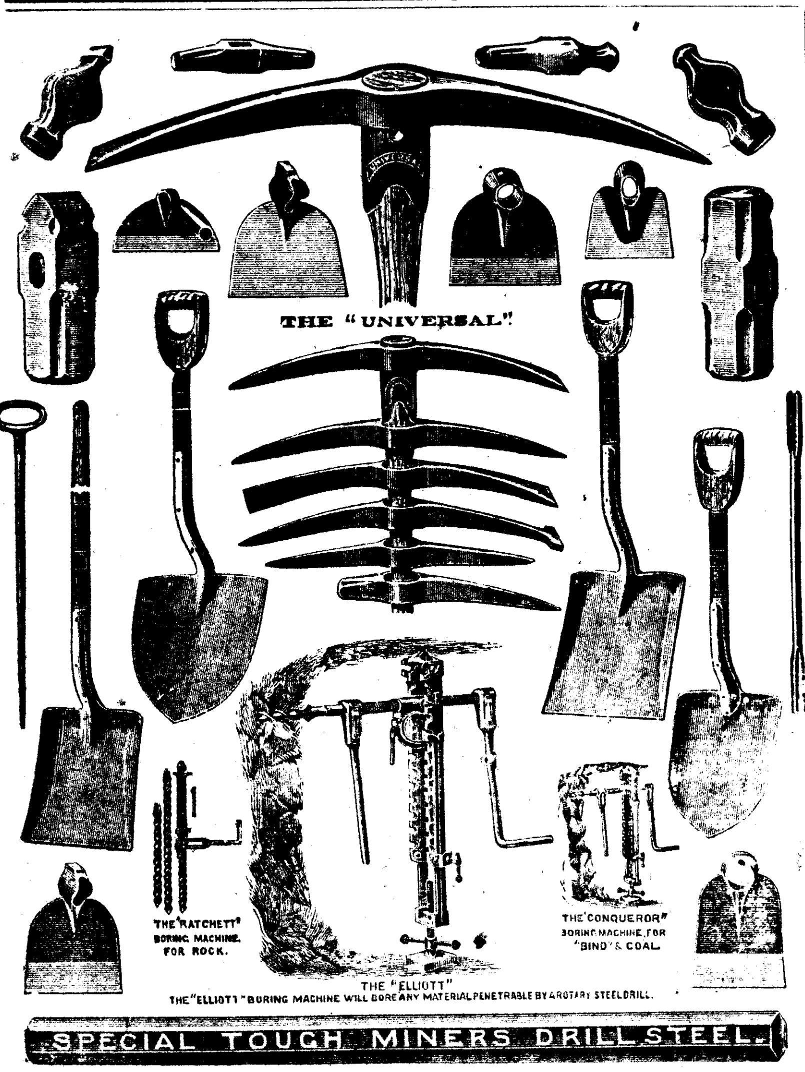

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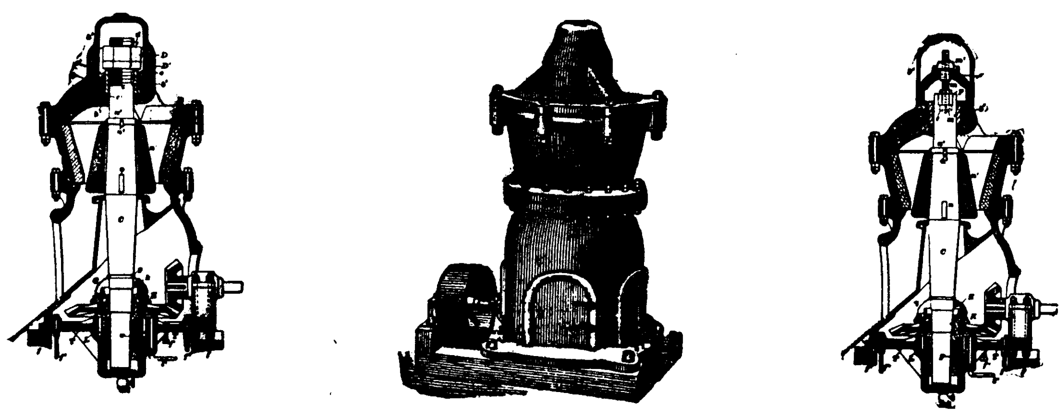

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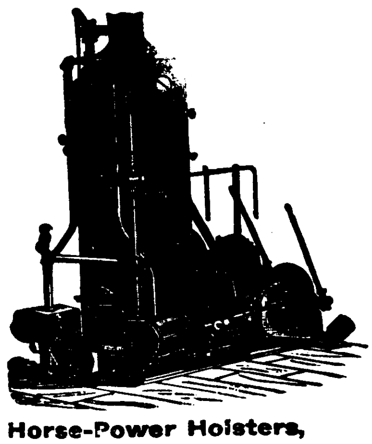

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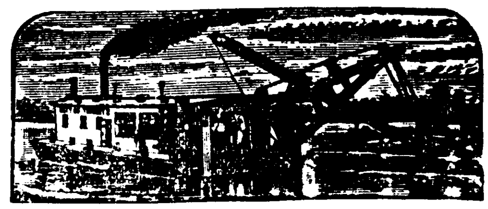

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B. T. A. BELL, Editor. Published Monthly. OFFICES: Slater Building, Ottawa.

VOL. XIV., No 10 OCTOBER, 1895. VOL. XIV., No. 10

The Lillooet, Fraser River and Cariboo Gold Fields, Ltd. —The Directors Feather Their Nests.

During the early part of the year a company promoted by Mr. F. S. Barnard, M.P., and other British Columbia people, was submitted to the public in a somewhat meagre and crudely drawn up prospectus. This company was styled "The Lilloet (Cariboo) Gold Mine, Ltd," and its authorized capital was placed at £50,000 stg. in £1 shares. The property comprised some 480 acres near the village of Lillooet, Fraser river, known as the Irving, Jensen, Macdonald & Hurley, Robson, and Welton claims, and the purchase consideration was £17,500 in fully paid shares. But little was said of the value of the properties beyond the vague and laudatory puffs of one or two of the parties interested in their disposal, and, as but little development had been done upon them, their worth as producers was entirely left to the imagination of those who might be induced to invest in the enterprise Since then Mr. Barnard has been to London and has evidently made a full use of his opportunity. The name of the company has been enlarged to the more high-sounding and pretentious "Lillooet, Fraser River and Cariboo Gold Fields, Limited," followed by what can only be described as a hasty and ill-conceived proposal to increase the capital to £300,000 instead of £50,000 as formerly. At a meeting, duly reported elsewhere in our company notes, the shareholders are asked to sanction this remarkable increase in order to alter the company from a "prospecting syndicate into a larger development company." It is singular that the original prospectus made no reference whatever to the company being merely "a prospecting syndicate," but on the contrary clearly described it as being formed to acquire *and develop* the claims already mentioned. The *Saturday Review*, commenting on this effort to obtain additional capital, says:

"The last cable from the company's mining superintendent stated that he had 'sunk to some depth in the bed of the Fraser river and urgently wanted pumping machinery' to keep the water out. That pumping machinery has never been sent; what is the explanation of this? What have the directors done with the original £50,000? They have not produced any accounts and their conduct appears to us most extraordinary. They certainly have not developed the claims, although they may have spent the money. The plain fact is, as the company's mining superintendent tells us, the company's 'gold claims' are waterlogged, and we may infer that the company itself is waterlogged, and (as the existing shareholders are not inclined to subscribe anything more) an indulgent public is now invited to subscribe a further £250,000 for these incapable financiers to squander. And by what means do they seek to obtain that £250,000? Do they go straightforwardly to work and advertise their new issue to the public in the regular way? No; they are securing, in as many papers are honest (? dishonest) enough to encourage such methods, the paid insertion as news matter of the report of the company's meeting on Wednesday last, which report, we may add, consists almost wholly of the speech made by the chairman of the company. That speech is intended to answer the purpose of a prospectus introducing the new issue of capital to the public, and it may serve the purpose admirably, for it contains exaggerated and highly colored statements which never could with safety have been included in a prospectus. It is a one-sided and a glowing forecast of the company's wonderful prospects and vast prospective possessions. Above all, its insertion as news matter in responsible newspapers will lead the unsuspecting readers to suppose that the scheme which it deals with must be of a very sound and important character, for otherwise the various editors would not have devoted so much space to the report of the proceedings. This kind of thing is of course on a par with the shameless system, many times exposed but still going on, of inserting in various papers as *bona fide* news the paid-for puffs of worthless mining enterprises. We are astonished at newspapers and persons of reputation lending themselves to such disreputable practices. Are the gentlemen who at present compose the directorate of the company aware of these facts? or are they, like a great many honorable men, tools in the hands of some unscrulous promoter?"

Referring to the original prospectus we find "The directors are all personally interested in the sale of the property, that is to say, they receive £17,500 in fully paid shares and they pay therefor to the original owners of the claims £9,750, and have also paid in having the mine examined and reported upon some £1,750, so that in consideration of the consolidation of the claims and time and trouble taken in the matter and risk to the money advanced before the formation of the company and satisfactory results obtained, their joint profit receipts are £6,000 in fully paid shares." In this remuneration there was, perhaps, nothing very unreasonable. But Mr. Barnard and his associates, during their visit to London, have evidently become imbued with the atmosphere of "Golden Africa" (which, by the way, is not even gilt), and whereas when the company was formed they professed not to stand in need of any remuneration for their services on the board, at all events, until the shareholders had received a substantial dividend, they now very cooly ask for a minimum salary of £200 per annum each, while Mr. Barnard as managing director is to pocket every year a salary five times as much as the annual increment he derives as a member of the Dominion Parliament.

In a later article, under date of 28th ultimo, the *Saturday Review* says: "We should like to ask Mr. R. M. Horne-Payne, of Sperling & Co., how far his holding (jointly with Mr. F. S. Barnard) of 27,500 out of the total number of 50,000 shares issued by the company helped him to carry the resolutions referred to. These 27,500 shares are part of an original holding of 29,050. They are described as being 'considered as fully paid'; and we shall be glad to learn how much Mr. R. M. Horne-Payne paid for them. It would gratify us to know that he paid for them at the same rate as the 1,600 shares have been paid for which he has unloaded since June last. We have not space to deal *seriatim* with the resolutions which it is proposed to confirm on Thursday next, but the object of these resolutions appears to be an exceedingly drastic 'amendment' of the company's articles of association. Whole clauses are to be cancelled while others are to undergo radical revision. The original shareholders in this company should, before it is too late, very seriously consider these proposals to alter the company's articles of association. Should they finally decide to confirm the resolutions which are said to have been passed at the company's previous meeting, they will place enormous powers in the hands of the present directors, not the least of which will be the authority which these directors are ardently seeking (totally opposed as it is to the spirit of the original prospectus of the company) to vote to themselves 'remunerations' for their 'services' on a perfectly extravagant scale,"

The whole affair bears an unsavory resemblance to that reckless system of company promotion unfortunately too prevalent at the moment in London mining finance, and whose pernicious influence has on more than one occasion wrought havoc with promising mining investments in Canada.

At the moment when considerable interest is being taken in the development of our mineral resources, not only in British Columbia but in the other provinces, many worthless propositions are afoot, and the intending investor must be wary.

The auriferous gravels of British Columbia are beyond peradventure an exceedingly promising field for the investment of that foreign capital which we so earnestly desire, but successful effort can only be realized from judicious capitalization, careful selection of properties, competent management, and the strictest economy in administration.

Gold Mining in Ontario.

The gold field of the Rainy River district, like most other gold camps, in the earlier stages of development, has suffered not a little from the mistaken zeal of its friends. That gold occurs over a widely extended area in the district is now established and that it will be found profitable to mine it at a number of places is also probable, but the widely published statements of the fabulous richness at all points serve no good purpose and really retard its real progress. No one who is capable of forming an intelligent opinion of the value of gold properties will be deceived by these accounts: but men wholly unacquainted with the subject are attracted by them and are induced to squander their money on claims of doubtful value and often to erect mills in advance of any development which would warrant such an expenditure. The inevitable result of such methods is a number of expensive mills shut down for want of ore to work and a consequent withdrawal of public confidence in the gold producing capabilities of the region.

Mr. W. McInnes, of the Geological Survey, who has been investigating the geology of this region, and whose map and report will shortly be issued to the public, was seen on his return the other day and courteously gave the REVIEW the following summary of the occurrence of gold and the mineral development of this section of the country:—

"As far as our knowledge of the geology of the district permits us to judge, the gold is confined to the Keewatin belts, along the entire length of which it occurs at intervals. One belt of these rocks extends from Rainy Lake, with a limited development only on the American side of the international boundary, along the Seine and Atikokan River eastward and beyond the eastern boundary of the district. Besides the main central belt there are a number of spurs and forks extending northward and north-eastward into the Laurentian area.

"All along these belts gold has been found, not always, it is true, in paying quantities, but enough to give good prospects of profitable mining at different points.

"The best veins have been found, up to the present, in the divisions of the Keewatin embracing the quartz porphyric and various altered rocks of like origin. In rocks belonging to this class are situated the mines about Bad Vermillion and Harold Lakes, where mills have been erected, and those on the American side of the international boundary. Similar Keewatin belts in the Manitou region have yielded gold at a number of points, but nowhere has development been carried far enough to warrant the erection of mills in that district.

"The 5-stamp mill at Harold Lake, operated by the Wiley Bros. of Port Arthur, has been working during the latter months of the summer. They are here trying only to save what free gold they can hold on the plates, and are storing the tailings for future treatment. A brick of gold from the mine, with a reported value of about $900.00, was brought out before I left and they were expecting another daily.

"The Sultana, at Lake of the Woods, where they are down about 200 feet, was regularly turning out bricks of gold which would well repay them for their work

"Most of the other properties were being worked chiefly in the line of development, and, if that policy is adhered to, satisfactory results may be looked for and disastrous failure averted."

EN PASSANT.

The Mining Society of Nova Scotia will hold its next general meeting in the rooms of the Society at Halifax on Thursday, 21st November next. A verbatim report of the proceedings will, as usual, be found in these columns.

The second volume of the proceedings of the General Mining Association of the Province of Quebec will be issued to members next month. The volume contains something over 300 pages of valuable matter respecting the progress of mining in various parts of the Dominion and is profusely illustrated and very handsomely gotten up. Arrangements for the next meeting at Montreal in January are progressing and a good programme is already assured.

That our Geological Survey is thoroughly alive to the necessity of furthering the interests of mineral development has frequently been questioned, the chief complaint being that new fields of discovery were overlooked while prominence was given to territory not at present economically available. Whatever cause for objection may have existed in this regard, certainly none can be made this year, the investigations of Dr. Dawson's field force being very largely directed to mining localities throughout the country at present attracting attention, as a reference to the following will show:

Slocan Silver Districts, B.C.—Mr. R. G. McConnell and Mr. H. Y. Russell.
The Rainy Lake Gold Region—Mr. W. McInnes.
The Iron Resources of Frontenac and Leeds, Ont.—Mr. E. D. Ingall.
The Gold Fields of Nova Scotia—Mr. E. R. Faribault.
The Coal Deposits of Nova Scotia—Mr. Hugh Fletcher.
The Quebec Gold Fields—Mr. R. Chalmers.

In addition to these, and other important surveys, a very notable work is being carried on in the Northwest, where a boring is being put down under an experienced oil-well driller in the tar sands of the Athabasca The ensuing reports of the Survey should therefore be of more than ordinary interest to our readers.

At a meeting of Council of the Ontario Mining Institute, held on 11th instant, arrangements were made for the immediate publication of its first volume of proceedings. Members who have not already done so are requested to return the revised sheets of their contributions to the Secretary as quickly as possible.

Deep sinking in Queensland has apparently not been a success, if we may judge by the following remarks of the Under Secretary for Mines in his report for 1894. He says: "The sum of £10,000 was placed on the loan estimates for the purpose of enabling the minister to grant assistance towards proving auriferous and other metalliferous lodes in deep ground, on such of the goldfields and mineral districts as have made but little or no progress in this direction of late, owing to the inability of unaided private efforts to cope with the magnitude of the undertaking, and more particnlarly so as to open up new channels of lucrative employment to an increased number of miners. In the case of such applications as may be approved by the minister—who may, if he sees fit, call in such advice from geological and mining experts as can throw light on the matter before him—the latter may authorize the payment of a subsidy towards deep sinking, not to exceed an equal sum to be found by the applicant, and on such terms as will amount to a guarantee of the *bona fide* expenditure of the money in such a manner as will most likely lead to the attainment of the desired object. The applicant binds himself to repay the Government the amount of assistance so loaned as soon as the mine is worked at a profit—that is to say, that half the profits obtained shall be paid to the minister until the debt incurred shall be extinguished. I am under the impression that the principle underlying this offer thus to assist in the development of the mining industry is hardly as yet sufficiently understood, for there is evidence that some of the applicants, at least, are under the impression that the intention is to help individuals to develop their properties, instead of, in the first instance, proving that payable lodes exist at depths that have hitherto not been penetrated in the locality. To put it plainly, the object is to assist vertical instead of lateral prospecting. The latter cannot be said to have been a success in any way here, and must be considered to have amounted simply to assist in fossicking, and in no instance has it led to create new openings for profitable occupation for an increased number of men. I trust that the legislature will see fit to provide a sum annually in the future that may be available to assist prospecting our deep ground, and even if the results of the first experiment should perhaps not be quite commensurate with the expenditure, for I am confident that eventually, when the difficulties attached to everything new have been overcome, such assistance will present itself as the most legitimate aid to the mining industry, as it must lead to additional profitable employment to an increased number of miners."

Mr. W. A. Carlyle, M E., lecturer in mining at McGill College, is understood to have declined the position of Government mining engineer offered to him by the Hon. the Minister of Mines for British Columbia. This is an important appointment, and in view of the great progress being made in the mining of the precious metals in that province we trust political influence will not be brought to bear in the interest of any applicant for the position, but that a first class metalliferous engineer with a thoroughly practical experience in mining and milling will be secured. Of course, first-class men cannot be secured for nothing, but the expenditure of a few thousand dollars per annum on a live Mining Inspector will prove in the long run money well invested in the interests of the province.

Just as we go to press, the news reaches us of the clean-up from the Horsefly and Cariboo gold mines, British Columbia, in which Montreal capital is very largely interested. The despatch says: "A cone and bar, weighing in all 3,587 ounces, are at 150 Mile House *en route* for Montreal. The cone contains 2,435 ounces, valued at $41,857, and is the result of a twenty-nine days' run at the Cariboo mine, Quesnel Forks. The bar contains 1,152 ounces, valued at $25,150, from a run of forty days at the Horsefly mine, on Horsefly River." The despatch also reports a strike of rich gravel at the Horsefly, prospecting $8 to the pan. This is, indeed, good news, not wholly unexpected, however, and the returns, large as they are, would doubtless have been much greater but for unforeseen delays and accidents at the mines. We hope to give full particulars in our next issue. In the meantime these returns will be an immense stimulus to the investment of foreign capital now finding its way into British Columbia.

A large deposit of graphite of very superior quality has been discovered on the Madawaska, near Renfrew, Ont. The property has, we understand, been acquired by Mr. T. J. Watters, at a price of $45,000.

CANADIAN COMPANIES.

Lillooet, Fraser River and Cariboo Gold Fields Co., Ltd.

An extraordinary meeting of shareholders was held in London, Eng., on 18th ult. Mr. R. M. Horne-Payne presided, and the other director present was Mr. R. Northall Laurie. Mr. Malcolm Hubbard, the company's solicitor, was also in attendance.

The Secretary (Mr. Edgar Bennett) read the notice convening the meeting.

The Chairman, in the course of his address, said: Gentlemen, you have heard the notice summoning the meeting together, and I regret very much that there are not more directors present today; but the others are residents in British Columbia, and although some of them have been over here recently they had to return—especially Mr. Barnard—in order to look after the company's business. (Hear, hear.) I am aware that many of you have been taken by surprise at being called here today for the purpose of increasing our capital to such a very large extent as that of which we give you notice in the summons to attend the meeting. I am also aware that some of the newspapers have criticised the amount of new capital which we ask you to give us as being out of all proportion to the old capital, and unreasonable in the absence of detailed figures, and moreover unreasonable inasmuch as the new capital required is more than should be prudently expended on properties which we have acquired with the old. I am here today for the purpose of giving you the detailed figures which these dissatisfied shareholders have asked for, and of explaining to you in detail the reasons why your board have considered it desirable to so largely increase the capital; and I feel confident that before I sit down these very shareholders who came here for the purpose of opposing our resolutions will have made up their minds to give us their hearty support. Since the formation of this company your directors have energetically carried out the objects for which the company was formed, and which we described in the prospectus. In the first place we were so fortunate as to secure the services of Mr. D. T. Hughes as mining superintendent. He is a gentleman of great experience, and brings with him the very highest recommendations, and a most successful record from California. Your directors have already experienced the benefit of his excellent judgment, and feel that under his guidance the company's mining operations will be economically and successfully continued. Immediately after the formation of your company, or as soon after as your directors had been able to secure the services of Mr. Hughes and gather together the necessary force of men, operations were commenced on the Lillooet properties, and under Mr. Hughes' direction a very careful survey was made of the property, and how best to introduce the necessary water in the most economical and satisfactory way. Gangs of men were kept working continuously in three shifts a day of eight hours each, but in spite of this energetic investigation, it was thought desirable to make such a very cautious survey of the position before expending your money on the erection of flumes and machinery, so that it was only about six weeks ago that the exact line for the water to be brought on was finally determined. Meantime your company has obtained possession of ali the properties mentioned in the prospectus with the exceptionof one lease, with regard to which, after very careful investigation and the sinking of further shafts, Mr. Hughes reported that the prospects did not warrant the expenditure of capital necessary to work it, but advised, if possible, obtaining from the same vendors certain other properties of theirs in the immediate vicinity, which are found to be more valuable. This has been successfully accomplished; the new properties have been thoroughly and carefully examined, investigated, and proved, and so far promise exceedingly well. From week to week Mr. Hughes reports on both, more and more favorably. The value of these properties was practically ascertained by Mr. Hughes before their acquisition, and his opinion has since been amply justified. Before passing away from the Lillooet properties, I have the pleasure of telling you that on Monday last we received a cablegram from Mr. Hughes, stating that he had now sunk on to an undoubted old channel on the Fraser river, of very great richness in free gold, and had also sunk on to the ancient juncture of the Cayoos creek with the Fraser river, and asking us to immediately authorize the erection of pumping machinery to keep out the water. There is no reason to doubt that Mr. Hughes, who is exceedingly cautious and conservative, truly estimates the nature of this discovery; and, if it is as he states, history will justify the sharholders of this company in congratulating themselves on having one of the most valuable properties of the time. (Hear, hear.) Whilst developing with all possible energy the Lillooet properties your board has also devoted its energies to prospecting and examining claims and mines throughout British Columbia, and has succeeded in securing several very promising properties, which have been developed, assayed and sufficiently proved to amply justify their being worked on a large scale. These properties have been mostly acquired on the principle which your directors have adopted throughout and believe in adhering to—*i.e.*, without the payment of any cash, but by giving the vendors a reasonable interest in the future profits of their respective properties, or, in some cases, paid-up shares in this company. Your directors have selected six of these properties as being the most promising. These properties occupy nearly 1,500 acres." After a brief description, the Chairman continued: "Of course, at this meeting, being an extraordinary one, it is not proposed to submit any detailed accounts, but your directors inform you that of the cash capital of this company, up to the present we have expended in development and research only about £7,000, which has been remitted to British Columbia; otherwise your capital has been lying in London at interest. We are now satisfied that from the result of our investigations we are in a position to invest the money in a way which will be highly remunerative, and with a minimum risk. That British Columbia is one of the very wealthiest portions of the empire is already established; its salmon canneries, which this year will send 480,000 cases, representing practically 5,000,000 of this fish, and a value of half a million sterling, to market, independently of some 300 tons of fresh frozen fish sent to the chief markets of the Eastern United States and Canada; its renowned seal fisheries, its marvellous and unlimited supply of timber, and its great coal-fields, have amply demonstrated this; but your directors are satisfied that British Columbia cannot even be considered as second to South Africa in its gold-producing possibilities. British Columbia forms about one-half of the great mineral belt of America, the southern half of which, situated in the United States, has given to the world during the last half century something like three-quarters, or probably even more, of its total gold supply. A glance at any map of the American continent will show the Rocky Mountain range, which is practically the mineral belt of the American continent, to be about one-half in the United States and one-half in British Columbia and Canada. The gold of British Columbia first commenced to be exploited in 1858, and since then has yielded an output of $500,000 a year, but this has of necessity been merely the result of the efforts of individual miners, working with their hands and such primitive machinery as could be conveyed to the mines on mules' backs for some 400 miles from Vancouver over the world-famed Cariboo road, which might well be described as a wooden bracket nailed on to the precipitous cliffs of the Fraser canon. It is interesting to note that in those days the whole of the transit arrangements of the province were in the hands of Barnard's Express, one of the few enterprises that has ever had the permission of Her

Majesty's government to issue its own postage stamps, and which was founded by your present vice-chairman's father, and practically owned and managed by your vice-chairman from the time that he was twenty years of age until the establishment of the Canadian Pacific Railway. You will, therefore, see that in your vice-chairman and the gentleman whom we ask you to elect to-day as general manager of your company, we have a man of life-long experience, and whose ability to manage a great enterprise has been amply tested and proved. It was not until the year 1888 that the Canadian Pacific Railway drove its way through the heart of this region, and in any way opened up the vast mineral wealth to general enterprise; but even this was of very limited assistance, and it still left the best-known mining camps at several hundred miles north and south of the road, and it was practically not until last year that, through the opening of the branches of the Canadian Pacific Railway, and the enterprise of the Provincial Government in railway building, the country was opened to any appreciable extent Immediately several local companies were formed, with local capital, and they have met with considerable success—one or two with enormous success. One mine alone, which twelve months ago changed hands at $75,000, has, within the year, been purchased by a syndicate of United States capitalists for $1,500,000; and I see in the local newspapers a rumor that it has now been formed into a company, of which the purchase price is $2,000,000. This looks like a very big jump, but in the case in point I have reason to believe it is one which is amply justified by the output and product of the mine in question. These local companies are only just commencing now to make a regular output, and it was not until the end of this year that, attracted by the success of these preliminary companies, large amounts of United States capital and capital from Eastern Canada were sent into British Columbia for investment. At the present moment a gold boom is raging, miners are rushing into the country in thousands, and the attention of the world is being drawn to the vast mineral wealth of the country that is being brought to light. Our company, fortunately in the field twelve months before the rest, and assisted by the energetic and loyal efforts of its experienced British Columbia directors, has prosecuted its efforts with eminent success, and we believe we have secured some of the most choice properties that have yet been brought to light in this province. We have also every reason to believe that with our organization secured in the capital which we ask you to authorize us to arrange for to-day, assisted by the sympathy of the people, and aided by the support of the legislature of British Columbia, we shall be able to continue the successful exploration and exploitation of this vast field of mineral wealth. Amongst those who have recently issued a report of their investigations of the country, stand forward prominently Dr. G. M. Dawson, Director of the Geological Survey of Canada, and Mr. John B. Hobson, one of the most prominent experts of the west." The chairman gave extracts from reports of these gentlemen as to the richness of British Columbia in minerals, spoke of the opening up of the country by railways, of the great coal mines of the province, of its timber resources, and of the abundance of labor, and proceeded: "The country is also within easy access of Europe—far easier, indeed, than is South Africa, as Europeans can be now comfortably, even luxuriously, transported to the mines in from fifteen to twenty days. If, therefore, South African results have been great and eminently satisfactory, and if their prospects are absolutely apparently unlimited, we still feel that we may safely conclude that the results in British Columbia will be equal to them, for we cannot lose sight of the fact that British Columbia is more than half of the great mineral belt of North America, the southern half of which has already produced an enormous proportion of the world's supply of gold. Before, however, going into such a great enterprise as the development of the mining resources of British Columbia, or even before committing themselves to the large development which your present possessions require, and the expenditure on machinery necessary for the profitable working of them, your directors have felt that they must have sufficient capital at their backs to know that they can carry through this work to a successful issue, and that they have sufficient financial backing to guarantee them large additional capital if the results which they obtain justify them in asking for it. They have, in the scheme which they to-day lay before you, accomplished these ends. They have succeeded in obtaining the guarantee of amply sufficient capital to work your present possessions, and they have also succeeded in obtaining perhaps the strongest financial backing which it is possible to have in all Europe. Amongst the new directors whom we ask you to elect to-day will be seen the names of certainly two of the best known European bankers and financiers. They need no words from me to recommend them to your favorable consideration. The position of the company which Mr. Rosenheim directs, or assists to direct—viz., the Anglo-French Exploration Company—and his equally successful connection with other companies, has proved an ample introduction for his name on the British market. Baron de Machiel's name is sufficiently well known throughout Europe to make it unnecessary for me to refer to him. In Dr. Goldschmidt we have a scientist of the very highest order, and in Mr. Forbes George Vernon, the present representative of the British Columbia Government in this country—to whose zealous and indefatigable efforts as Agent-General we largely owe the fact that we ever came to consider the extension of our enterprise and the development of British Columbian resources, and who was for seven or eight years minister of Public Works in British Columbia—we have one of the very first men of local experience and judgment. But if amongst our new directors we have men of great financial position and name, I can assure you that they are merely types of the gentlemen who have put together their money to subscribe our new capital, and there are many other names on the list of equal celebrity. When your directors had made up their minds that it was for your best interests that we should extend our operations on a large scale, they consulted their brokers in London and in Paris as to how this might best be done, and your brokers organized a syndicate to guarantee new capital, in which they themselves, showing their good faith in the enterprise, have taken a very large share. Your directors have also taken a very large share. I wish particularly to draw your attention to this fact. You will at once realize that it would practically have been impossible to carry through the scheme if your directors had not come forward and shown their confidence in it by putting their hands into their pockets in no mean way, and I may tell you that one of your new directors has subscribed £30,000 of the new capital, another has subscribed £20,000, whilst I myself have induced my firm and friends in this country to put up £40,000. This money has already been paid into the bank. I do not mention this with a desire to advertise the fact, but because there is an option attached to this subscription on the same lines that have already been adopted by the British South African Company, and because we hope that when in twelve months this option matures, by our efforts we shall have made the shares of your company worth perhaps £4 or £5 apiece, and I do not wish you to be able to say then, or even to think then, that we have been guilty of a breach of our trust in making a profit out of the shares of the company. I wish you particularly to note the facts in connection with this matter, and to note them well and for good and all, and I may add that if any shareholder here would like to take part in guaranteeing the subscription of capital it is not too late for him to do so. The syndicate will be managed by your company's Paris financial representatives, the senior member of whose firm is proposed as one of the new directors, and they are prepared to guarantee the subscription of half of the new issue, viz., £100,000, if it should not be subscribed forthwith by the present shareholders, on condition of the syndicate having for one year the option of taking at par the remainder of the new issue. These are practically the same lines already adopted by one or two of the most celebrated and successful South African Companies, and I am confident that the shareholders to-day will feel and agree with me that they are fair and reasonable terms. Owing to the important increase in the business which it is proposed your company should undertake, we feel that we should have a larger directorate, and we therefore ask you to increase the number of directors from five to nine. We also ask you to ratify the action of your board in negotiating with Mr. Frank S. Barnard, M.P., to act as managing director of this company, and take charge of its executive affairs in British Columbia, at a salary of £1,000 per annum. I feel sure that the shareholders will not only not hesitate, but they will congratulate themselves on the opportunity of electing and securing the services of men of such calibre and European reputation as those to whom I have already referred as being proposed as the new directors. I am sure also that the shareholders will feel that it is only just that we, directors, who have hitherto acted for you with no salary or recompense whatever, saving only the large interests which we have in the shares of your company, should ask for some definite remuneration henceforth, considering the fact that we shall now be called upon to give a great deal of our time and our very best services to the direction of a large enterprise. I shall therefore ask you to vote a resolution granting us a minimum salary of £200 each per annum. As this in itself will be a very small recompense for the time and work which we shall be called upon to give to your affairs, we shall ask you to give us, to divide amongst us, 10 per cent. of all the profits we shall make for you after a dividend of 10 per cent. cumulative has been paid on the shares. In conclusion, I may say your directors consider that the company now embraces every element of success, and every element necessary to enable it to become one of the great enterprises of the day. It has a vast field of practically unlimited mineral wealth, the sympathy and support of the province, great railway facilities, ample and cheap water, coal, timber, and labor, an invigorating and good climate, ample capital for its present necessities, and a directorate containing some of the most experienced and successful local men, whilst from the powerful financial connections represented on its board it has the assurance that it will always have ample means at its disposal to continue successfully in operation. Finally, your directors have reason to believe that the legislature of British Columbia, being fully aware of the keen competition of other countries to secure capital for the development of their industries, will recognize the efforts of this company to open up the mineral resources of the province, and extend to it every encouragement and legitimate assistance. I trust, gentlemen, that when the time again comes round to have the pleasure of meeting you, assembled together here, which will be at no very distant date, we shall have got at least two of our mines in first-class working order, and that I shall have the gratification of asking you to vote the payment of a substantial dividend on your shares. I shall now be very happy to answer any questions which any shareholder may wish to put me, and shall then proceed to move and explain the resolutions which we ask you to agree to to-day.

No shareholder desired to ask any question.

The Chairman said—I am glad to see that we appear to be unanimous, and the directors are very gratified by the kind confidence you place in their efforts.

Seven resolutions giving effect to the scheme explained in the chairman's speech were next separately put from the chair, and seconded by Mr. Laurie. Each was carried with unanimity.

Mr. Northall Laurie said he had to report that the Board had received with regret the resignation of Mr. Edgar Robson as a director, and had proceeded to elect Mr. Horne-Payne in his place. Mr. Payne had frequently visited their properties, and therefore spoke with experience and knowledge. It was owing, in a great measure, to his exertions that the powerful syndicate of English and foreign capitalists had been formed to develop their property. (Cheers.) He asked them to confirm the election of Mr. Payne as a director. (Hear, hear.)

Mr. Macaulay seconded the motion, which was cordially agreed to.

The Chairman, in reply, said—I thank you gentlemen, very much indeed for confirming my election, and I shall certainly devote my best attention to the affairs of the company. (Hear, hear.) I also thank you for attending here to-day, and for the confidence you have shown in your directors by the entirely unanimous way in which you have adopted the resolution. (Cheers.)

Mr. Mitchell Innes said they must not separate without passing a vote of thanks to the chairman, which vote he proposed. (Hear, hear.)

Mr. Verner seconded the motion, which was heartily adopted, and a word or two from the chairman closed the proceedings.

Bell's Asbestos Co. Ltd.—An extraordinary general meeting of this company was held last month at the Cannon Street Hotel, London, Eng., Mr. H. Heywood presiding.

The Chairman said the meeting had been called for a very practical purpose, and to put in form the instructions of the shareholders to the directors. The directors were appointed not only to look after the proprietors' interests in the works and the profits and the management, but also for the purpose of enhancing as much as they possibly could the value of their shares and their property, and as it had been suggested to them on several occasions that the existing shares in the company's capital should stand at £1 each instead of £5, they thought it desirable to send out a circular letter to every shareholder, begging that he would express his opinion, "Yea" or "Nay." The replies to that circular were very largely in favor of the reduction being made, fully 80 per cent. of them supporting the change. Of course, acting upon the shareholders' wishes, the directors made the recommendation, but the decision rested with the meeting. It had been urged that there were many small investors who might be induced, if the shares were reduced, to take five or ten at £1 each who would not be satisfied as holders of one or two £5 shares; and it was hoped that the small shareholders would be large buyers of the goods produced by the company. If that proved to be the case, their prospects would improve very materially. (Applause.)

Mr. Bolling moved: "That each of the existing shares in the company's capital be divided into five shares, so that the capital may be £200,000, divided into 200,000 shares of £1 each.

Mr. Bird seconded, and the resolution was carried.

The Chairman then submitted the draft new regulations of the company. It would doubtless be remembered, he said, that at the last meeting the shareholders were good enough to suggest that the remuneration of the directors should be changed, and that they should receive a somewhat increased allowance. He pointed out that that could not be done without altering the articles, but that the Board would take the question into consideration. They consulted the company's solicitors, who considered it desirable that the articles, which were more or less obsolete, should be brought up to date. The solicitors consulted counsel, and the result was before the shareholders. One of the principal alterations was as to the borrowing powers, so that they might borrow without any question on the part of the leaders. Then it was proposed to eliminate the article that gave them power to issue shares to bearer instead of to a registered owner. It was suggested that the Chairman, instead of receiving £150, should receive £250 per annum as a minimum remuneration. He had from time to time pointed out that, although they had made and were making very large profits, he thought it scarcely wise for those profits to be divided without their having a very large reserve fund. There had always been a great temptation to pay a large dividend, so

GENERAL MINING ASSOCIATION OF QUEBEC.

Group Taken at Quebec, 28th June, 1895.

F. T. Shutt, Ottawa. George E. Drummond, Montreal. John J. Penhale, Black Lake. C. W. Morgan, Toronto. L. J. Lynch, Quebec.

J. Smith, Brownsburg. —— T. W. Gibson, Toronto. L. A. Klein, Black Lake. J. Obalski, Quebec. L. Gendreau, Jersey Mills. John Blue, Capelton. Jas. Mitchell, Sherbrooke. G. Y. Chown, Kingston. A. W. Stevenson, Montreal. W. T. Bonner, Montreal. J. Burley Smith, Glen Almond. J. T. Dwyer, Montreal. Prof. Nicol, Kingston. E. B. Haycock, Ottawa. R. W. Prittie, Toronto.

—— —— Hon. E. J. Flynn, Quebec. Hon. George Irvine Q.C., Quebec. Mrs. Klein. Mrs. Lynch. Jas. King, M.L.A., Quebec. —— B. T. A. Bell, Ottawa. R. H. Brown, Sydney, C.B. Mr. Justice Sedgewick, Ottawa.

—— Miss Lynch. —— ——

the directors' remuneration might be very considerably increased, and in order to avoid that, the clause had been altered. It was proposed that the directors should be remunerated to some extent according to the profits earned, namely, by a percentage, after 10 per cent. net profits had been earned, that they should set aside a certain amount to reserve, and that their share should be reduced from £200 to £100 for each 1 per cent. paid in excess of 10 per cent. The regulations had been passed by the Stock Exchange Committee.

Mr. Bolling proposed the approval of the draft new regulations, and this was seconded by Mr. Stallybrass

The resolution was carried, and the regulations were formally declared to be the new regulations of the company.

Nova Scotia Steel Co. Ltd.—The profits of the year ended 30th June, 1895, were $22,578.35; to this must be added the balance of credit of Profit and Loss Account, Nova Scotia Steel and Forge Co. Ltd., 1st July, 1894, $3,880.75, also balance at balance of credit of Profit and Loss Account, New Glasgow Iron, Coal and Railway Co. Ltd., 1st July, 1894, $90,814.59; a total of $117,279.69. The directors recommend that this amount be distributed as follows:—

Reserve for insurance against bad debts	$2,436 22
Reserve for blast furnace renewals	3,301 25
Reserve for general depreciation	20,000 00
	$25,797 47

Leaving a balance to be carried forward to credit of Profit and Loss for the year of $91,482.22. The following is a statement of the assets of the company as given in the accounts:—

Mining properties	$1,173,497 03	
Blast furnace plant	320,477 70	
Railway and rolling stock	201,807 68	
Real estate, plant, &c	580,452 05	
Mining machinery	14,143 32	
		$2,290,468 74
Pig iron, coke, &c	156,618 24	
Scrap steel, scrap iron, &c	42,706 17	
Supplies, furnace sand, fire brick, ores, &c.	11,459 69	
Steel manufactured and partly manufactured	208,166 06	
Coal	1,742 87	
		420,693 03
Ledger accounts		75,776 40
Total		$2,786,938 17

The liabilities are:—

Capital stock, preference	$1,030,000 00	
" ordinary	1,030,000 00	
		$2,060,000 00
Union Bank	407,515 76	
Bills payable	103,964 87	
		511,480 63
Depreciation	107,436 93	
Furnace renewals	3,420 78	
		110,857 71
Reserve for bad debts	13,117 61	
Profit and loss	91,482 22	
		104,599 83
Total		$2,786,938 17

Oxford Gold Mining Co. Ltd.—Messrs. G. J. Partington, C. E. Willis, G. E. Francklyn, Chas. Archibald and W. H. Covert have received letters of incorporation under this designation to operate the Oxford gold mines at Musquodoboit Harbor.

Styne Creek Consolidated Gold Gravels Co. Ltd., has been incorporated in British Columbia with an authorized capital of $250,000, and headquarters at Vancouver, to carry on mining in British Columbia, and particularly to acquire and hold mining leases of the lands known as the Van Winkle Bar, in Yale district, and all the water rights, privileges, &c., held at present by the Van Winkle Consolidated Hydraulic Mining Co. Ltd., and also a mining lease of a claim situated on the right bank of the Fraser river, in Township 15, Range 27, west of the sixth I.M., in British Columbia, and all water rights, privileges and assets held at present by the Styne Creek Gold Mining Co. Ltd. The promoters of the new company are: R. G. Tatlow, Edward Mahon and C. Smith.

Northumberland Stone Co. Ltd., makes application for charter of incorporation under the statutes of New Brunswick. Authorized capital, $10,000, in shares of $10. The directors are: Thos. A. Kinnear, Sackville, N.B.; B. B. Tweed, Sackville, N.B.; W. C. Milner, Sackville, N.B.; Napoleon LeBlanc, Botsford, N.B.; and Foster Pickard, Shediac, N.B. The chief place of business is at Sackville, N.B.

Hall Mines, Ltd.—In an interview, Mr. H. E. Crosdaile, the manager, referring to the operations of this company at the Silver King mine, Toad Mountain, B.C., stated that the tramway for carrying the ore from the mines 4½ miles to the smelter is about completed, the smelter plant is now on the ground and by the beginning of the year smelting operations will begin. The smelting plant will have a capacity of 100 tons a day, and the tramway will bring the ore from the mines at the rate of ten tons an hour. There are 7,000 tons of ore now on the dump and 100 men working at the mines. One great advantage of the ore is that it is self-fluxing. It averages across the whole vein without any sorting, and, taking a very conservative estimate, between 40 and 50 ounces in silver, and 5 per cent. in copper; besides, it runs well in manganese, iron and lime, which will obviate the necessity of other fluxes, with perhaps the exception of a little iron. The product of the smelter will be a medium grade copper matté, running several hundred ounces in silver. Tests of the ore have been made in both Swansea and New Jersey and it has been proved to be practically self-smelting—a most important factor in its economical treatment. Ore bins have been erected at the mine of 5,000 tons capacity and at the lower terminus of the railway of 7,000 tons capacity, so that a supply may always be kept on hand and prevent any delays. A railway siding has also been put in and every care taken to make quick and economical handling of ore, coke and matte. At the mine the vein is being thoroughly tested by means of boring by power drills, which are operated so as to prospect the vein below the present workings. The results are proving quite satisfactory. With the smelter in operation a means will be at hand for the owners of such properties as the Poorman and other gold producing claims in the district to get their ore treated at home, and in that way the development of mining will be directly assisted. A mill will probably be erected in Nelson to concentrate such ores before they are sent to the smelter. Mining development is going ahead very busily in the Nelson district at present.

Byron N. White Company, Ltd.—Tenders have been invited for the necessary plant for the concentrator for the "Slocan Star" mine, but the contract has not yet been awarded. The mill will have a capacity of 150 tons of ore a day, and will be run by a Pelton wheel of 85 horse-power. The water will be flumed from both branches of Sandon creek to insure an abundant supply during the lowest stages. This will require some 3,000 feet of fluming. A gravity tramway, 1,800 feet long, will be put in from the mine to the mill. It is proposed to have the mill running by the 1st of January. There are 26 men working on the "Slocan Star" mine at present, but the winter force will number 50. The output averages from 10 to 12 tons of clean galena ore daily, and about 5 tons of concentrating ore are mined for every ton of clean ore. It is estimated that there are from 15,000 to 20,000 tons of concentrating ore on the dump ready for the concentrator.

Maud Hydraulic Mining Company.—A meeting of shareholders was held at the offices of this company at Vancouver on 26th ulto., "to consider an offer of purchase of the property belonging to the company."

Van Winkle Consolidated Hydraulic Mining Co., Ltd.—A meeting was held at Vancouver on 23rd ulto., to authorize the company to dispose of the whole of its assets to another company, for the purpose of working their claims conjointly with others.

Cariboo Hydraulic Mining Company.—Everything is now going along satisfactorily at the claims of the Cariboo Hydraulic Mining Company. The large ditch is supplying about 2,800 inches of water, and three monitors are being operated for about 18 hours daily. The character of the ground being worked is improving, and should no accident occur the results of the final clean-up this season should be satisfactory to the shareholders.

Montreal Hydraulic Gold Mining Company.—This company is energetically pushing the prospecting of its claim in the Cariboo district, B.C. Water has interfered with the tunnelling to some extent, but means are being taken to overcome this. One tunnel has now been run 1,000 feet and will be driven 200 feet further. Crosscuts will be made on either side. So far the results of the work have shown that the whole of the gravel bears good "pay," some portions of the grounds giving exceptionally good returns. Work in surveying for the ditch and building roads will be continued, while the contracts for the pipes will be let, so that the company may be able to commence actual hydraulic operations next season.

Cariboo Gold Fields, Ltd.—The development of this English company's claims proceeds energetically. The plant and the materials for the pipe-line (which will be about 12,000 feet in length) have reached Ashcroft, and it is expected that by the middle of next season hydraulic work will be commenced. Much interest attaches to this scheme, as it is the first hydraulic claim in the province to be worked by elevators, although we believe the Harper claim on Horsefly creek will be worked in this manner.

Peter's Creek Gold Mining Co., of Cariboo, Ltd.—This company is being promoted by Vancouver people, the authorized capital being stated in the prospectus at $25,000. The object of this company is to take over the lease of 1½ miles of ground on Peter's Creek from the present lessee and to undertake the thorough prospecting of the ground by sinking to bed-rock.

Gold Hill Mining Co., of Ontario, Ltd., is seeking incorporation under Ontario statutes to carry on mining in the counties of Hastings and Addington, in that province. Authorized capital, $250,000, in shares of $50. Head office, Madoc, Ont. Directors, O. R. Sprague, Madoc; B. F. Fellows, J. T. Ferries, G. O. Stohrer and Anna Matilda Stohrer, Syracuse, N.Y.

Patterson Gold and Silver Magnetic Separator Co. Ltd., is being incorporporated in Toronto with an authorized capital of $125,000, in shares of $100, to carry on the business of mining, and to buy and sell machinery. The patent rights it is proposed to acquire, is that of a gold and silver magnetic separator invented by a G. A. Patterson, Denver Col. The directors of the new company are Thomas McCraken, Dr. W. T. Stuart, Toronto; H. H. Powell, R. N. Ball, Woodstock; and G. H. Patterson, Denver, Col., the inventor.

North American Graphite Mining and Manufacturing Co. Ltd.—This company is pushing forward the development of its graphite property in the Township of Buckingham, Ottawa County, Que., and the machinery for the new mill which has been erected is rapidly being got into position.

Regina, Ltd.—The main shaft of this mine in the Lake of the Woods District, Ont., is now down 60 feet, and the air-shaft ten feet. The tunnel has been drifted 90 feet, and the vein shows up well at all points. The average width of the vein has been three and a half feet. It is five feet now at the bottom of the shaft and the ore shows visible free gold. The first level from the main shaft will be started in a few days. The walls of the vein are well defined throughout and the ore milled produced very satisfactory results.

Danville Slate and Asbestos Co., Ltd.—A correspondent writes: "We keep up our production steadily, widening old pits and opening new ones. In addition to this we have put up a new mill building, now nearing completion, which will be better equipped by far than any other of its kind anywhere. The building itself is a most substantial one, 160 ft. long and 60 ft. wide, with large outbuildings for engine and boilers, for stock, etc. We expect to commence work in it in a few weeks. The 100-ft. chimney and extensive factory-building are, of course, the wonder of the neighborhood and people come from a distance to look at it. The slate quarry is now under the able management of Mr. Harry J. Williams, formerly of the Beaver Asbestos Co., Ltd. He has made many changes and has put in new and improved machinery, and we now look forward with every confidence to success. Our output of roofing and school slate is constantly increasing and business is satisfactory. These two enterprises in asbestos and slate are no small matters, and there is always plenty of work on hand with them. We employ now about 450 persons, and Danville and neighborhood reaps a rich harvest."

Le Roi Mining and Smelting Co.—At a meeting of directors of this company held at Spokane, Wash., a dividend was declared of $25,000, or 5 cents per share. Since the company recently put in its fine new plant it has been shipping 3,000 tons per month. It pays for freight charges and treatment $14.50 per ton, but has a contract with Heinze, Breen and others, who are building the 100-ton mattéing-plant at Trail Landing, B.C. under which they are to take the ore at the bins after October 1 and treat it for $11 per ton. In view of the near approach of this more advantageous arrangement, the company will not make such extensive shipments to the other smelters for the next two weeks. Most of the ore is now going to the Everett smelter. Two hundred tons have just been shipped to Deadwood, to be used in an experiment with the ores there, and some has also been shipped to Tacoma. The ore is in sharp demand by the smelters because of its heavy percentage of iron. The new machinery works to perfection, and enables the company to double its yield with slightly increased expense. The new 100-ton boiler consumes less than two-thirds as much wood as was consumed by the old 80-ton boiler. Wood sells for $2 a cord, and pine and cedar are chiefly used. Some fir and tamarac are burned, but they have to be brought some distance over mountain roads, while the pine and cedar are taken right from the property of the company.

"The mine is now down 375 feet, and the shaft is going down in ore," said Col. Turner. "We shall continue on down to the 500-foot level." The company has just bought a diamond drill, to be used in prospecting underground. It cost $2,000, and will be run by electricity. It will drill 36 feet in 24 hours and will save a good deal of dead development work. The hotel and boarding-house are lighted by electricity, the company having its own dynamos. Two arc lights are in front of the hotel and there is an electric light in every bunk-room. The purpose is to light the mine also with electricity, and the company will still have enough power and to spare for the diamond drill.

Judge George Turner, who has lately directed the active management of the company's property, resigned from the presidency to take the position of general manager, and his brother, Col. W. W. D. Turner, was elected in his place. Col. Turner is the largest individual stockholder in the company. The dividend will be paid through the Traders' National Bank. "We are not making any promises," said Col. Turner, but we hope to declare a dividend monthly from now on. We have 40,000 tons of ore in sight, and even if all development work were stopped now, we would have enough ore to keep us running for a year with an average output of 100 tons daily."

Nearly four-fifths of the 500,000 shares of the Le Roi are held in Spokane, about 100,000 shares being held in Danville, Ill. The principal owners are George Turner, Col. W. W. D. Turner, Col. I. N. Peyton, W. J. Harris, Col. W. M. Ridpath, D. W. Henley, L. F. Williams and Major Armstrong. Other stockholders are Judge Binkley, Judge Blake, Ed. Sanders and Frank Graves. The Le Roi mine was one of the first locations in the Trail Camp, B.C. Joe Morris and Joe Bourgeois discovered the iron outcroppings of the group that has since become famous, and took samples of the ore to Nelson. The returns were discouragingly low, and they were inclined to drop the discoveries, when they met E. S. Topping, who was running a little store there, and who was favorably impressed with the ore and the accounts the men gave of the ore bodies. Bourgeois and Morris were strapped, and offered Topping his pick of the locations if he would pay the recorder's fees for the other claims. He accepted the offer, went down to Trail Creek, and after looking over the ground selected the Le Roi. A few months later Topping came down to Spokane and was showing some of the ore around the city. He met the Turners, Col. Peyton, Geo. Forster and others, and they liked the appearance of the ore, and after having careful assays made, took a bond for 16-30ths of the mine, the consideration being named at $16,000. Later others were taken in, the bond was bought, 9-16ths more were purchased from Topping, and the property was capitalized at $500,000. That was five or six years ago, and since then, through good times and hard, the owners have kept pegging away—building roads, putting in machinery, doing development work and standing generally the brunt of opening up the now famous Trail Creek district. To date they have taken out and expended $150,000. The ore extracted has just about paid for the mine and all improvements, and yesterday's dividend is what the boys call "velvet." Naturally there was a great deal of good feeling among the owners last night.

The Canadian Electric Forging and Smelting Co., Ltd., has applied for Dominion charter of incorporation with a capital stock of $500,000 in 5,000 shares of $100 each. Directors: George Dexter Burton, Boston, inventor; Wm. John Morrison, electrical agent; James Richard Code, barrister-at-law; and Wm. A. Johnson, electrician, of Toronto, Ont., and Wendell Phillip Hartshorn, of the village of Pennyan, N.Y., capitalist. The objects of the company are the acquisition of patent rights for processes of forging, smelting, heating, cooking and the manufacture of chemicals, by-products, and gases, by electricity; the manufacture and sale or lease of machinery, etc., and construction of necessary water, steam and electrical plants and circuits for such electrical purposes; also the carrying on and operating works for forging, refining, smelting, treating of ores, metals and chemicals, by-products, heating, lighting and cooking by electrical methods; also the acquisition of mining lands and rights and the working of mines; to buy and sell stock in companies organized for electrical and power purposes.

The Credit Forks Mining and Manufacturing Co., Ltd., is applying for Dominion charter of incorporation with an authorized capital of $200,000 in 2,000 shares of $100 each. Directors: Robert Carroll, Toronto, manufacturer; John Benjamin Vick, of Toronto, manufacturer; John Henry McKnight, of Toronto, contractor, and Frederick John Beharriell, of Toronto, accountant. The objects of the company are to purchase and acquire the business and assets of the firm of Carroll & Vick, quarrymen, limeburners and contractors; to purchase, manufacture, sell and deal generally in lime, cement, brick, terra cotta, etc.; to mine, quarry and generally deal in stone of all kinds, at the Credit Forks, in the Province of Ontario. Head office at Toronto, Ont.

Beaver Mouth Hydraulic Co.—On October 1st this company made its second payment on the property in the Cariboo District, B.C., sold to them by F. S. Reynolds, several months ago. Four shafts have been sunk to bed-rock, depth being from 90 to 136 feet.

Bridge River Gold Mining Co., on Horseshoe Bend, Lillooet District, B.C., has 25 men at work making a cut to change the river bed. When the cut is finished the company will have a quarter of a mile of river channel which is known to have rich pay dirt. The cut is being pushed to completion as rapidly as possible.

Kootenay Mining and Smelting Co. Ltd.—The Pilot Bay smelter, in a run of 100 days, has produced over 2,020 tons of silver-lead bullion. Of this 98 per cent. was made from ore from the Blue Bell mine (owned by the company), which also produced all the fluxing iron and lime rock. Between 140 and 200 tons of lead ore are now being taken per day from that mine. The concentrating ore is brought from the mines to the smelter, a distance of ten miles, and concentrated (the concentrating plant having a capacity of 200 tons). After being concentrated, the ore is calcined in roasters and then smelted. The smelter is now turning out 20 tons of base bullion per day. Mr. Roberts, the superintendent of the Blue Bell mine, from which the ore treated by the smelter is chiefly obtained, has got things down to a systematic basis far working. The company's plant is situated at Pilot Bay, on a peninsula nearly it the centre of the east shore of Kootenay lake. It consists of three main buildings: the smelter, the concentrator, and a building which contains the roasting furnaces. These buildings partially enclose a yard in which are situated the bins containing the ores, lime, coke, charcoal, etc. These materials are hauled from the barges, which bring them to the works, up an inclined plane to the top of the concentrator building. From that point they can be carried to any part of the works or to the bins in the yard, as may be required. There is also an elevator by which the concentrates or other material can be raised to any level that is desired. Besides these buildings there are blacksmith and carpenter shops, an assay and business office.

In the concentrator building are two 9 x 15 Blake crushers, four 4-compartment arch jigs, two double column jigs, two double-deck buddle tables and two Frue vanners. The capacity of the concentrator is about 200 tons per day. In the roasting house are four reverberatory furnaces, each 65 x 17 feet, with a capacity of 12 tons each per day. It is probable a mechanical furnace may be added which would practically double the capacity. The smelter at present consists of only one stack. The arrangements, however, will allow for the erection of two more stacks, and there is no doubt, that if the supply of ore will allow of this addition, the enlargement of the works would put the enterprise on a still better footing for successful financial operation. The smelter at present can treat 100 tons of ore per day, with the requisite complement of lime, charcoal and coke, which amount to about 40 tons more. In the first week of operation the output of base bullion averaged about twenty tons per day.

The power to operate the concentrator is supplied by a 150 horse power Corliss engine; an 85 horse power Reder engine works the blowers, while a 30 horse power high speed engine drives the dynamo which supplies the electric light with which all the buildings are lighted.

The ore which is at present being smelted comes from the Blue Bell mine, about 9 miles up the lake from the smelter, and the No. 1 mine at Ainsworth. The bulk of the ore from the Blue Bell mine is first concentrated and the concentrates roasted. No other flux but lime rock is required, as the ore carries a large percentage of iron.

This is certainly the most wonderful property in the West Kootenay district and is remarkable for the immense quantity of ore in sight. The early workings of this property date back 70 years ago when the Hudson Bay Co. had a post in that vicinity. At that time they ran a tunnel into the mountain fully 100 feet for the purpose of extracting the galena which was taken out, melted and made into bullets for the trade with Indians. Not far from the old opening may be seen a slag-pile near where the furnace stood. It was no doubt a very crude affair, but it served the purpose. It was easy mining as the ore through which the tunnel runs is chloride. But little of this old tunnel is now in use, probably not more than 50 feet, but it is of service in the upper workings of the mine. At present it is used for a thoroughfare to take waste material to the dump. The lower cross-cut tunnel is opened on the side of the mountain about forty feet above the lake, and is continued for 1,200 feet and intersects the vein about 800 feet in and at a depth of 175 feet, and cuts across the vein 68 feet. The vein of sulphide ore lies next to the hanging wall, and the carbonates lie on the foot wall, which has not yet been encountered and it is certain they have more than 100 feet. On the surface they are working a large open cut, quarrying the sulphide ore on one side. Each shot will dislodge 50 or 60 tons of mineral. On the other side men are engaged in shoveling the carbonates into wheelbarrows and dumping it into the stopes, from whence it is conveyed into chutes in the lower tunnel where it is loaded into cars and unloaded in the ore bins on the lake, and from thence to the barges. In fact all of the ore in this open cut is handled the same. Fifty feet above the lower tunnel is a large stoping chamber 100 x 68 x 25 feet all sulphide ore. The floor of the stope is solid mineral. In driving the lower tunnel a vein of copper was encountered which at the surface showed only a narrow stringer. At fifteen feet it was one foot in width and at 135 feet it had increased to 6 feet and 8 inches, the ore assaying from 11 to 26 per cent. copper. This will no doubt prove a valuable addition to the property. The company employs 40 men at the mine and this force has no difficulty in getting out 200 tons of ore daily.

An air compressor is now on the ground and it is expected work will be commenced on the vein of copper which will also increase the daily output. A pumping plant will also be put in, all being worked by the same power.

The mine is located about nine miles from Pilot Bay, where the smelter is located. The company keeps two steam tugs constantly at work towing barges loaded with ore from the mine, transporting dry ores from the various mines in the vicinity, hauling rafts loaded with wood, lumber, etc.

The Poorman Gold Mining Company has filed articles of incorporation with the auditor at Spokane last week. While the principal office will be at Spokane, the property of the company is located in British Columbia. The capital stock is $500,000. The incorporators are J. A. Coram, of Lowell, Mass.; C. H. Palmer and C. S. Warren, of Butte, Mont.; Patrick Clark, W. J. C. Wakefield, S. I. Silverman and John A. Finch of Spokane, Wash.

Alamo Mining Co.—At a meeting of the proprietors of this company, held at the concentrator, Three Forks, B.C., last month, a dividend of 7½ per cent., amounting to $35,000, was declared.

Evening Star Mining Co.—This is the name of another Spokane company which has just been incorporated to operate in British Columbia, with an authorized capital of $1,000,000. The officers are: D. M. Drumhille, *President;* F. P. Hogan, *Vice-President;* H. B. Nicholls, *Secretary*, Spokane, Wash.; Dr. Russell, *Treasurer.* The claim to be operated is situated on the north-east side of Monte Cristo hill, in the Trail Creek district, B.C. 27 assays gave an average of $53 in gold. The claim is being opened up.

High Ore Gold Mining and Smelting Co.—The directors of this British Columbia company are: Cyrus Happy, J. H. Griffith, W. G. Estipy, Barry L. Rodgers and D. M. McLeod. Head office: 201 Mohawk Block, Spokane, Wash. Assessment work on the claim has been done. Crown grant applied for, and the necessary buildings erected for permanent work.

Ottawa Hydraulic Mining and Milling Co., Ltd.—The work of opening up this company's hydraulic property has been vigorously proceeded with during the summer. The claim is on the east bank of the Fraser River, between Anderson River and Four Mile Creek, and about the centre of the famous Boston Bar flat, in the district of Yale. Tests of the ground, as far as could be done with amount of water obtainable were:—

96 yards	gave	26½	cents per cubic yard.	
200	"	"	24	" "
150	"	"	22½	" "
225	"	"	27	" "

The directors of the company are: Lt.-Col. Joshua Wright, Capt. M. Neelin Garland, and Fred. W. Valleau. The stock is almost entirely held by Ottawa people. Capital, $250,000. C. M. Black is the engineer in charge of the works.

CORRESPONDENCE.

The Mechanical Separation of Lead-Zinc Sulphides.

SIR,—When one visits the different lead-zinc mining camps and inspects the various mills, and sees often the very crude mode of concentration, it is no wonder that the tailings from such works show still a richness of minerals which people on the European continent would consider hardly possible. But how is this? We always hear and read that "Americans have the best engineers, millmen and machines in the world." But surely any foreign expert visiting such establishments must be forced to the conclusion that the owners of these works had adopted in many cases the most antiquated idea of antediluvian millmen. But the one who is a little more familiar with our "peculiarities" in these things, can explain this somewhat differently. Now I am not going to entertain the readers of the REVIEW with these how's and why's; but I shall ask those interested in this theme: "Is it necessary, is it in all cases an unavoidable evil, to lose so large an amount of minerals in the tailings of our ores?" Very likely some will answer me, "Yes, we are obliged to throw a large amount on the tailings-dump, because a close concentration would not pay us, first, through the intimate mixture of the different components of our ores; second, through the small profit on the ore, besides high wages, a great painstaking in saving everything is not permissible." Now, I might doubt the correctness of both these reasons, because, if I can save 50 or 60 per cent. with one manipulation and with the crude machines in use, I can surely save the other percentage also by the addition of some more and suitable machines." These machines will not cost by far the attendance, interest and maintaining them, that the saved minerals will amount to when the year is over. It is a pity to see such waste. This kind of working is crude, unscientific, and is not creditable to our great industry, because it is not necessary. We have the machines to overcome most of these difficulties. "If you cannot find these machines in your home market, look abroad and see if you find them there."

Now, this advice is directed not only to our mining camps in general, but especially also to our new camps in British Columbia. I would like to draw their attention in time to this subject, so that they may not commence with the same mistakes as were made in some of the older lead-zinc sulphide camps. Because, if once commenced, such errors are difficult to redress without the sacrifice of a large amount of capital.

For instance, there are camps in British Columbia where they have a *low grade* of silver-bearing galena with a large amount of blende and copper and iron pyrites. These mines cannot afford to lose a large amount of their concentrates in the tailings, but they can also not afford to send their high zincous concentrates to the smelters; they have to separate the different components of their ore from one another, not only to save smelting expenses, but also to save freight to the smelters, and to make use of the zinc and copper ores for themselves to pay their milling expenses with these "by-products."

Then again, there are mines which have *rich* argentiferous lead ores with blende and pyrites; also these cannot justify a waste of 10 or more per cent. of their galena, because it means a loss of from $20 to $30 per ton; besides they have to decrease also the bulk of their concentrates for the reason that a number of these mines send their ore long distances into the States for treatment.

An especially close concentration needs those ores which are composed of galena, native silver, argentite, stephanite, ruby silver, etc. Not less so, those which carry not only argentiferous grey copper, but also gold—every per cent. lost means a heavy diminution of profit, which accumulates to a large sum at the end of the year, in many cases sufficient to pay for the milling, and often also for the mining expenses.

Germany possesses a great number of mines producing the same ores as those mentioned above. Now let us pick out one of their concentrating works, and see what loss they experience—that is, what the tailings of the mill assay. I have the official figures of the Himmelfahrt mine works before me; this is a government institution, and is situated near Freiberg, in Saxony. The ore which this mine produces is almost identical with the Ainsworth ore, carrying from 50 to 55 ounces of silver per metric ton (=2,204 lbs). The mill has a capacity of 150 tons a day, and is divided into two parts, so that different ores can be treated at the same time, and the same men attend to both sides. The tailings which leave these works assay: 0.01% silver, no lead, 10% sulphur and 9% zinc; neither would there be a loss in the last named metal, if the Freiberg blende contained not up to 33% iron, having the same specific gravity as the pyrites and also the baryte, which latter is found as gangue matter in some of the workings. Now what we have to consider principally here is the milling result—the low amount of silver lost, the winning of all the galena, and not less so, the separation of the components of the ore, that is, the separation of the galena from the pyrites and these from the blende, whereby the works are enabled to send only the pure galena and pure blende to the reduction works, and not everything mixed together, as we usually do. But why? Because they use different and improved machines for concentrating their ore, and save by this a large amount of money, which enables, and has enabled them now for centuries, to work those small veins to a profit. But let us see now what kind of machines they use in Germany for milling an ore as found in Ainsworth, or any other British Columbia mining camp. They have: 1st. Crushers; 2nd, roller mills; 3rd, different sizes of sieves; 4th, jigs; 5th, classifiers; 6th, concentrating tables, and 7th, buddles. 4, 6 and 7 separate the components of the ore by specific gravity. These machines are brought into market very much improved by the well-known Freid. Krupp Gruson Works in Magdeburg-Buckau, which are also the builders of the machines used in the above-mentioned mill. To show how economically these machines work, I shall quote here the analysis made of the tailings coming from the different machines in the Himmelfahrt mine.

1. From jigs for coarse sands—0.005% silver, nil lead, $\frac{8}{10}$% sulphur, and $\frac{9}{10}$% zinc.
2. From the Bilharz improved jigs for fine sands—0.001% silver, nil% lead, 2% sulphur, and 4% zinc.
3. From the concentrators—0.003% silver, 1% lead, 12% sulphur, and 9% zinc.
4. Slimes in settling pits—0.01% silver, 2% lead, 8% sulphur, and 6% zinc.
5. End tailings leaving the mill with the muddy slimes—0.01% silver, nil% lead, 10% sulphur, and 9% zinc.

How carefully the ore is disintegrated in this mill, that is, the production of fine slimes avoided, is proved by the fact that the slime water leaving the mill has in 35½ cubic feet only ½ lb. solid matter. Herein lies to a great extent its success, and the success of every mill where this kind of ore is treated, then only through a careful successive disintegration is it possible to save almost the whole amount of metallic minerals.

Someone might remonstrate against my comparison between the milling practice here and the one in Germany, "because in the latter country labor is cheap, while comparatively costly here, therefore close concentration would not pay here." This is a misconception of the real facts. I will not argue with them on the difference in the purchasing power of the money in these two countries, or on questions of political economy in general. No, the principal difference in this case is the machines, and comparing them with ours here, in regard to saving manual labor, we will see that the advantage rests with the newer German system. I will quote here from a paper * by A. G. Charleton, an authority in ore dressing. He says in comparing the different systems in Europe, and on this northern continent: "If the American losses in dressing be compared with those in Germany, it will be seen that the advantage rests with the system of the latter country." And further, in speaking of the Himmelfahrt mine works: "I would like to refer to the Frieberg works more particularly, because I think they are illustrative of American principles, so to speak, engrafted upon former German practice, presenting a model of economy in costs, as well as economy in saving of mineral to an extent *which has never been achieved before*, an advance which is undoubtedly in the right direction." Indeed, what manual labor has to be done in these works? A hand-picking of the ore before it goes on the machines; further, the carrying away of the mixed and finished products—this also could easily be arranged to be automatic; further, the emptying of the settling pits—and even this work is often done by slime or sand-pumps. Therefore, we see that manual labor can be, and is, limited as far as is practically possible.

I gave in the New York *Engineering and Mining Journal* of Aug. 31st, 1895, together with an article upon the same subject, also a reduced sketch of a mill planned by the F. Krupp Gruson Works for a mine in British Columbia. This mill, with a capacity of 60 to 70 tons per day, will do the same good work as the Himmelfahrt Dressing Works above described, with the difference that it will save also all the blende, because the British Columbia zinc blende is of lighter specific gravity than the Freiberg mineral, and very few mines have baryte to contend with, so far as I know.

In regard to those mines having not only galena and grey copper, but also gold in their ores, some slight changes in the arrangement of the mill have to be made.

In conclusion, I advise our British Columbia miners once more: "Do not hastily buy mills before you have a mine, and when you get a mine and you know your ore thoroughly, buy the best, that is, the most economic machines in the market, and by using them judiciously you will make your mine a success."

F. HILLE, M.E.

PORT ARTHUR, 21st October, 1895.

GOLD MINING IN ONTARIO.

Operations in the Seine and Lake of the Woods Districts.

(From our own Correspondent.)

Since the "Foley Combine" acquired the Ray-Wiegand (additional) lots, AL 75-6, the work of development upon these, and their original purchase, viz., AL 74, has gone on much more vigorously—if not more systematically. Machinery, including air compressor, and two Ingersoll drills, with pumps, hoists, &c., are now in position, and a force of miners at work in both shafts upon full time. No. 1 shaft is down 70 feet, on a comparatively small but exceedingly rich vein; while the No. 2 shaft has attained a depth of 36 feet upon a strongly defined, and, if possible, richer auriferous quartz lode than that of the No. 1. This, the No. 1, is upon the original Ray-Wiegand location, as is also the No. 2 shaft. Both these, and it may be observed, almost all their lodes have a strike of N. west 20° to 25° west, and are consequently nearly parallel, and invariably most pronounced in dip and strike; the dip being nearly vertical. About 95 tons of free milling ore, of splendid grade, may be seen upon the dump of No. 1, while the output of No. 2, with its stronger lode, exceeds that of No. 1 in quantity and value, the latter fact being due to the high percentage of coarse and fine native gold. In addition to the foregoing lodes, there are at least seven others distinctly visible, and upon all of which considerable stripping and testing by shallow pits has been carried out by the original owners and prospectors (Colonel Ray & Co.) Buildings, including officers' quarters, additional sleeping camps, engine house, &c., are now drawing towards completion, and the entire property is at present writing being closely inspected by the new company, most of whom are from Detroit and other mining centres of Michigan.

Next in order of merit, discovery and general interest, comes the estate of Colonel Ray, which, exclusive of his interests in the "Foley claims" referred to, owns and controls the entire area of block K 198 (now sub-divided into five lots), also AL 94, 95, 96, 97, 99 and 100. The sub-divisions referred to are as follows: E 258, E 259, E 260, E 261 and E 262, or nearly 500 acres, which traversed as it is by two series of auriferous lodes, viz: those from the "Hunter group," K 74-5, with their north-easterly strike, and the "Wiegand-Foley" lots, the strike of which is north 20° to 25° west, to say nothing of their being immediately adjacent to and in the same geological formation and horizon, render the conditions most interesting.

During the latter part of September, and early this month, a force of men under the supervision of Colonel Ray did some effective work in producing and stripping the numerous lodes traversing this tract, and obtaining samples of their ores, assays of which, it is needless to observe, gave most satisfactory results.

The "Bill Wiegand Claims."—Immediately east of the Ray and Foley claims, already partially described, comes the now well-known "Bill Wiegand claims," including AL 103, 104, 105 and 106 (all of 40 acres each). Work upon these lots has been carried out in a most intelligent and practical way during the past summer, and only this week discontinued for lack of capital. Here also may be seen the same rich series of auriferous quartz veins, with, in most cases, the same dip and strike as those upon the Ray claims, the exception being in the large lode traversing location AL 103 and 104, which describes a curve around the escarpment of both claims, dipping westward. A very appreciable amount of stripping has been done upon the principal lodes here, the width of which varies from 2 feet 4 inches to 12 feet 3 inches, and from almost all of which good panning, as well as some native silver, both coarse and fine, can be obtained. These, the "Bill Wiegand," lots have been thoroughly inspected by European capitalists with a view to investment, and doubtless will, in the near future, be placed under active development. The present owner, Mr. William Wiegand, of Fort William, remains in charge for the winter.

*Transaction of Federated Institution of Mining Engineers, England.

Harold Lake, upon the head waters of La Seine river, and the upper Seine generally, has lately attracted very considerable attention.

The Wiley-Gibbs mine and mill is doing remarkably good work, as may be proven by reference to their regular output of bullion. An additional battery of 5 stamps will be put in there, and fresh ground opened up shortly. Mr. F. S. Wiley and Superintendent Frank Gibbs are present at the mine.

Explorations.—Some excellent results in prospecting have been accomplished at no great distance from the Harold Lake mine quite lately, the assays of which (by perfectly valuable certificates), ranging from 14 to 34 ounces of gold, with some silver, to the ton of 2,000 lbs.

Calm Lake and Sturgeon Falls.—This long neglected though most interesting section is now receiving well merited attention. Near the Falls, the Everett Mining and Milling Company is doing some surface work in mining and putting up the necessary buildings for winter operations.

The Macdonald claim of "H. P. 167," nearer to Calm Lake and directly upon the proposed line of Rainy River Railway, has been bonded to a developing company, and will, it is anticipated, be at once placed under development, while lower down the stream, at the Bull claims, arrangements are also upon the *tapis* for work. The title to this valuable property has so far been delayed by the "timber limit unsettled claims," and to this unfortunate state of affairs is due much of the delay in opening up this and other equally valuable gold claims along the margin of the upper and lower La Seine. An interest in "the Bull claim" was lately disposed of to Mr. Silas Griffis of St. Catharines, who has secured several other valuable locations in this section. It was the intention of Mr. Griffis to purchase the entire claim, could the owners give him a title. This question of titles will, we trust, soon be settled, as but very little timber of a merchantable class exists upon the land, and this will all be cleared off shortly by the three lumber camps now being established there.

Among the other partially developed locations in the Shoal and Bad Vermillion Lakes section in addition to Ray, Foley and Wiegand (and in the same geological formation, viz., protogin granite), may be mentioned the Hillyer, Kelly-Mosher, the Bartley-Wilson, and, last but not least, the Randolph claims, AL 113-14-15-16—all in the protogin, and all carrying very appreciable quantities of native gold, in well-defined lodes.

English capital, at last, shows a disposition to acquire some of this territory, and, as a matter of fact, the Bartley-Wilson claims are bonded to Mr. Ferguson of London, while other English speculators and capitalists have a keen eye to "Bill Wiegand" *et al.*

The Ottawa Prospecting Co.—under the direction of the brothers Bush and Fred. Winning hold an extensive tract of mineral land which has been prospected and located for Ottawa capitalists, including it is said, Mr. W. A. Allan. This tract embraces a number of claims in the Keewatin series, directly opposite the Foley camp and site of Seine city, upon one of which lots, viz., K 236, some very fine results in gold have been obtained. Although most of these lots are in the Huronian slates so favorable to the existence of gold generally, they have also one or more claims of great pro ise in the granitic protogines, adjacent to the Ray-Wiegand "Bonanzas", where, possibly active operations under their manager, Mr. Winning, senior, may be carried on during winter months.

Mail Service.—Mail communication with the outer world is of the worst possible kind. It is altogether of the "go-as-you-please" description, and since the premature closing of the *Wiegand* office, no official appointment has been made, nor investigations held touching alleged irregularities, notwithstanding the fact of a series of complaints having been made to the department.

From the foregoing it may be inferred that while we have quite a fair showing of gold, and not a few very promising properties, we have also one or two fully developed grievances, one of which is the total want of an organized, or any regular, system of mail service nearer than Fort Francis, which fact, in view of the growing importance of our mining and other industries, shows an astounding amount of ignorance, or a total lack of interest in La Seine River District.

Mr. Archibald Blue, Director of the Bureau of Mines, who has just returned from an official inspection sends us the following respecting mining in the Lake of the Woods:

Sultana Mine.—The Sultana is now opened to a depth of 200 feet, and an immense body of ore is in sight between the first and second levels. Mr. Caldwell, the owner, is still managing the property, and his ten stamp mill continues to send to the bank at Rat Portage a weekly gold brick varying in value from $1,200 to $2,000. If the capacity of his mill was doubled or trebled it seems likely that the ore supply for it could be found, at least for some time to come.

Dominion Gold Mining and Dredging Co.—The Gold Hill and Black Jack properties, which were worked two years ago by American capitalists, without experience, have now passed into the hands of a London, England, syndicate, and are expected to yield better results. Mr. Robert H. Ahn, who is well known in Toronto, is local manager of the syndicate. He had fifty men employed at the Gold Hill mine, where three shafts were being put down. The Colorado stamp mill, which the old owners had put in, was being repaired throughout and new machinery added. Mining machinery, such as hoisting drums, air compressors, etc., is also being shipped in to the Gold Hill and Black Jack. The same syndicate has purchased the reduction works at Rat Portage. The old ore-crushers have been torn out and are being replaced by four batteries of five stamps each. When all the improvements are in, this promises to be a first-class mill.

Regina.—Another English company, whose president is General Wilkinson, purchased about a year ago a property on Whitefish Bay, known as the Regina mine, and a well-built ten-stamp mill has been erected there. The formations consist of granite and altered trap, and several veins cross the property from one formation into the other. Mining work has, so far, been undertaken on only one vein, where a shaft has been sunk and a tunnel driven into the granite. It is a fine looking ore, and shows considerable free gold. The mill had been running only three or four days at the time of my visit, but I have since learned that the first week's run gave $1,700 from the plates alone. The works are in charge of Mr. Wm. G. Motley, an English mining engineer of large experience, and the company has been organized with a capital of £130,000.

A number of other locations are being developed, and it is likely that other mills will soon be built. A company, organized by Mr. Wright of Ottawa, is at work on a location 22 miles southwest of Rat Portage, known as the Gold Mountain Mine. It is a bedded vein some 60 feet wide, and numerous assays made by Prof. Donald of Montreal are said to give an average of $12 to $13 per ton. The company is now awaiting Prof. Donald's report upon the property before deciding to erect a mill.

I think that gold mining in this country was never more prosperous than now. It has got past the experimental stage in some localities, especially in Lake of the Woods; and while it is not likely that all prospects will prove of value or that all investments will yield returns, I do not doubt the possibility of making gold mining pay in Ontario. Men, however, must show as much judgment and enterprise who go into gold mining as into any other business.

A Port Arthur correspondent writes: Some excitement was caused lately by the discovery of an auriferous quartz vein in the talcous schists near Jackfish station east of Port Arthur. I have not seen the vein myself, but I have heard from miners who have worked there that it is about 15 feet wide, and traceable for a long distance. I have seen and tested ore from this vein, which was heavily charged with chalcopyrite. It may develop into a good paying low grade ore mine. Some very rich stringers of free gold occur in this vein, but of what extent, or if they will continue towards depth, is still an open question. The mine has all facilities for operation, the railroad, Lake Superior, and also a splendid water-power is close by.

A prospector writing from the Rainy River country says: "I left for Lake Osinawa country on the 13th of August and was out 23 days by the Seine river. It is about 200 miles from Shoal lake. I had a pretty hard trip of it as there are 34 portages to make, some of them 1½ miles long. I took no guide with me other than the map (Lawson's), that I got last Spring and found it better than any Indian one could get here. I left Mr. Haycock and my brother working on K 236 where they did good work. They discovered four new lodes, three of which pan very well and are well worth sinking on.

Since I was away Mr. Foley has commenced working on the claim adjoining 231 K that he bought from the Wiegand Bros. last winter. (He paid $42,000 for 80 acres). He has 35 men and 4 steam drills at work. He is sinking on a lead that was 18 inches on the surface. He is down now about 40 feet and the lead has widened to 3 feet and is still gaining. He is putting on more men ever day. The Hillyer mine also is going to start up again as soon as matters can be fixed up. Mr. Hillyer was here a few days ago with a party that intend going in with him. They started the mill, ran 7½ hours and cleaned up from the plates alone 6¼ ounces of gold. There was a party up from Rat Portage while I was away, who made an offer of $15,000 for any location near Hillyer's location, the terms $3,000 down and the balance in 4 months, provided he would be allowed to sink 100 feet and to drop out should he not want the claim after testing the lead, also that the location should show at least two leads not less than 3 feet wide.

While up the river I met a Mr. Wiley who is working the mine of Lake Harold. He was going out to Fort William and was taking the first gold brick from the mine. It was the result of a five days run and was worth $800.00. The lead he is working on is only 35 inches wide. There are a good many men with money coming in now and the prospects are a great deal better than they were a few weeks ago."

The Geological Survey of Canada has just issued a very fine geological map of the Seine River district, Ont., on the scale of four miles to the inch. The map, like that of Lawson's on the Rainy River region, is a very fine piece of work and is just what is required by the large number of prospectors, miners and capitalists interested in the gold and other minerals of that new section of our country. A report on the geological and mineralogical features of the new field, by Mr. W. McInness, who has just returned from the field, will follow at an early date.

We learn that the old Deloro mine at Marmora, Hastings county, has been leased and will be worked.

LEGAL.

Judgment in the Watters—Powell Mica Suit.

Judgment was given this month in the Superior Court, Hull, in the suit of Mr. T. J. Watters, of the Lake Girard Mica Mining System against Mr. W. F. Powell, of Clemow & Powell, mica miners, for the ownership of valuable mining rights on lot 7 of the 10 range of Hull Township, County of Ottawa, Que.

The properties was originally owned by Maurice Foley, a farmer, who purchased them from the Crown, and were in '72 leased by him subject to a yearly rental and a royalty, for 99 years, to the late T. P French, Inspector of Post Offices. Mr. Watters purchased the rights under this lease from the heirs of Mr. French. Mr. Powell acquired his assumed rights from Mr. Pierce Mansfield, of New Edinburgh, who claimed to own the mining rights in question by virtue of a lease of the same given in '74 by Michael Foley, the son of Maurice Foley.

Previous to the commencement of the suit Mr. Powell had begun work on the mica deposit known to exist on the lot, and had extracted several thousand dollars worth of mineral during the three or four weeks before he was disturbed. At the end of that time the mica was seized by Mr. Watters and has since remained in charge of the guardian. The first issue was entered upon in 1893, and during that time the ground has heen contested inch by inch, several interlocutary appeals have been disposed of. In rendering his verdict the judge said that the defendant had acted in bad faith in taking legal possession of this property and refusing to deliver it up. The plea raised the question of prescription, the defendant claiming that he, Pierce Mansfield and Michael Foley, were the owners of the property by reason of their possession. His Honor stated that there was no evidence in the record to justify this pretension of the defence, and consequently dismissed the plea.

The plea regarding the validity of the title deed under which French held the mineral rights was the most important. This deed had been executed by the late Morris Foley and been witnessed by one witness only. Morris Foley did not know how to sign his name and signed the deed with his mark, which was a cross.

This plea raised this very importent question, as to whether the purchase was good in Lower Canada since the deed was signed with his cross, in the presence of one witness only. This point had been very thoroughly argued at the hearing of the case and numerous authorities had been sent to His Honor.

His Honor considered that Foley's mark was valid and dismissed the plea.

The substance of the judgment is that Mr. Watters gets the mica mine from which considerable mica has already been extracted and also the mica which has been extracted therefrom, which is valued at between seven and eight thousand dollars, and the defendant is condemned to pay the costs. Mr. Watters is ordered to pay Mr. Powell six hundred dollars to cover the costs which had been incurred by him in extracting the mica awarded to Mr. Watters. Mr. Henry Aylen, Q. C., conducted the case for Mr. Watters, and Mr. J. R. Fleming, Q. C., for Mr. Powell.

How Gold Occurs in Nature.*

By W. Nichols, S. B.

I cannot during a single lecture treat the subject at all in detail. I can only give you the general principals.

Although gold occurs nowhere in abundance, and although it occurs infrequently in sufficient quantities to pay for mining, yet it occurs in minute portions in all rock. It has not been shown to occur thus everywhere, but its presence has been indicated in so many places as to render such an inference legitimate. The city of Philadelphia is built upon clays which contain more gold than would pay for rebuilding the entire city, nevertheless this clay is more valuable for bricks than for the gold it contains. Around Boston there are places where it is said that a man might earn twenty-five cents a day washing the gravels for gold. Gold occurs even in the sea, which contains something less than one grain of gold to the ton of sea water. Many devices have been invented for the purpose of obtaining this gold from sea water, but none have proved practicable, and it is not probable that any ever will prove practicable. These occurrences do not constitute ores of gold, for the metal is in too small quantities. An ore of gold must contain sufficient metal to pay the cost of extraction. This gold disseminated through the rocks does sometimes occur in paying quantities, and then we have a true gold ore. Such ores occur in some of the Southern States and elsewhere. Some of the deposits of the Black Hills of Dakota are of this class. In these ores the gold usually is in invisible particles, so that in appearance the ore is merely a common slate sandstone or other rock. The gold is concentrated from this state of dissemination into ore deposits by natural agencies which are always acting. These ore deposits are of three classes:—First, associated with silver, copper or lead, in deposits which are primarily worked for these latter metals; second, in quartz veins; third, in gravels which are derived from these quartz veins, the placer deposits. The first class should studied as deposits of copper, silver, or lead, although very considerable amounts of gold are obtained from them. We will not discuss them here.

The quartz veins. I cannot give you a definition of a vein, for geologists are not agreed upon this point.

The gold bearing veins are fissure veins. A fissure vein is a rent or fissure in the surface of the earth, often extending to very great depths, which has become filled with minerals deposited from solution in water.

Sometimes the fissure reaches a region of fused rock, or rock kept from fusion only by the weight of the overlying mass. The fissure then fills with the molten material, which cools therein. This is not a vein, for in a vein the minerals are deposited from water, but a dyke. These dykes never contain ores of gold. More often the fissure does not reach such molten material, and fills with minerals deposited from water. It is then a vein. Very many minerals occur in veins. Fortunately gold bearing veins are quite simple. Two minerals form almost the whole of their contents. These are quartz and pyrite. Quartz is a hard, white, brittle mineral and is the chief constituent of the veins. The other common mineral is pyrite, which may or may not be present. It is brittle, bright yellow, and always occurs as crystals. It is often mistaken by the inexperienced for gold, hence its nick name "fool's gold." The difference is very great. The pyrite is so hard that it can scarcely be scratched by the knife, not at all unless the knife be a good one, while gold is very soft. It occurs in peculiar crystal shapes, which gold does not assume. It crumbles to a dark powder under the hammer; gold flattens into plates. The gold occurs disseminated throughout the quartz and pyrites, usually in invisible particles, scales, grains, threads, etc. Other minerals are often present in smaller quantities.

The origin of fissures was discussed by Prof Salisbury in our last lecture. We will now consider how the minerals get into them. They are carried, as I have already said, in solution in water and deposited there. It sounds improbable, but there is nothing that water will not dissolve, though often in excessively minute quantities. When the water is highly heated and subjected to great pressure its solvent power is vastly increased. It then decomposes or dissolves readily many substances upon which its action when cold is imperceptible. Water falling upon the surface of the earth, as rain, or flowing over the streams or resting in depressions, as ponds or lakes, soaks into the ground and reaches great depths, where it becomes very highly heated by the internal heat of the earth, and at the same time it is subjected to great pressure from the weight of the overlying rocks. In this state water decomposes or alters many of the rocks through which it passes and takes many substances into solution. Hot, under great pressure, and loaded with chemicals that it has extracted from the rocks along its path, it takes into solution the substances which we find later in the veins. Reaching a fissure, the water rises through it and as it rises it reaches cooler regions and regions of less pressure; here, no longer able to hold the quartz, gold and other minerals in solution, it deposits them upon the walls of the fissure, the water often issuing at the surface as a mineral spring. Thus the vein is formed.

In some places, as in the Southern States, there occurs another kind of gold-bearing vein. In this case the waters have percolated through porous parts of the rock, depositing minerals in the interstices between the particles of rock—perhaps dissolving some of the "country rock" to make room for the "vein stuff." These veins are often not included between distinct walls, as is the case with fissure veins, and the minerals are not in so pure a state, but for our purposes we need make no further distinction between them.

Veins are divided into two parts by the "water level," a fact of the greatest importance to the miner. The water level is the upper surface of the water standing in the ground. This is shown by the height at which water stands in wells. Below the water level the quartz is usually firm and compact. The pyrite when present is bright and unaltered. The gold is largely—not completely—in the pyrite, and so completely enclosed that no amount of pulverizing will free all of it so that it may be saved by the ordinary process of milling. The gold is not chemically combined, but disseminated in very fine threads, scales, crystals, etc., which may be seen when the pyrite is destroyed by acids.

Above the water level the air has access, and the vein is more or less decomposed. The pyrite is a combination of iron and sulphur; the iron rusts exactly as metallic iron would, and the yellow or brown rust, known to geologists as limonite, stains the quartz yellow.

The sulphur also burns and goes away in solution. The quartz becomes honeycombed with cavities where the pyrite and other minerals have been removed. The gold remains behind as small particles enclosed in the quartz and in the cavities. It is much more easily extracted from this weathered vein than from the unaltered portions below.

Indications of richness of veins are very uncertain. The only one at all sure is an assay. As I have said, gold occurs chiefly associated with quartz and pyrite. The pyrite may be absent. In rich veins the quartz is apt to be discoloured and mixed with many impurities. The greasy appearing quartz is more likely to be rich than others, and a peculiar banded appearance may also indicate richness. A pure, hard quartz is likely to be pure. These indications are of very little value, as exceptions are extremely numerous. Pyrite which is fine grained is apt to be richer than the coarsely crystalline. When gold occurs in grains visible to the naked eye ("specimen gold") it may be taken as evidence that the vein is probably poor, although such veins at times prove very rich. Very little dependence can be placed upon these indications. More reliable information may be obtained from the position of veins. These veins occur almost exclusively in mountainous regions, because the forces by which they are formed, the forces originating fissures and those causing the circulation of underground waters, are more active here than elsewhere. There is no great mountain system in the world in which ores of gold do not occur. I do not mean that gold occurs in every mountain or in every range of mountains, but somewhere in every system.

Veins occur in systems, each vein parallel to the others. If one vein of a system is rich, the parallel ones are probably rich also; while veins of a different system intersecting these would probably be different in contents and perhaps poor. If the contents of both systems are the same, and both are rich, then where two cross the vein stuff will be richer than either alone. The nature of the surrounding rock influences the deposits in the vein. Where a vein passes through two rocks, say slate and granite, it may be rich in the slate and poor in the granite, or vise versa. The deposits of ore in the veins is very irregular. It occurs often only in particular parts of the vein, or in "pockets," or in "chimneys," or "chutes," which run through the vein in various ways. Gold occurs in all geological formations. It is not confined chiefly to any one age, as was formerly supposed. It occurs among rocks of many kinds. One is struck, however, by the frequency with which valuable deposits occur between walls of slate.

The placer deposits are formed from the destruction of the veins, and are never found far from them. At the surface veins, in common with all rocks, are subject to disintegration. By the action of heat and cold, of frost and rain, and in general by exposure to the weather, the rock is broken into small angular fragments, forming sand and gravel. This sand and gravel is washed down the hill-side by rains and streams, and thus the deposits of gravel in the valleys are formed. When these gravels contain the debris from gold-bearing veins they themselves must be gold-bearing and constitute the placers. The gold in the placers is more concentrated often than in the veins because of the sorting power of the water, by which the heavy gold is left near its source, or dropped wherever the current slackens, while the lighter gravels are carried further along. The rich placers in the streams or in gravels left where streams formerly flowed may be worked, and the poorer gravels be left. These are the shallow placers. An interesting modification of the gravel deposits is the deep-seated placer. Placer deposits were formed in times long past in stream beds. After they were formed, a great volcanic eruption occurred and great streams of lava reached the valleys and filled them, completely destroying the streams or turning then into new channels. Since then the disintegration of the rock and the consequent degradation of the surface has continued, but the hard lava has resisted this process until what were the hills have been worn to valleys, and the valleys, protected by their lava caps, have become hills. These are now mined by tunnelling into the gravel from the side of the hill.

We find the gold at first in the rocks, thinly disseminated, and in the sea. Thence it is concentrated into the great veins. By the destruction of the veins it is further concentrated and put in more available form in the placers. From the placers some reach the sea again and is deposited among the rocks now forming, whence at some future time it may again be transferred to veins and placers, for the forces by which these things were done in the past are yet acting and will continue active.

*Digest of Lecture delivered at Field's Columbian Museum, Chicago.

The Equipment of Mining and Metallurgical Laboratories.

By H. O. Hofman,*

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The mining and metallurgical laboratory, as we understand the term in this country, is a place in which mechanical and chemical working tests are made on ores, fuels and furnace materials. It is of quite recent origin. The first laboratory of this kind to be used in connection with teaching was put into operation in 1871 at the Massachusetts Institute of Technology.† The idea had already existed in the mind of President W. B. Rogers when he wrote, in 1864, his pamphlet on "The Scope and Plan of the School of Industrial Science of the Massachusetts Institute of Technology;" but several years elapsed, and an extended visit to the mines and mills of Colorado, Utah, Nevada and California was required before this idea could take a form adapted to the purposes of original research as well as of instruction. The laboratory was given from the first into the charge of Prof. R. H. Richards, who, by improving its methods and enlarging its scope, has brought it to the position which it occupies today as the leading representative of its class. Private laboratories for making tests upon ores had previously existed here and there, especially on the Pacific coast, for silver and gold ores; but in the educational field the Massachusetts Institute of Technology was the pioneer. To-day there is hardly a school of mines in this country that has not a more or less complete mining and metallurgical laboratory. In European mining schools there is very little laboratory teaching. Most of them are located in mining districts, where the students can personally see and engage in the practical work of mining, concentrating and smelting. Those which are in large cities, at a distance from mines, labor under a great disadvantage. The student only sees practical work when he makes an occasional visit to mining regions, and is otherwise left entirely to theory. It must not be inferred, however, that the location of a school in a mining district can make the laboratory superfluous. On the contrary, one who, like the present writer, has received his training in such a school, sees clearly afterwards, how one-sided becomes the teaching in a mining district without the addition of such laboratory work. The instructor is only too liable to give most, if not all, of his time to elaborating unnecessary details of the local methods, past as well as present, and to pass over with amazing celerity those branches of the subject not represented in his district. Yet even as regards local work, upon which he puts such undue stress, he is likely to be too theoretical, because, not being practically engaged in it, or able to apply such tests as are furnished in the laboratory, he necessarily falls into too abstract a way of viewing the whole subject. The result is that his instruction tends to produce theorists, who speak with unwarranted assurance concerning the most difficult problems which the engineer has to solve; but who, if confronted with a simple, concrete question, are at a loss what to do.

That this lack of laboratory training in German technical schools (which are among the foremost in Europe) is beginning to be realized as a defect was evidenced by the intense interest and careful study bestowed upon the subject by the commissioners who came to the Columbian Exposition two years ago. They did not hesitate

*Trans. Am. Inst. of Mining Engineers, 1895.
†R. H. Richards, *Trans.*, i., 400.

to praise our system and to express the hope that it might be adapted to meet their necessities on the other side of the Atlantic.

The mining and metallurgical laboratory, then, as developed in this country, may be considered a necessary adjunct to every school of mining engineering. In it the lecture-instruction is illustrated with practical experiments, carried out by the students themselves. But it has also a larger scope. By the method of experiment, the student learns how to take hold of each problem as it presents itself and carry it through the different stages until it is, or the reason is discovered why it cannot be, satisfactorily solved. He is thus taught to observe closely, to make careful notes, to compare the results obtained and draw his own inferences and conclusions, and, finally, to report what he has done in clear and accurate language.

In fitting up a laboratory, we have to consider only the departments of mechanical concentration and metallurgy. Practical mining can be taught only in the mine. Some schools (for instance, the one at Ballarat, Victoria, Australia) are provided with a model of full natural size, showing a shaft with the lode, cross-cuts, etc. While this, apart from the question of expense, is an improvement on the small models formerly so extensively found at schools, it cannot but give a false impression of what a mine really is. The practical study of mining, in this country at least, is carried on to-day in "summer schools." The students spend some time in mines, going systematically through the different kinds of work, and thus becoming sufficiently familiar with mine-operations to listen understandingly to lectures on the subject. It is the merit of Prof. H. S. Munroe, of Columbia College, to have given to the summer school of mining such an impetus that to-day there is hardly an American mining school without this auxiliary course.

Before discussing in detail the equipment of a laboratory, it is desirable to consider the relation which the laboratory plant should bear, as regards general arrangement and the kind and size of apparatus, to the large scale working plant of actual practice. A commercial concentrating works, for example, must treat daily a considerable quantity of ore, and must work cheaply, which can only be done if the machines are so connected with one another that the ore shall receive a minimum amount of handling after the work is once under way. In the laboratory, on the other hand, the work, being purely experimental, must be carried on, step by step, in a deliberate and tentative way; and it is therefore essential that the operator shall be able to inspect the material under treatment before and after every operation. Consequently, the machines must be separate, that they may be easily accessible for starting, stopping, accelerating and retarding, and may be connected at will; in short, that the work may be modified indefinitely under the immediate eye of the experimenter. A laboratory in which this principle is neglected carries in it the germ of failure. The writer was once connected with such an establishment, in which a full-sized ore dressing plant had been erected according to the plan followed in commercial work, viz., the crushed ore was raised by a bucket elevator to a set of screens placed in a line step-wise, one discharging into the other, and the sized products falling directly upon the jigs and the table below. Of course, a few tons of ore were quickly disposed of; but when the products obtained were examined after the experiment, the observer did not know very much more than he had known before. Such a working plant may be of some value for obtaining more accurate quantitative results after all the necessary details have been determined by the use of detached machines; but it will do little more than substantiate what has already been sufficiently proven.

There are two opposite views concerning the kind and size of machinery proper for laboratory use. One holds that it should follow as closely as possible that of a working plant. The other maintains the superiority of somewhat different and smaller apparatus as better suited to experimental purposes and also more economical. Having tried both kinds, the writer decidedly prefers the latter, especially for educational purposes, and is of the opinion that there are few mechanical questions to which a machine smaller than the commercial size cannot give a satisfactory answer. In addition to economy, convenience and other considerations, the saving of physical strain upon the student secured by the smaller apparatus is of importance. Fatiguing operations, especially for those unaccustomed to the work, exhaust the powers and unfit the student for mental effort.

The best size for the single machine can only be arrived at by repeated trials, which have now been made for almost all given cases, as will be shown later on.

In the discussion of the details of a laboratory, it will be more profitable to start from the basis of an actual working laboratory, whatever may be its defects, than from an imaginary perfect one. The laboratories of the Massachusetts Institute of Technology, shown in plan in Fig. 1, may well serve this purpose.

The following are the different rooms, pieces of apparatus, etc., referred to by numbers in Fig. 1. In the present paper numbers enclosed in brackets are to be understood as referring to this figure.

1. Milling-room.
2. Blake Challenge rock-breaker.
3. Cornish rolls.
4. Gates rock-breaker.
5. Hendrie-Bolthoff sample-grinder.
6. Iron sampling-floor.
7. Cornish feeder.
8. Automatic feed-trough.
9. Richards' *Spitzlutte.*
10. Coarse Collom jig.
11. Fine Collom jig.
12. Convex continuous round table.
13. Hendy Improved Challenge ore-feeder.
14. Stamp-battery.
15. Amalgamated plates.
16. Frue vanner.
17. Richards' movable sieve jig.
18. Water-tanks.
19. Steam-drying tables.
20. Bucking plates and Taylor hand-crusher.
21. Sampling-table.
22. Ore-bins.
23. Pounding-block.
24. Upright engine.

24.1. Morrel agate mortars.

25. Dynamo, 50 V by 50 A.
26. Dynamo, 2 V by 50 A.

26.1. Revolving barrel.

27. Depositing-table.
28. Leaching-tubs.
29. Larger amalgamating-pans.
30. Small amalgamating-pans.
31. Settler.
32. Tank.
33. Space to grow in.
34. Store-room.
35. Blacksmith's drilling machine.
36. Carpenter's bench.

36.1. Ball-mill.

37. Assay-room.
38. Students' desks.
39. Pulp-balances.
40. Muffle-furnaces.
41. Crucible-furnaces.
42. Stack.
43. Iron table.
44. Balance-room.
45. Button-balances.
46. Store-room.
47. Store-room.
48. Furnace-room.
49. Blacksmith's forge.
50. Anvil.
51. Blacksmith's table.
52. Water-jacket blast-furnace.
53. Furnace ore-bins.
54. Brückner roasting-cylinder.
55. Copper-refining furnace.
56. Large hand-roasting reverberatory.
57. Roasting-stall.
58. Cast-iron kettle
59. Large cupelling-furnace.
60. Small hand-roasting reverberatory.
61. Small cupelling-furnace
62. Pot-furnaces.
63. Space to grow in.
64. Professors' laboratory.
65. Table for electrolytic work.
66. Experimental *Spitzlutte.*
67. Chemical desks.
68. Hood.
69. Blow-pipe room.
70. Tables.
71. Cases for apparatus, etc.
72. Sink.
73. Library.
74. Book-cases.
75. Space to grow in.
76. Table.
77. Professors' desks.
78. Lithographic notes, etc.
79. Toilet-room.
80. Lockers.
81. Basins.
82. Closets.
83. Professors' room.
84. Stack.

These laboratories are located in the basement of the Rogers building, in the main building of the Institute, and comprise the entire department of mining, engineering and metallurgy, with the exception of the lecture-rooms and collections. While at first * all the metallurgical work, including dry-assaying, was done in the room marked [48] and the milling-work in the space now covered by machines [13] and [16], there are to-day a separate furnace-room [48], an assay- and balance-room [37, 44], a milling-room [1] and a blow-pipe room [69]. To these may be added two storage-rooms [46, 47], a toilet-room [79], a library [73] and the private laboratory [64] and office [77]. Upon closer inspection, it will be seen that the apparatus is pretty closely crowded. Although there is some "space to grow" [33, 63, 75], and there are places near [1] and [33] still open. there is little room for additional permanent machinery, the available space being necessary for erecting temporary apparatus and giving room to move about in. A laboratory built to-day with a liberal allowance of space and of funds would probably be planned somewhat differently as regards general arrangement, and would also possess a larger amount and variety of apparatus. The work in it would be easier and could be more conveniently and quickly, but not better, done.

In discussing the machines and furnaces, sufficient data will be given to enable the reader to form a clear idea of the relation which the laboratory-apparatus bears to that used in large-scale work.

The apparatus of the laboratory is best classed under three heads, corresponding with its purposes:

A.—Concentrating.
B.—Sampling and assay.
C.—Metallurgical.

A.—Concentrating Apparatus.

1. *Coarse Crushing.*—Coarse-crushing is represented by the Blake Challenge rock-breaker [2], with a receiving-capacity of 4½ by 5 inches, and the Gates rock-breaker [4] with a receiving-hopper 12 inches in diameter. The machines are at a sufficient height above the platform to allow a wheelbarrow or bucket to be placed below the discharge. A pipe, connected with a small suction-fan, serves to carrry off the dust, if desirable. The Blake is used for crushing lump-ore, the jaws being set 1¼ inches apart; the Gates for smaller sizes, the liners being set at ½ inch. The Dodge and Lowry crushers may be added to the plant if it is desired to crush ore more uniformly than can be done with the Blake or the Gates type; but this will hardly be necessary for the testing of ores, although it might be useful for illustrating class-work. The small Taylor hand-crusher [20] is very convenient for breaking up specimens.

2. *Fine Crushing.*—For fine crushing there are: a pair of Cornish rolls, a stamp-battery, a non-discharging ball mill, sets of pans, a sample grinder, and bucking plates.

The Cornish rolls [3], 9 inches in diameter and 9 inches in face, are of chilled iron, without the outside shell so common for large scale work; are driven by direct and cross belt, and make 70 revolutions per minute. The pressure on the sliding box is maintained by springs. The rolls have a large feed hopper, with adjustable discharge slot, holding about 100 pounds of quartzose ore. The crushed ore is directed by three converging pieces of sheet iron (a short, steep one at the back, and a long, flatter one on either side), towards an oblong opening, 5½ by 27 inches, through which it drops into an oblong sheet-iron box, 14 by 36 inches, of No. 22 iron, with sides 6 inches and ends 4 inches deep. The upper edges of all sheet iron boxes or vessels used in the laboratory are bent around a ¼-inch iron rod to give them strength, and are painted with asphalt varnish. If the ore is to be screened, an oblong wooden screen frame, 54 by 11 inches inside dimensions, made of 2½ by ⅞-inch wood, and closed at the upper end, is suspended in a slightly inclined position from four iron (1/16-inch) hooks from the wooden frame of the rolls, and oscillated by an excentric of 1-inch throw and 200 shakes per minute, driven from the main shaft below. The ore drops upon a piece of sheet iron, 11 by 12 inches, in the upper end of the frame, passing over which it comes to the screen (54 by 12¾ inches). Through this the finer parts fall into a sheet iron box, while the coarser ones are carried over into another which adjoins the first. The screens are fastened to the lower sides of their frames by means of angle hoop-iron and screws.

The crushing capacity of the rolls per hour is 600 pounds of quartzose ore to ¼-inch size, or 300 pounds to ⅛-inch, or 150 pounds to 1/16-inch. While they serve their purpose for fine crushing, as a preliminary operation in ore dressing, yet, if ore is to be rolled previous to chloridizing and leaching, Krom rolls are very desirable for finishing, the Cornish rolls serving in that case as roughing rolls.

Roller mills, such as the Huntington, Griffin, and Tustin, or discharging ball mills, such as the Brückner, while doing satisfactory work in dry and wet rolling, are better suited for the mill than the laboratory, on account of the difficulty of cleaning up.

The stamp battery [14 and Fig. 2] is of the California pattern. It has the usual single discharge mortar for wet crushing, but only three stamps; the weight of the stamps is 228 pounds; the mortar bottom is 19¾ by 6 inches; the depth 5 inches; the discharge surface 20 by 10½ inches; the screen-frame 21½ by 13 inches; and the screen surface 18⅞ by 9¼ inches. The cams permit the lifting of the stamps to a height of 8 inches. The rate of crushing Nova Scotia gold quartz with a 7-inch height of discharge, a length of drop of 5¼ inches and 98 drops per minute is 3,353 pounds in twenty-four hours, or 1 pound for every 4,198 foot-pounds developed. With a 7½-inch drop and 60 drops per minute, it is 2,117 pounds, or 1 pound for every 5,816 foot-pounds. The coarsely crushed ore is fed to the battery by a Hendy Improved Challenge Ore Feeder [13]. A double discharge mortar, of which one side can be closed by an iron plate, will soon replace the old mortar, so that in the laboratory it will be possible to do both dry and wet stamping. In planning a new mill a battery with three stamps would not be chosen. The choice would lie between a 5-stamp battery of light stamps, say 300 pounds each, a 1 or 2-stamp battery, the stamp weighing 750 pounds, and a steam stamp. The 5-stamp battery has the advantage that the same number of stamps is used as in common practice. It would not be feasible to have a full size 5-stamp battery, as it entails too much work and requires more ore than is convenient and suitable for experimental work in the laboratory. The 1 or 2-stamp battery with 750 pound stamps dropping in a narrow double discharge mortar, one side of which could be closed at will, the discharge to be on a level with the base of the die and to be raised by chuck blocks to 16 inches, and the stamps to have a length of drop of from 4 to 10 inches, would be very acceptable. The results obtained with it would resemble very closely those of large scale work. As to the desirability of a steam stamp for laboratory use, the writer feels himself at present unable to express an opinion.

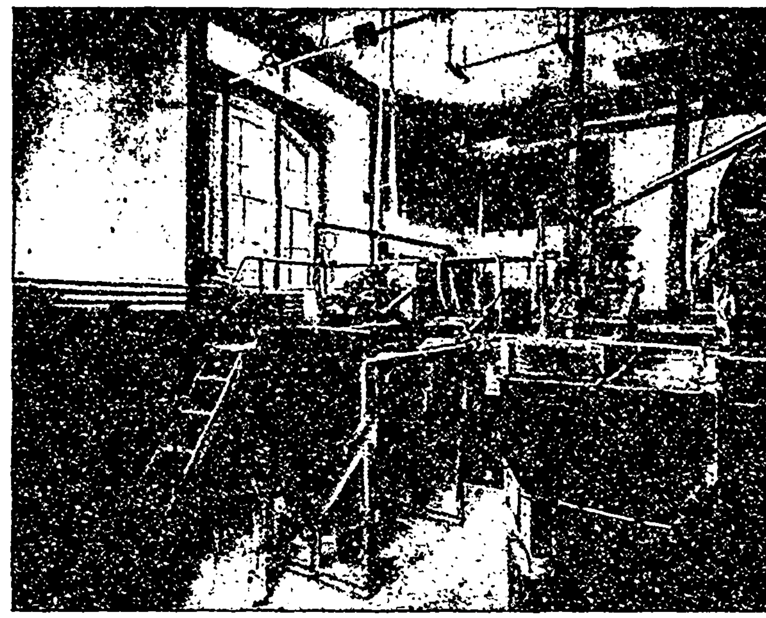
* R. W. Raymond, Statistics of Mines and Mining, 1874, pp. 499 and 500.

The Equipment of Mining and Metallurgical Laboratories.

FIG. 2.

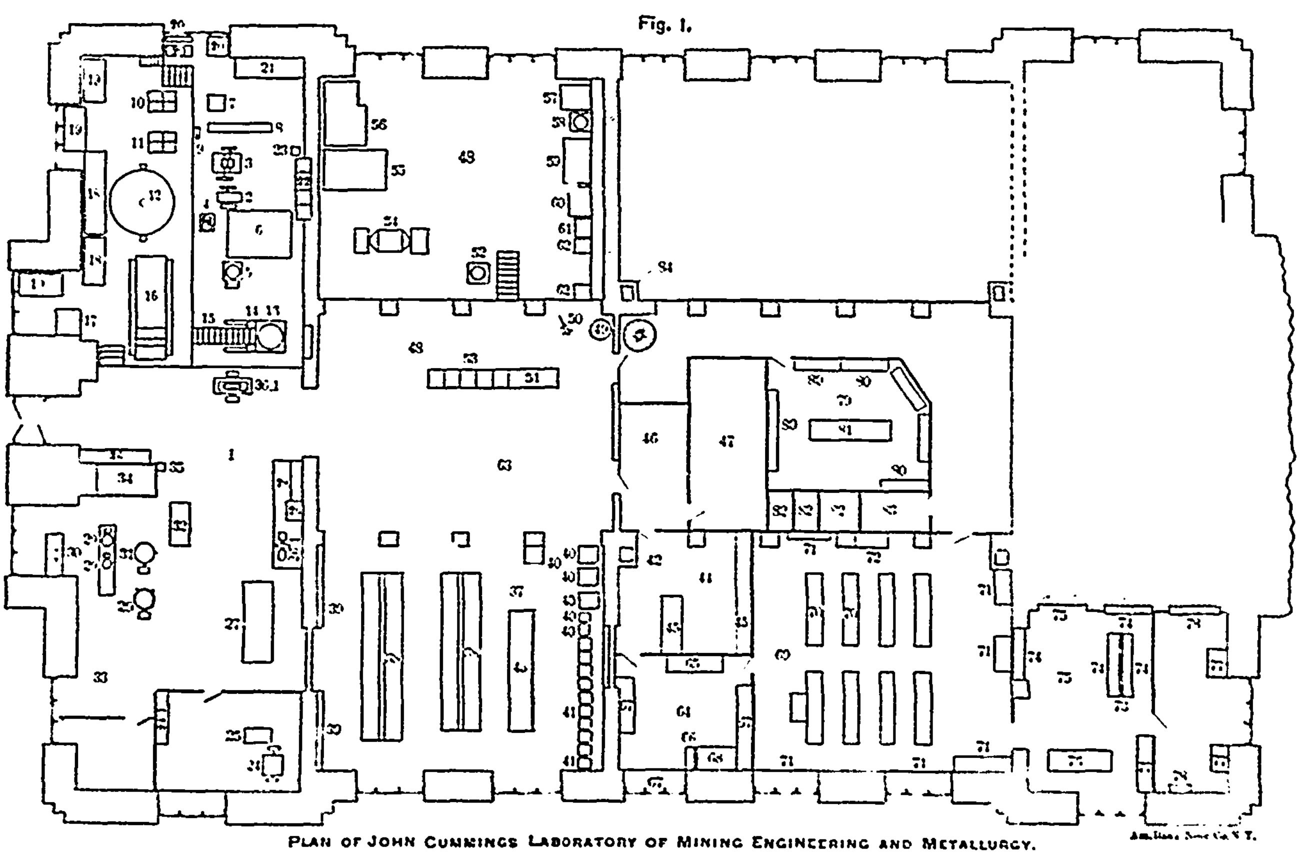
Stamp Battery and Amalgamated Plates.

FIG. 3.



A Pair of Two Sieve Collom Jigs.

Fig. 1.



The other fine-crushing apparatus, such as the ball-mill, the pan, the sample-grinder, the bucking-plate, etc., will be discussed under the heads of sampling and metallurgical apparatus.

3. *Sizing.*—The sizing or sifting of ore is more tedious in the laboratory than it is in the mill, because the screening surface is necessarily smaller, and all sifting has to be done without the use of water. If there is only a moderate quantity of ore, the sizing is best done by hand on a platform covered with an iron plate [6]. Sieves with wooden frames from 24 to 18 inches in diameter, and iron or brass wire-gauze having from 4 to 20 meshes to the linear inch, are well suited for this purpose. With very small quantities of ore, nests of sieves with metal frames, 8 inches in diameter, and wire-gauze ranging from 20 to 120-mesh are convenient; the screenings to be caught in a metal pan. With large quantities of ore the sifting has to be done by machinery, and the shaking sieves referred to above are used for this purpose. There are fourteen of these, representing the sizes 2-, 4-, 5-, 6-, 8-, 10-, 12-, 16-, 20-, 30-, 40-, 50-, 60- and 80-mesh. They sift per hour about 2,000 pounds of 8-mesh ore, 1,000 pounds of ore ranging from 14- to 30-mesh, 300 pounds of 50-mesh, and about 150 pounds of 60- to 80-mesh material. As this work is somewhat slow, it is better to do it in separate sizing-boxes. Two inclined boxes, having screens of 3-, 10-, 18-, 30- and 60-mesh, and 4-, 8-, 14-, 24-, 24- and 50-mesh respectively, are satisfactory for the purpose. They are made of ½-inch pine, are 90 inches long, 18 inches wide and 5 inches deep, and have wooden covers screwed down on a felt band. They are oscillated 200 times per minute, by an eccentric and connecting rod, which gives them an end-shake. The ore is fed into the hopper at the upper end, and drops on a piece of galvanized iron, whence it passes on to the first (the coarsest) sieve. What is too coarse to pass strikes a dam at the opposite end and is discharged into a vertical spout at the side, to which a cloth bag is attached, through which it passes into a pail. It would seem as if the Coxe gyrating screen, which does such excellent work in sizing all sorts of minerals, might well be suited for laboratory purposes, either in the form of a single screen or a nest of screens. The trommels, as commonly employed in large scale working plants, are out of place in a laboratory. If a trommel is to be used, the polygonal form seems the most suitable, as the different screens could be easily adjusted and removed. It would be necessary in all cases to house the trommel.

4. *Hydraulic Classification.*—Hydraulic grading is done at present in the Institute laboratory only in an ascending current of water. Grading in a horizontal current of water, or *Spitzkasten*, will shortly be introduced, as it has been proved to be indispensible for the successful working-up of fine slimes. Now the fine sands and slimes are only settled, but not graded. Hydraulic classification is practiced with small samples of finely-pulverized ore, as a preliminary test before working small lots. The samples are treated in the Richards pointed tube,* where the mixed sands, held in equilibrium by an ascending stream of water are, by slightly slackening the current, drawn off slowly into the glass bulb, which, when filled, is exchanged for another. The contents of each bulb are then separately sifted through a nest of graded sieves, and weighed and examined, to find out just how effective the work has been, and what will be the best sieve-size for the trial test. In working, the material, after it has been crushed to the proper size, is passed through the automatic feed-trough [8], or the Cornish feeder [7], into a Richards *Spitzlutte* [9], when the discharge of the spigot will go to the jigs [10 and 11] and the overflow either to the vanner [16] or the slime-table]12], or first to the former, and, as tailings, to the latter. It is proposed to have the overflow, when worked directly on the slime-table, run first over a *Spitzkasten*, and then to feed separately the spigot-discharge, thus insuring better work. Another way of using the Richards *Spitzlutte* is to feed only carefully-sized ore, when the spigot, in many cases, will give clean heads and the overflow clean tailings, provided there are no included grains. The capacity of the *Spitzlutte* with a ½-inch spigot, is about three-quarters of a ton of sized material to 1 ton of mixed material per hour.

The automatic feed trough and the Cornish feeder serve to convert dry pulverized ore into liquid pulp, delivering it to the *Spitzlutte*, the jigs or the slime washers. The feed trough is of wrought-iron, 10 inches wide at the top, 3 inches at the bottom and 7 feet long, and is placed in an inclined position on a wooden trestle. On the inner side the trough is marked off, so that the same quantity of ore may be washed down by the travelling jet in the same interval of time, which is usually one minute. The travelling jet is a ¾-inch iron pipe, pointed downward and fixed in a wooden truck, having two of its wheels on one edge of the trough and the other on a rail 3 inches away from the opposite edge. The pipe is connected by a rubber hose with the water main. The carriage is pulled up the inclined trough by a weighted cord, running over a pulley at the upper end of the trough to a shaft near the roof, around which it is wound once or twice and kept taut by the weight. To this weight is fastened a second cord, running over a pulley near the roof to the lower end of the trough, which serves to raise the weight, and thus to lower the carriage. In order to prevent the rubber hose from obstructing the upward travel of the carriage and the even flow of the water, it is suspended from the rail by small grooved wheels, and the loops are replaced by 6 iron pipe return bends. Thus the suspended hose shows three zigzags, which are close together when the carriage is at the lower end of the trough, and separate as it travels upward, but are held together at the upper ends by strings, which do not allow them to get more than 24 inches apart.

The Cornish automatic feeder is a four-sided truncated pyramid of sheet-iron. It is 24 inches high, and the bases are 18 and 12 inches square. To the smaller base are attached four legs, on which it stands in a sheet-iron box, 16 inches square and 6 inches deep, contracted at one end into a spout. The legs (pieces of angle iron) firmly connect the hopper and the box, leaving a distance of ½-inch between them for the ore to pass through. This is charged into the hopper and washed down the spout by a jet of water playing usually between the walls of hopper and box, but occasionally (if especially quick feeding is desired), upon the ore in the hopper.

5. *Jigging.*—The jigs in use for water sorting are plunger jigs and movable sieve jigs. The former are represented by two Collom jigs [10 and 11 and Fig. 3], used for ores ranging from 30 to 5-mesh, the latter by a Richard's jig [17] for sizes larger than 5-mesh.

The Collom jigs are two compartment machines. They are supported by a V-shaped iron frame on either end. The screen frames are 12½ by 18½ inches. The length of stroke is adjustable to ¾-inch and the number of strokes can be varied by the use of three-step pulleys, 8, 10 and 12 inches in diameter, from 130 to 180 per minute. The ore coming from the feed trough, the feed hopper or the spigot of the *Spitzkasten* travels over the jig, while the tailings at the opposite end are collected and unwatered in a sheet-iron box. From this they are drawn at intervals, while the water which overflows goes into the water tanks [18]. The jigs have no automatic discharge for concentrates; since, for the purposes of instruction and experiment, it is better to stop them every little while and skim off the different layers formed. The manner of working, therefore, is the same as that of large scale one-compartment jigs. The reason for having a two-compartment jig is that "every machine as far as practicable, should have its guard."† Any middle product not remaining on the first sieve will be collected on the second sieve and thus prevented from passing off into the tailings. The Collom jigs here described were put in to replace two three-compartment Harz jigs formerly in use, the screen frames of which 16 by 12¾ inches, were much too small to do satisfactory work. The reciprocating motion was derived from an excentric adjustable to 2 inches; and the number of strokes could be varied from 100- to 200 per minute by four step-pulleys, 6, 7½, 9 and 10½ inches in diameter. The jigs had an automatic side discharge for heads.

The movable sieve jig serves to illustrate the lectures, to work ore coarser than 5-mesh and to do the water sorting in graded crushing and jigging. The sieve frame is 14 inches wide, 22 inches long and 12 inches deep, the ore bed can reach a depth of 10 inches. The rods of the screen frame, ¾-inch in diameter, are divided into two parts to facilitate taking the machine apart. The two lower or jigging rods, 48 inches long, are forked at their lower ends and have an eye at the top through which passes a connecting rod, ¾-inch in diameter, suspended from the upper or excentric rods, which are 25 inches long. The excentrics are adjustable to 2 inches, the excentric shaft is 51 inches long and 1⅝ inches in diameter. It has a conical pulley with seven steps, its smallest diameter being six inches, its largest 8¼ inches. The number of strokes per minute ranges from 100 to 200. The counter shaft is placed 14 inches above the excentric shaft; and the whole is attached to a strong wooden frame. The water tank in which the ore is jigged is 33 inches long, 27 inches wide and 22 inches deep. Small boards extending from the sides into the tank serve as guides for the screen frame. The hutch work is drawn off at the sides; the tank rests on a wooden box and its top is 36 inches from the floor.

6. *Slime-Washing.*—Of the different machines in common use for working slimes [*i.e.*, material not coarser than 30-mesh] only two are represented in the laboratory: a Frue vanner [16] and a convex continuous round table [12]; a greater variety being excluded by the lack of space.

The Frue vanner is of normal size, *i.e.*, it has an inclined rubber surface 4 feet wide and 12 feet long. Either plane or corrugated belts are used. The normal adjustment for full work in the laboratory [inclination of belt 3½ inches in 12 feet, travel of belt 32 inches per minute, and 195 shakes of 1-inch throw per minute] has to be changed, if the pulp flows directly from the light three-stamp battery upon the vanner, as the battery furnishes only about 1½ tons of pulp in twenty-four hours, while the normal rate of the vanner is 5 tons. The simplest way is to change the inclination to 2½ inches in 12 feet and to regulate the flow of water accordingly. If the vanner is to do full work, the pulp from the battery is collected in the settling tanks and fed at the required rate and with the necessary water by the Hendy feeder of the stamp-battery. In order to permit this, the connecting-rod of the friction-plate is replaced by an excentric rod, the excentric of which has a 2-inch throw, and is on a small counter-shaft near the ceiling. The counter-shaft is driven from the upper shaft of the laboratory and makes 100 revolutions per minute. The ore which is fed by the carrier-plate is washed by a jet of water into a sheet-iron trough and conducted from behind the mortar into the ore-spreader of the vanner.

The convex continuous round table is 8 feet in diameter and has a slope of ¾ inch to the foot. It is of ⅛-inch sheet-iron, painted with tar, sanded and rubbed smooth, and is supported by an umbrella-frame. It receives its pulp from a fan-shaped distributor, which discharges against one side of a central cone, 14 inches high and 18 inches in diameter, and its wash-water on the opposite side from a horizontal curved pipe with perforations on the inner side. The three products, tailings, middlings and heads, flow into a circular launder. The compartments for heads and middlings are 12 inches wide and hopper-shaped; that for the tailings is 6 inches wide. The heads and middlings are drawn off at intervals into a pail; the water of the heads compartment overflows into that of the middlings, and the overflow of these into the tailings launder. The heads are washed off by jets of water; the middlings are sprayed in the usual way. The machine treats from 1 to 1½ tons of ore per day.

There are in the laboratory, of course, the ordinary implements for panning and vanning to check the work done by jigging and slime-washing, and to assist in amalgamating operations.

7. *Electro-Magnetic Separation.*—The magnetic separation of magnetite or of iron ore rendered magnetic by a preliminary roasting is represented by a small Chase endless-belt machine* placed near the tank [32]. This receives the waste-water from a 6-inch Pelton water-wheel which drives the concentrator. Many interesting data of magnetic separation are recorded in the journal of the laboratory. It may be incidentally remarked that a small Pelton wheel forms a most satisfactory motor for any apparatus that is to be driven independently in a laboratory having water under pressure at its disposal. Of course, a pressure-regulator is necessary to equalize the uneven flow obtaining in a city main.

8. *Dry Concentration.*—There are no arrangements in the laboratory for dry concentration. To make tests that would be in any way satisfactory would require too much space.

9. *Distribution of Power and Water.*—The machinery of the laboratory is driven by a 15 horse-power upright engine [24] having a common side-valve. Its cylinder is 9 inches in diameter; it has a 9-inch stroke, and is usually run at 200 revolutions per minute. The main shaft, 1¾ inches in diameter, is on the ground floor and runs the entire length of the milling-room. Its position is approximately indicated by Nos. 1 and 3 in the plan (Fig. 1). It makes 240 revolutions per minute. Near the double ball-grinding mill [36.1] it is connected with the counter-shaft of the same diameter placed near the ceiling. This also runs the entire length of the mill-room along the center line of the Frue vanner. It makes 200 revolutions per minute. Thus the different machines are set in motion either from the main or counter-shaft, the choice depending upon the location and direction of the belts.

The large dynamo [25], an Eddy shunt-wound machine of 50 volts and 50 amperes, is driven at the rate of 2,200 revolutions per minute. It has a separate driving shaft, 1¾ inches in diameter, making 550 revolutions per minute. The small dynamo [26], also an Eddy machine of 2 volts and 50 amperes, is connected with a counter shaft, and makes 1,400 revolutions per minute. Electricity has so far been used in the laboratory only for the separation of ores and for the deposition of metals. For electric fusion a differently wound dynamo would have to be added, in order to secure the necessary amperage.

The water required in the laboratory is received from the city main, but is not conducted directly to the different machines, since there would be no regularity in the flow. It runs into the end compartment of the water-tank [18], from the bottom of which a centrifugal pump, 18 inches in diameter, delivers it into a 2-inch main pipe running along the upper platform, on which are placed the machines Nos. 13, 14, 18, etc. Two-inch tees supply the different machines from the top of the main. By the aid of separate pipes and 3-way cocks the overflow from the jigs can be pumped upon either the vanner or the round table, the overflow of the vanner upon the table, and the contents of the settling tanks upon any of the washing-machines or into the sewer.

10. *Auxiliary Apparatus*—By referring to the plan (Fig. 1) and its legend, the different auxiliary apparatus used in ore dressing and in metallurgical work can easily be seen. Prominent among these are, for instance, the steam drying tables [19], on which the products are dried so as to permit comparison of the weights of ore before and after treatment.

The plan does not show the thirty odd large bins, 4 feet wide, 4 feet deep and 4

* Trans., xxiv., 438.
† Richards, Trans., xxii., 701.

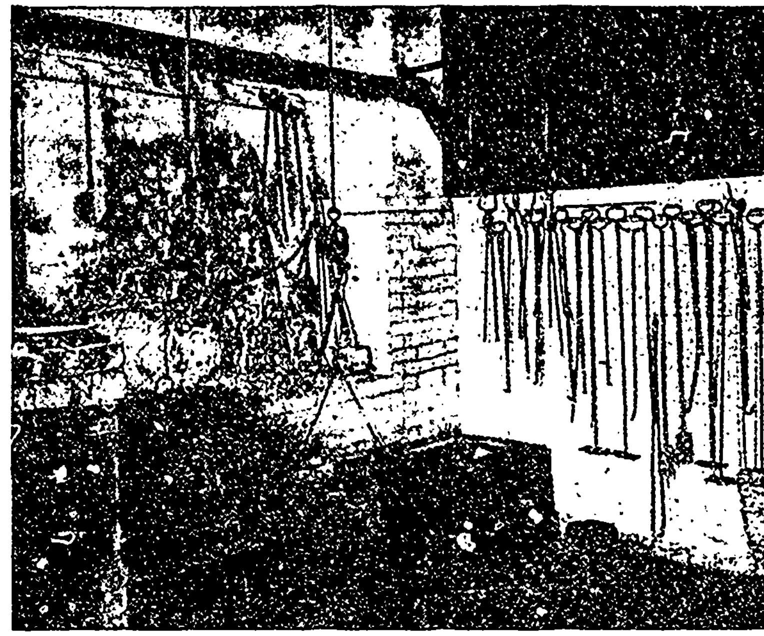
* Trans., xxi., 503.

The Equipment of Mining and Metallurgical Laboratories

FIG. 4.

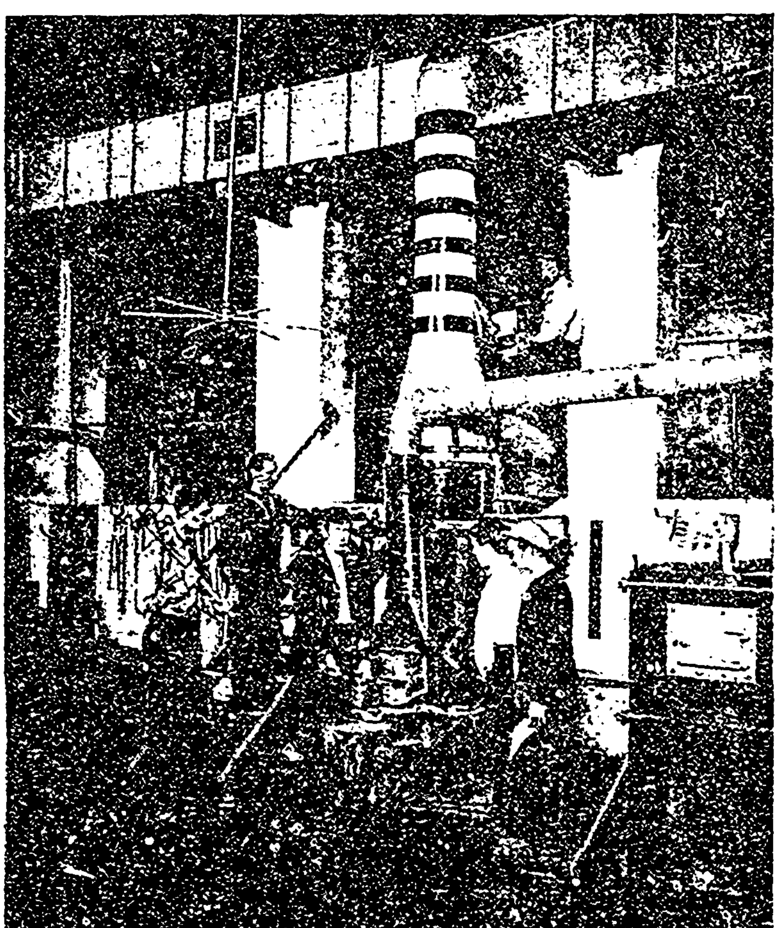
Bruckner Roasting Furnace.

FIG. 6.



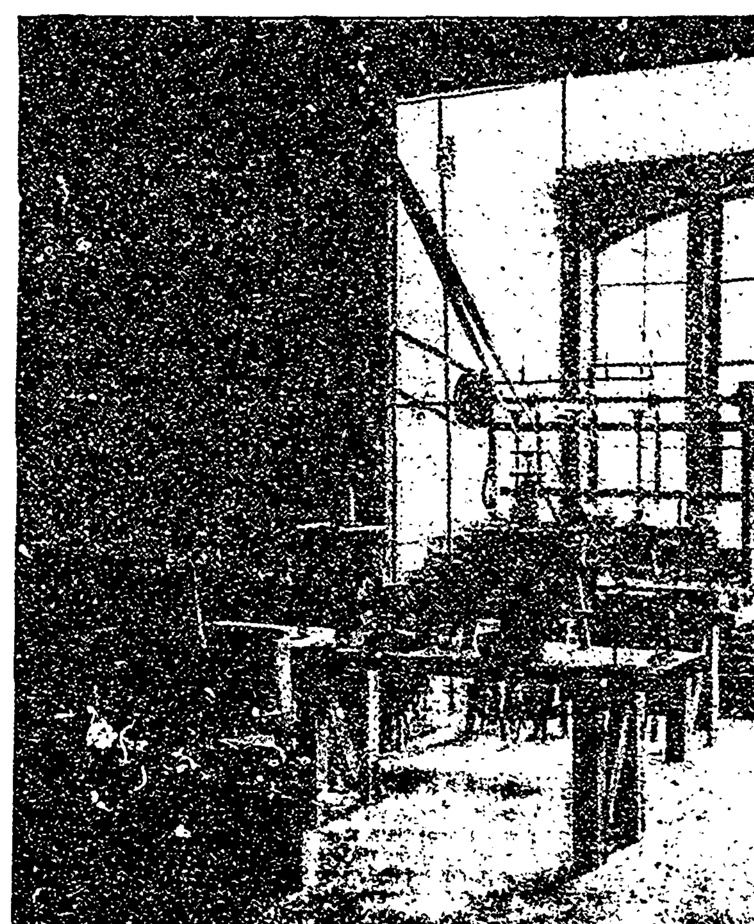
Furnace for Pot-Melting, with Travelling Lift for Covers.

FIG. 5.



Water-Jacket Furnace for Smelting Lead and Copper Ores.

FIG. 7.



Laboratory Amalgamating-Pans.

feet high, for ores, fluxes, fuels and intermediary products. They are accessible from the furnace room by two doors, and from the milling room by one door.

B.—SAMPLING AND ASSAYING APPARATUS.

Ore sampling is generally done in the laboratory by hand. If it is desirable to do mechanical sampling, only intermittent machines—those which take the whole of a stream of ore at stated intervals—are allowable. The small-size machines of Bridgman and Constant do good work. Ores are crushed in rock-breakers and rolls and pulverized in the Hendrie and Bolthoff sample grinder [5] or on bucking plates [20]. Samples for analytical purposes are ground fine in four Morrel agate mortars [24.1]. These ores are all sampled by hand on the iron sampling floor [6] or on the sampling table [21]. Liquid pulp, fed upon or coming from washing machines, is passed through specially constructed automatic samplers (see *e.g.*, Fig. 2). Samples from alloys are taken by chipping, punching, sawing and boring [35]. In laboratory instruction too little stress is apt to be laid on the sampling of ores and metallurgical products. It is a most important and necessary part of the work, the whole of which is really invalidated if the sampling is inaccurate.

Assaying, in its broadest meaning, includes the quick quantitative determination of any element or compound met with in metallurgical work, embracing not only fire assays but also what is known as analytical work on solids, liquids and gases. In the Institute metallurgical laboratory assaying is restricted to fire work (except as regards the parting of doré silver buttons or chlorination assays). All analytical work is done in the chemical laboratories. The assay laboratory has two divisions: the assay room proper [37], and the balance room [44]. The assay room has eight pulp balances [39], weighing accurately to 1 milligramme with a load of 60 grammes, and six flux balances, accurate to 0.1 gramme with a load of 600 grammes. They are distributed among the students' desks [38], of which there are fifty. There are twelve crucible furnaces [41]; nine muffle furnaces [40], three of which have lately been erected in "the space to grow" [63]; and, lastly, an iron table [43] for hot crucibles, etc. Under the table is a shelf for crucible and scorifier moulds, and beneath this are small bins for fuels. Along the side of the table are four posts, with anvils for breaking crucibles, hammering buttons, etc. The crucible furnaces are 27 inches high and 12 by 12 inches in the clear. They are enclosed in wrought iron plates, and thus firmly held together. The top of each furnace is horizontal, and is covered by a fire-clay tile, around which is shrunk an iron band, with two hooks riveted to it. The cover is suspended from a wire cord passing over a pulley attached to the ceiling, a counter-weight being at the other end.

The muffle-furnaces are of different kinds and sizes. Five are Judson coke-furnaces, two with muffles, 4 by 7 inches, closed at one end, and three with muffles 8 by 16 inches, open at both ends; also, three coke-furnaces, with sheet-iron housing and fire-brick lining, having muffles 7 by 12 inches, closed at one end; and, lastly, one two-muffle furnace for bituminous coal, with muffles, 6 by 13 inches, open at both ends. Oil- and gas-furnaces are not used. The draft for all the furnaces is furnished by one main chimney [42], 2 by 3 feet, and about 80 feet high.

The balance-room contains one analytical balance and nine button-balances [45]. The principal aim has been to have the leading makers, such as Ainsworth, Becker, Oertling, Troemner and others, represented. The balances are accurate to 0.01 milligramme, with a maximum load of 0.5 gramme.

C.—METALLURGICAL APPARATUS.

While the various operations of the concentration of ores and fuels can be carried on in a school- or general experimental laboratory so as to give practical results, the case is likely to be somewhat altered when it comes to metallurgical processes. If we take, *e.g.*, a leading process—that of smelting in the blast-furnace, we cannot reduce the operations to a laboratory-scale, and obtain results which will serve as a guide for practical work. Nevertheless, smelting in the blast-furnace ought to be a part of the laboratory work, on account of its educational value. If a student receives for treatment a batch of ore, examines it mineralogically and chemically, makes the necessary analytical determinations of his fluxes and fuel, calculates his charge, smelts it and sums up his results by weighing, assaying and analyzing the products, he learns more about smelting than any amount of lecturing or cursory visiting of works can ever teach him. Only by taking hold himself and carrying a process through to the end, can he learn how to think metallurgically, and thus become really qualified to listen intelligently to what is taught in the class-room.

There are, however, many metallurgical processes—such as roasting, amalgamating, leaching, electro-deposition and other operations—which can be performed in the laboratory on a small scale with trustworthy economic results. In fact, the engineer is guided, in the planning of amalgamating- and leaching-mills, by the results obtained in such laboratory-experiments. This class of work should therefore have a prominent place in the laboratory. From what has been said, it will be evident that most operations relating to the metallurgy of iron and steel must be excluded. Attempts have been made to imitate large-scale iron and steel-work in the laboratory. For instance, the Sheffield Technical School, in England, has a small open-hearth steel-furnace; the Polytechnic School of Aix-la-Chapelle, Germany, has a small puddling-furnace; but the writer, though not acquainted with the results obtained, is much inclined to doubt whether they will be found to justify the large outlay of time and labor involved. We must always keep in mind that it is not the province of an engineering school to perfect the student in any one branch of his profession, so much as to ground him in the fundamental principles upon which he is, later, to build for himself in detail.

In the laboratory of the Institute the processes chosen for instruction are those involved in the treatment of lead, copper, gold and silver ores and the ores of some of the minor metals, although it should be added that crucible-work and other small-scale heat-treatment of iron and steel, especially with regard to their physical properties, are not excluded.

The furnace-room [48] contains apparatus enough of various kinds to carry on all the necessary operations, so arranged as to occupy as little space as possible. This forces a crowding of the furnaces; but as the work can be so laid out that adjoining furnaces need not be used at the same time, less inconvenience results than might be at first supposed. The necessary draft is furnished by a stack [84] 2 by 3 feet and about 80 feet high. A horizontal main flue, 3 by 3 feet, running along three sides of the room—sometimes near the ground, sometimes near the ceiling, according to the height of the furnaces—collects the gases. Each furnace, however, can be shut off from it by a damper in its branch-flue. Too much stress can hardly be laid upon the necessity of securing a strong draught. The main and branch-flues should be large, and the stack of ample section and sufficient height, so that it shall be possible to run each of the furnaces alone or any number or all of them together. With a well-fitting damper, it is an easy matter to cut off too much draft; if there is too little, the result is fatal.

1. *Roasting.*—For this purpose there are three reverberatory furnaces and one stall.

The large hand-reverberatory [56] covers 8 feet 2 inches by 5 feet 7 inches, and is 4 feet 8 inches high. Its hearth is 4 feet 2 inches long and 3 feet wide, and lies 9½ inches below the top of the fire-bridge, which is 9 inches wide. The height of the 9-inch side wall is 11 inches to the spring of the arch, the height of the arch 5 inches. The furnace has one working door, 14 by 9 inches in size, and 2 feet 10 inches from the ground. The gases pass off through three openings, 9 by 9 inches, in the roof, into a branch flue running across the furnace and ending in the main flue. The fire-place, 2 feet 3 inches by 1 foot 9 inches, lies 16 inches below the top of the bridge, which is 8 inches below the roof. It has a door 12 by 9 inches in size, and 2 feet 6 inches from the ground. The furnace treats charges of about 250 pounds of pyritic ore.

The outside dimensions of the small hand-reverberatory [60] are: Length, 8 feet; width, 2 feet 8 inches; height, 5 feet. The hearth is 2 feet square and 6½ inches below the top of the bridge, which is 3 inches wide. The height of the 4½-inch side-wall is 8 inches to the spring of the arch, and that of the arch is 5½ inches. The working door is 9 by 6 inches, and 2 feet 10 inches from the floor; the flue running over the furnace is 5 inches square. The fireplace, 1 by 2 feet, is 10 inches below the top of the bridge, which is 7 inches below the roof, and its door, 9 by 6 inches, is 2 feet 6 inches above the floor. The furnace works small charges, of say, 25 pounds of pyritic ore.

The drawback of roasting in such small reverberatories is that the charge is liable to become too much cooled near the working door. If there had been more room, both roasting furnaces would have been constructed, like the reverberatory smelting furnace, with the working door at the end and the flue just above it; the air necessary for roasting being admitted through the hollow bridge. It might also be an improvement to have the hearth built in an iron pan, and so arranged as to permit its being removed, cleaned, and examined after an operation, although this is not so necessary in roasting as in smelting.

The third reverberatory roasting furnace, the Brückner cylinder [54 and Fig. 4], gives opportunity to study the behavior of an ore on a revolving hearth. The outside dimensions are: Length, 6 feet, and diameter 2 feet 8½ inches. The cylinder is of ³⁄₁₆-inch boiler-iron, and has a 2½-inch fire-brick lining. The throat is 12 inches, and the charging hole 8 inches in diameter. The cylinder, the axis of which is 3 feet 5 inches above the ground, revolves on two iron friction rings (35 inches in diameter), which rest on four 12-inch carrying rollers. One of the carrying roller shafts (2⁷⁄₁₆ inches in diameter), is rotated by a worm gear (62 teeth of 1-inch pitch), at the rate of 20 revolutions per hour. The fire-box is detached and rests on castor wheels. By removing the box backwards or sidewise, the amount of air admitted can be increased. An additional improvement would be to make the throat of the fire-box muffle-shaped, leaving that of the furnace circular. In order to have complete control over the flame, the grate (18 by 24 inches), is laid 20 inches below the bridge. The carbonic oxide gas generated is burned by warmed air entering the furnace just above the bridge, after having been forced through five flues in the side wall and roof of the fire-box. The ash-pit, 8 inches deep, is closed and connected with a blast-pipe. This furnace treats charges of about 200 pounds.

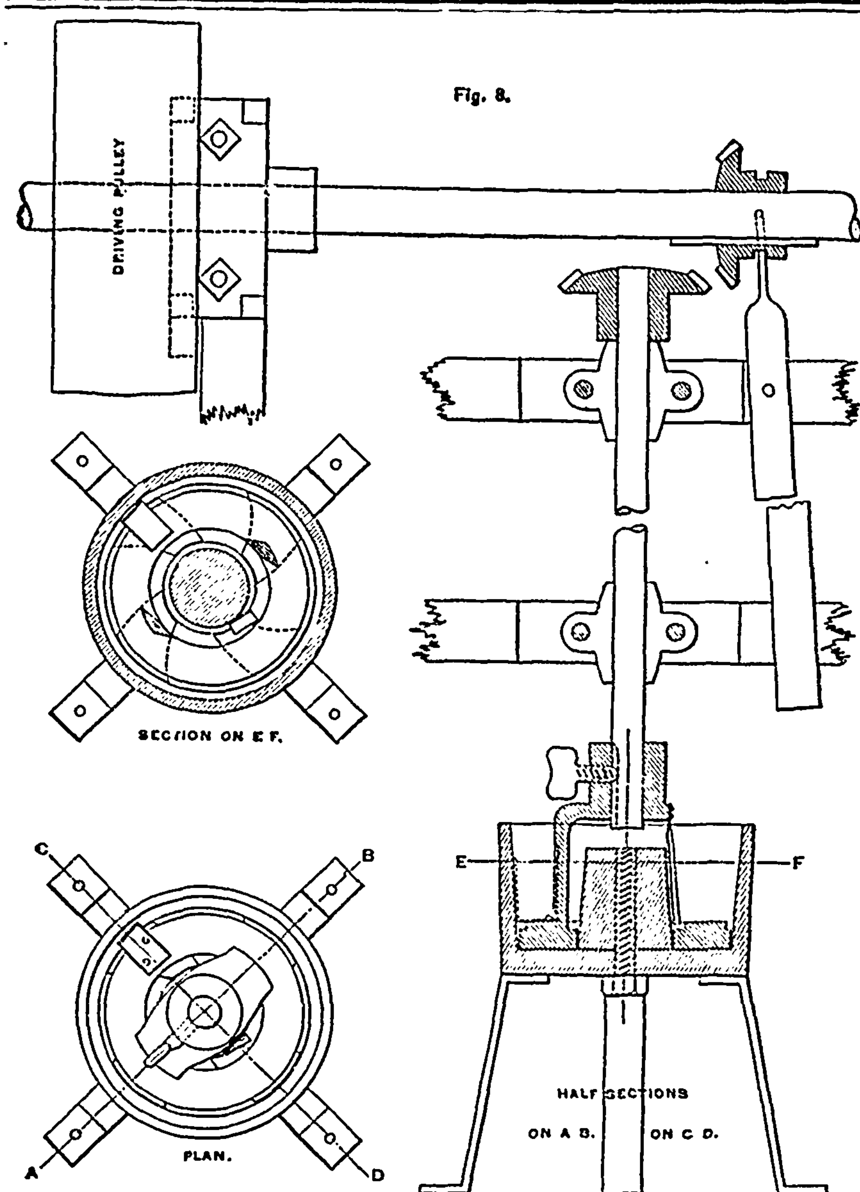
The stall [57], which completes the roasting apparatus, is commonly used for treating coarse copper-bearing pyrites previous to smelting in the blast furnace. It is 3 feet 3 inches deep, 2 feet 3 inches wide and 3 feet 7 inches high to the spring of the arch. The arch is 6 inches high. The walls are 4 inches thick and well anchored. The ore is roasted on a temporary grate of wrought iron bars. The front is bricked up half way, the upper half being closed by an iron plate with peep-hole. The charge varies from 1,500 to 2,000 pounds, and a roast lasts from two to three days. The results in desulphurization are very similar to those in large stalls. The management of the stall affords a splendid lesson in the regulation of draft.

2. *Smelting.*—Smelting is carried on in the blast-furnace, the reverberatory-furnace and the crucible-furnace.

The blast-furnace [52 and Fig. 5] has had to undergo several changes before it reached the present satisfactory form. The first furnace, 18 by 15 inches at the tuyere level, was built of brick. It had one tuyere at the back, run with a "nose" the ore being charged towards the back and the fuel towards the front. It would last one day, or perhaps two days, and then had to be relined. The next furnace, 18 by 16 inches, with three ordinary tuyeres, and charged in horizontal layers, burned out in less than a day. When provided, however, with one water-cooled tuyere at the back, projecting 8 inches, it was run successfully, and had to be relined only once a year. With this furnace ores were smelted for about six years, until, in 1884, the present one replaced it. This is a water-jacket furnace, resembling the circular copper-smelter in common use to-day. The height of the furnace, 6 feet 6½ inches, is divided as follows: height of four hollow cast-iron columns, 17½ inches; thickness of annular collar, 1 inch; distance to tuyeres, 1 foot; diameter of tuyeres, 2 inches, and height to feed-door, 3 feet 10 inches. The diameter at the bed-plate is 1 foot 5 inches; at the tuyeres, 1 foot 6 inches; at the throat, 1 foot 11 inches. The furnace has a conical hood 2 feet 9 inches high and 25 and 11 inches in diameter, which ends in a vertical flue leading into the main flue. The feed-door is 13 inches high, 14 and 9¾ inches wide. The water-jacket is of ⅜-inch boiler-iron and has a 3-inch water-space. The feed-water is supplied from the city main through a ¾ inch pipe near the top, the overflow-pipe being tapped into the upper-flange. There are four tuyere-holes, lined with solid bored blocks of bronze. The tuyere-pipes are of wrought-iron steam-pipe; the horizontal arm has at one end a conical turned bronze nozzle, at the other a T, the vertical leg of which is connected by a pipe with the tuyere-bag, and the horizontal leg, reduced in diameter by a bushing, is closed with a cap having a glass-covered peep-hole. The bustle-pipe is 4 inches in diameter. The bottom of the furnace is closed by a wrought-iron plate clamped to the collar of the four columns. The crucible is lined with brasque tamped in solid from above to the level of the tuyeres, and then cut out from below into the desired shape, the lining reaching up to the tuyeres.

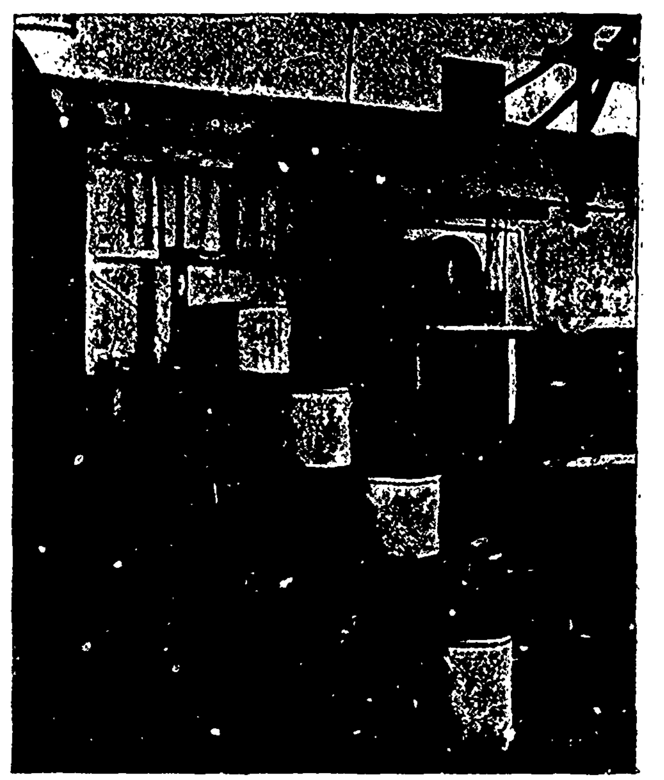
In tapping the melted masses from the furnace different methods were tried before the present one was adopted. With an internal crucible and separate metal- and slag-taps the metal easily became cool; with an external crucible and continuous flow it cooled even more quickly. The present practice is to tap the melted masses into a small cast-iron overflow-pot, having the form of an inverted pyramid 6 inches deep, 12½ inches square at the top and 2½ inches square at the bottom. This retains the metal, matte and foul slag, and is removed after every tapping by means of iron hooks inserted through rings on either side. The clean slag overflows into an ordinary conical slag pot, 14 inches in diameter and 16½ inches deep. A detached carriage serves to take away the full pots and return the empty ones. A devereux slag-pot may in the future replace the arrangement now in use. The fumes from tap-hole and slag-pot are drawn off by a hood connected with a small fan. The furnace has a daily smelting-capacity of about 6 tons of charge, not counting the fuel. It is not run, however, for 24 hours at a time. The furnace, warmed during the preceding day and night, is usually blown-in at 8 a.m. and blown down again about 4 p.m. This period is sufficient to give the student all the instruction that he can get from carrying on a smelting operation on such a small scale. Longer runs would mean greater physical exertion without corresponding benefit. When a run is completed, all the products are carefully separated and, if necessary, the matte adhering to foul slag or metal is separated by an additional crucible-fusion, and thus a complete account of stock is taken. With the present arrangements the loss of metal in flue-dust has to be arrived at indirectly by difference. It is proposed, however, to save the flue-dust, either by cooling or filtering or by wet condensation, and thus to obtain direct figures.

Fig. 8.



RICHARDS LABORATORY AMALGAMATING-PAN.
SCALE: 2 inches = 1 foot

FIG. 9.



Leaching-Tubs Arranged for Mechanical Stirring.

Three reverberatory smelting-furnaces were once considered necessary to fill the wants of the laboratory for agglomerating lead and copper-ores, smelting lead-ores, cupelling base bullion, bringing forward matte and refining copper. Two furnaces are sufficient. The English cupelling furnace [59] serves for the last three operations; while the other two, formerly carried on in a reverberatory-furnace (replaced to-day by he Bruckner cylinder) will be taken up again when the copper-refining furnace [55] has been rebuilt as a reverberatory furnace with movable hearth inclined from bridge to flue. The cupelling-furnace is of the ordinary pattern. The test is 18 by 24 inches, and is wedged fast against the test-ring; the fieplace 18 by 24 inches, is run with the under-wind; the grate is laid low, 20 inches below the top of the bridge, which is 9 inches wide and 15 inches below the roof. In order to burn the carbonic oxide gas formed there is a special tuyere in the side of the furnace just above the level of the bridge. In addition to the tuyere at the back of the hearth, there is a second one in the roof connected with a U-shaped pipe passing through the flue. Hot blast comes into play when a quick raising of the temperature is desired. The different kinds of reverberatory work so far practised in this furnace, such as liquating drosses on an iron plate, softening and cupelling base bullion on a hearth of lime tone and clay, concentrating matte and refining copper on a hearth of a mixture of raw and burnt fire-clay or closely-fitted refractory tiles have been so satisfactory that the idea of a fixed hearth for laboratory-purposes has been entirely given up. In the furnace 150 pounds of base bullion, assaying about 150 ounces of silver per ton, are cupeled in 6 hours, or 200 pounds of black copper are brought through the different stages to tough-pitch copper in 7 hours.

The plan, Fig. 1, shows a small cupelling-furnace [61], which is used sometimes to refine impure silver from the English cupelling-furnace in quantities larger than can be satisfactorily treated in one of the muffle-furnaces. It has a small fire place, 8 by 14 inches, and 15 inches deep, the flame rising from which strikes the fire-clay tile forming the roof, and is deflected so as to strike the silver (placed in an oval cupel test, 8 x 14 inches, and 2 inches deep, filled with bone-ash).

Crucible-work is of considerable importance in a metallurgical laboratory, as it is not only adapted for independent experiments, but serves to bring into suitable form the different mixed products obtained in the processes carried out on a larger scale in the laboratory. Small crucibles are commonly heated in the assay-furnaces; for larger charges there are two pot-furnaces [62, and Fig. 6], worked with under wind. They are 14 inches square and 23 inches deep; the blast is introduced through the ash-pit door, and the ash-pit is 9 inches deep. A furnace holds conveniently a No. 35 graphite crucible.

3. *Distillation and Sublimation.*—Both these operations are of subordinate importance in laboratory-work. Distillation of mercury is carried on in half-pint and one-pint bulb-retorts, which are heated over four-tube Bunsen burners. The delivery-pipe is cooled by suspending from it an iron trough filled with cotton-waste, which is kept wet. Reduction of zinc oxide or sublimation of arsenic, realgar and sulphur are rare operations, and no special apparatus is assigned for this purpose.

4. *Crystallization.*—The principal process coming under this head is the Pattinson process, for which a cast-iron kettle [58] is used, 21 inches in diameter and 14 inches deep, covered with a hood and heated by a fire-place 21 inches square. This kettle is rather small for the Pattinson process; it is the one in common use for desilverizing argentiferous lead by the Parkes process, and for melting and liquidating, in general, readily fusible metals and alloys.

5. *Amalgamation.*—The process of amalgamation is especially well adapted for laboratory-work, since small-scale experiments give results directly applicable to large-scale work. The different appliances for treating gold- and silver-ores in this way are therefore well represented. There are a stamp-battery, a ball-mill, two revolving barrels and a number of pans of different sizes.

The stamp-battery, as a pulverizer, has already been described under the head of fine-crushing. In using it for the amalgamation of gold-ores, the arrangement and management of the copper plates (see Fig. 2) differs from that of large-scale work in having five small plates, 24 by 11 inches, and $\frac{1}{8}$ inch thick, laid cross-wise over the apron-table, one overlapping the other,* instead of a single large sheet of copper, and also in not having inside plates. By having several outside plates, and cleaning them up separately, it can be seen how the gold saved decreases with the distance from the mortar-discharge, and the required length of plate can thus be determined. In order to prevent absorption of gold by the outside plate, it is coated with silver-amalgam. On an inside plate this would be scoured off and gold would be absorbed by the copper, thus vitiating the test; hence, inside plates are not recommended.

The ball-mill [36.1] is used for grinding and amalgamating small lots of gold ore and for cleaning up the battery residues. The plan shows a circular cast-iron [$\frac{3}{4}$ in.] plate, 22 inches in diameter, on either end of a horizontal shaft, 2 inches in diameter and 27 inches long, in the center of which is the driving pulley, 20 inches in diameter. To each plate is bolted a flanged cylindrical box (7 inches deep, 17 inches in diameter and 1½ inches thick), having a 4-inch charging hole opposite the shaft, to be closed by a wooden bung, and a 1¼-inch discharge opening, to be closed by a screw-plug. From thirty to forty 1½ inch steel balls do the grinding. The mill makes 48 revolutions per minute, and works two charges of 15 pounds of ore in about ten hours.

The revolving barrel [26.1] serves for amalgamating without grinding, as well as for leaching. Its general arrangement is similar to that of the ball-mill. To either end of the horizontal shaft, 1½ inches in diameter and driven by a 20 inch pulley, is attached a wooden cylinder, 7 inches in diameter and 11 inches long, made of ⅞-inch staves which receives a 2-quart glass-stoppered fruit jar, made tight with a rubber washer and screw clamp. The jar is packed with felt into the wooden frame. The shaft makes from 20 to 25 revolutions per minute. Small lots of ore, of 1,000 grammes, more or less, are worked in about eight hours.

There are ten amalgamating pans [29 and 30, Figs. 7 and 8]. Three of these are accurate copies, in reduced size, of those used in practical work. They are 30, 18 and 12 inches in diameter, have sides 12, 8 and 6 inches deep and discharge into a 30-inch settler, 12 inches deep, making 15 revolutions per minute. They treat charges of 250, 30 and 20 pounds respectively, in from five to eight hours. The other seven pans

* Richards, Trans., viii., 362; Technology Quarterly iii., 45; Editorial, Engineering and Mining Journal, April 12, 1890, p. 418.

[Fig. 8] especially constructed for laboratory experiments, are only 7 inches in diameter. Three of these are of copper; the others of iron. The pan has a solid central core and no dies; the muller and shoes are cast in one; the pulp is prevented from settling on the core and sides by adjustable scrapers. The muller can be raised or lowered on the driving shaft, which is driven from above and easily thrown in and out of gear. The pans are heated by Bunsen burners. The muller makes 90 revolutions per minute and the pan works charges in three or more hours. The reason for choosing such small-sized pans is that in one day's work, two students will finish without outside help a set of experiments. They start, for example, in the morning, four pans with the same ore, treat it in four different ways and finish the cleaning-up in the afternoon. A larger pan or a pan of a more complicated construction will not permit this. In cleaning up, a large-sized Spitzlutte, 3¾ inches in diameter and 13 inches high, with a ¾-inch water inlet pipe is commonly used, as it does quick and effective work.

6. *Lixiviation.*—The leaching of ores and intermediary products can be done in the laboratory in stationary vats by percolation, or by mechanical stirring, or in revolving barrels. For leaching by percolatioa there are two forty-gallon vats (not shown in the plan, Fig. 1) of wood lined with lead. These will be replaced with sheet-iron vats poured with melted roofing-pitch. For leaching in stationary vats with mechanical stirring there are three sets of 8-gallon vessels [28 and Fig. 9] of glazed earthenware, 12 inches in diameter and 14 inches deep. The wooden stirrers, with their iron driving shafts, make 75 revolutions per minute. For leaching in a revolving barrel the same apparatus is used as for amalgamation. Gold, silver and copper ores are commonly, and zinc and nickel ores occasionally, treated by wet processes in the laboratory

7. *Electro-Metallurgical Work*—Electricity has so far been used only for the refining of silver and gold-bearing copper. The large depositing table [27] holds the electrolytic baths. They are of wood pulp, poured with melted roofing-pitch, of glass or of earthenware, as the case may be. No definite sizes have been, so far, adopted, but electrodes are usually made 7 by 10 inches. The current is furnished by the dynamos already referred to; thermo-piles and storage batteries are not in use.

D.—CONCLUSION.

It is somewhat difficult to estimate the cost of the laboratory-apparatus, because one thing has been put in after another, and alterations have been frequently made. It could probably be duplicated for about $15,000. The annual cost of running the laboratory, excluding wages, fuel and power, is $1,200.

"That it is conducted in connection with class-room work, and not independently, need hardly be mentioned. With the school-courses of the fourth year the students are thoroughly trained in the laboratory, their work there supplementing and illustrating the lectures. The last term is largely devoted to the working up of theses, which are always founded on laboratory-experiment. While the student does not handle every apparatus, he sees most of them in operation. Every Saturday each student makes, before the assembled class, an oral report of his laboratory-work during the past week, and its continuation for the coming one is discussed and laid out. The whole class thus gets the benefit of the work of each individual member. The time devoted to laboratory-work is 325 hours, and to class-room work, including preparation, during the same year, 225 hours. The most satisfactory arrangement would be to have during the entire year two days a week for laboratory-work. One of these should be uninterrupted for making a complete experiment, the other might be divided into two half-days.

Experiments for Ascertaining the Comparative Effect of Explosives.*

In experiments for determining the effect of explosives, such determination can only be effected by comparing the explosive force of the various substances one with another, and also with one taken as a standard of comparison; and the most useful method for carrying out such tests is the Trauzl lead block, which was employed in the present case. The lead block has a cylindrical hole, inside which a determined quantity of the explosive to be tested is exploded; and the extension of the hole thus brought about serves as a measure of the explosive force of the substance in question.

The nearly cylindrical lead blocks used in the Schalke tests were prepared as shown by Fig. 1, having a height of 24 cm. (9½ in.) and a diameter of 14 cm. (5½

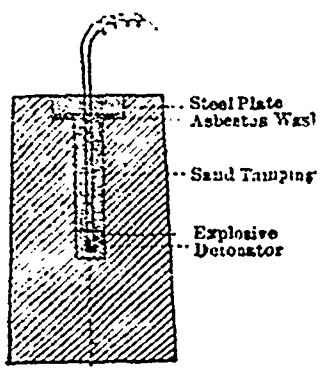


Fig. 1.

in.), a slightly conical form having been adopted for facilitating casting of the block. The cylindrical hole of 25 mm. (1 in.) diameter and 145 mm. (5⅝ in.) deep, is increased above, for receiving the cover, to a diameter of 60 mm. (2⅜ in.). The metal used was the best refined lead; and, in order to secure as uniform a composition as possible, all the blocks used in one experiment were cast at the same time.

The explosive to be tested, contained in a paper case with detonator, was placed at the bottom of the hole, which was then filled up as far as the recess with dry, well-sifted sand, the hole being then covered with a steel plate over an asbestos washer, while, for introducing the wire of the electric detonator, the steel plate and asbestos washer were bored through in the middle.

* From a communication to Gluckauf, of Essen-an-der-Ruhr, by Bergassessor Winkhaus, originator and now director of the Explosives Testing Station, in the form of a mine-working, at the Consolidation I. Colliery, Schalke, Westphalia.

The lead block thus arranged was wedged tightly into a strong wrought-iron frame (shown by Figs. 2 and 3) with the assistance of an iron [illegible] and two pairs of wedges. Both before and after firing, the size of the hole was measured by means of

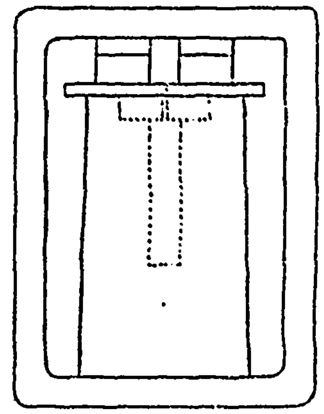


Fig. 2.

water in graduated test-tubes, the difference between the quantities showing the extension of the hole effected by the explosion.

In order to carry out the tests under practically similar conditions with all the substances, the explosion was determined by the strongest detonators, No. 8 (containing 2 grammes of mercury fulminate), used with safety explosives.

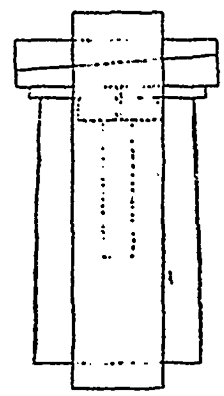


Fig. 3.

The series of experiments included the safety explosives now used in the mines of the Westphalia Superior Inspection district, as also gelatine-dynamite in order to afford a standard of comparison; and the results of these experiments, in which 10-gramme charges were always employed, are recorded in the following tables:—

GELATINE DYNAMITE.

Serial No. of Test.	Hole in Lead Block. Before explosion. Cub. cm.	Hole in Lead Block. After explosion. Cub. cm.	Increase of Hole. Cub. cm.	Mean Increase. Cub. cm.	Difference of Increase between each Test and the Mean. Cub. cm.	Difference of Increase between each Test and the Mean. %
1....	62	696	634	....640....	− 6	0.94
2....	62	708	646		+ 6	0.94
3....	62	704	642		+ 2	0.31
4....	62	695	633		− 7	1.09
5....	62	703	641		+ 1	0.16
6....	62	708	646		+ 6	0.94

CARBONITE (KOHLEN-CARBONIT).

1....	62	278	212	....232....	−20	9.6
2....	62	295	233		+ 1	0.4
3....	62	301	239		+ 7	3.0
4....	62	281	219		−13	5.6
5....	62	321	259		+27	11.6

FIREDAMP DYNAMITE (WETTER DYNAMIT).

1....	62	384	322	....325....	− 3	0.92
2....	62	389	327		+ 2	0.61
3....	62	393	331		+ 6	1.84
4....	62	387	325		+ 0	0.00
5...	62	383	321		− 4	1.22

			PROGRESSITE.			
1....	62	465	403	....397....	+ 6	1.5
2....	62	476	414		+17	4 3
3....	62	467	405		+ 8	2.1
4....	62	429	367		- 30	7.6
			WESTPHALITE.			
1....	62	559	497	....470....	+27	5.7
2....	62	533	471		+ 1	0.2
3....	62	544	482		+12	2.6
4....	62	491	429		- 41	8.7
			DAHMENITE.			
1....	62	571	509	....495....	+14	2.8
2....	62	536	474		- 22	4.5
3....	62	557	495		- 10	0.0
4....	62	562	500		+ 5	1.0
			DAHMENITE A.			
1....	62	551	489	....502....	- 13	2.6
2....	62	550	488		- 14	2.8
3....	62	568	506		+ 4	0.8
4....	62	588	526		+24	4.8
			ROBURITE.			
1....	62	603	541	....549....	+ 8	1.4
2....	62	609	547		+ 2	0.4
3....	62	607	545		- 4	0.7
4....	62	625	563		+14	2.6

The analyses of the explosives tested are given as follows by various authorities. According to the president of the Berlin Mining Laboratory, gelatine-dynamite contains 64.5 per cent. of gelatinised nitro-glycerine, 26 per cent. of nitrate of potash, and 9.5 per cent. of ground wood, while the carbonate contained 25 per cent. of trinitro-glycerine.

Firedamp dynamite from the Schlebusch factory, Hamburg, contains 52.9 per cent. of trinitro-glycerine, 32.7 per cent. of epsom salts and 14.4 per cent. of fossil meal.

The composition of progressite is given as 92 per cent. of ammonia nitrate, 6 per cent. of aniline hydro-chlorate, and 2 per cent. of ammonia sulphate.

Westphalite, from the factory at Sinsen, consists of 94 per cent. of ammonia nitrate, 5.4 per cent. of resin, 0.4 per cent. of ammonia sulphate, and 0.1 per cent. of each of sal-ammoniac and smut.

Dahmenite, as made by the Castropher Sicherheits-Sprengstoff Actien-Gesellshaft, consists of 93.3 per cent. of ammonia nitrate, 4.8 per cent. of naphthaline, 1.6 per cent. of potash chloride, 0.1 per cent. of sal-ammoniac, and 0.2 per cent. of ammonia sulphate.

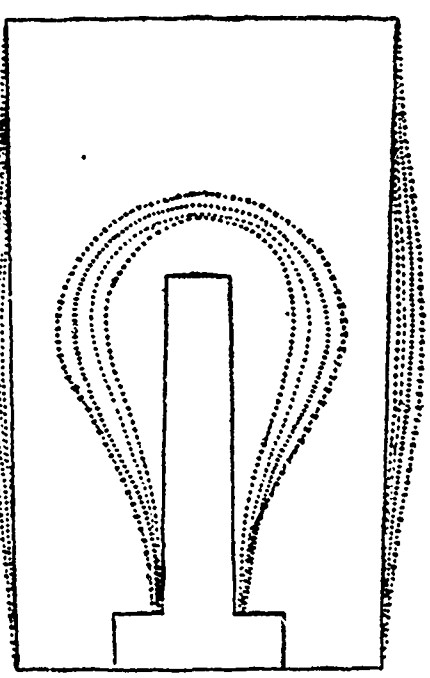


FIG. 4

Roburite from the factory at Witten-an-der-Ruhr consists of 17.8 per cent. of dinitro-benzol, 79.2 per cent. of ammonia nitrate, 0.3 per cent. of sal-ammoniac and ammonia sulphate, with the remaining 2.7 per cent. of moisture.

The results obtained reveal the curious fact that the inherent explosive values, with the same charges and under the same conditions, in the case of the explosives gelatine-dynamite and firedamp dynamite only differ slightly, at the most by 1 per cent., but, on the contrary, in the case of the other explosives, very considerably, in fact up to as much as 11.6 per cent. from the calculated mean value. It would appear that this circumstance can only be attributed to the composition of the explosive itself, which in the case of gelatine-dynamite and firedamp dynamite, are very uniform, while the other safety explosives appear to be much wanting in uniformity. A careful analysis of carbonite (Kohlen-Carbinit) showed, for instance, a higher nitro-glycerine content in the middle than at the outside. According, therefore, as more or less of the middle or the outside is used, there must follow a greater or less widening out of the hole. With a granular nature of the ammonia nitrate explosives there also comes into question the non-uniform granulation of the product.

If the mean content be compared, and the widening-out obtained with gelatine-dynamite (of 640 cubic centimetres) be called 1, the following figures will be obtained for the explosives in question :—

1. Gelatine-dynamite..... .... 1.000
2. Carbonite (Kohlen-Carbonit). 0.360
3. Firedamp dynamite................ 0.508
4. Progressite 0.620
5. Westphalite.................. 0.734
6. Dahmenite.................. 0.773
7. Dahmenite A.................. 0.784
8. Roburite.................. 0.858

The question now arises, how far, by means of the values thus found, conclusions may be drawn as to the action and suitability of the various explosives in practical mine working.

For showing the nature of their action, Fig. 4 gives a representation of the widening-out of the hole in the lead block effected by 10-gramme (⅓ oz.) charges of the explosives gelatine-dynamite, westphalite, firedamp dynamite, and carbonite—the lines made by roburite, dahmenite and progressite, which are very similar, being left out of the drawing so as to avoid confusion. In the case of all these extensions the space appears more or less bellied out, which results from such experiments with all high explosives, and differs considerably from the form made by a slow explosive such as blasting-powder, which latter (as shown in Fig. 5) was effected by a charge of 25 grammes (⅞ oz.), or two and a-half times the quantity used in the case of the other explosives. The space formed measures 61 cubic centimeters (3¾ cubic inches), giving a proportion with respect to gelatine-dynamite of 1.19, a figure which is quite contrary to the value obtained in practice. A comparison of explosives with very different speed of combustion is therefore not possible by means of the lead-block test. At the same time, however, in one with high explosives the acquired results are influenced by the most various circumstances.

First and foremost comes the resistance of the lead-block walls. As will be seen by the cross-section shown in Fig. 4, the thickness of the walls diminishes with the increase of the widening out, and accordingly also the resisting capability of the cylinders; for obtaining a considerable extension, a proportionately smaller power is therefore required than for the production of a small bellying. This is manifest from the following experiment:—Ten grammes of gelatine-dynamite gave a mean widening-out of 640 cubic centimetres (⅓ oz.), and 15 grammes a widening-out of 1,054 cubic centimetres, while, according to calculation, it should only amount to 960 cubic centimetres. (The widening-out due to the detonator alone can be left out of consideration in these comparisons, because experiment shows that it only amounts to 9 cubic centimetres.) The above circumstance must exert a specially unfavorable effect in the case of explosives which only give a slight widening-out; and it will, therefore, be more correct, in determining values for comparison, if those quantities of the various explosives be determined which are in the condition of producing the same widening-out of the hole. In such a case the explosive effect is in inverse proportion to the determined quantities of explosives.

Endeavors have been made to determine these weights; and the following proportions have been obtained from the experiments, the details of which are given in the original communication :—

—	Quantity of the Explosive Required to Produce the Same Increase of Space.	Explosive Action in Comparison with Gelatine-Dynamite Taken as 1.
	Gr.	
Gelatine-dynamite	10	1.000
Carbonite..............................	21½	0.465
Firedamp dynamite....................	17	0.588
Progressite...........................	17	0.588
Westphalite..........................	14	0.714
Dahmenite A..........................	13	0.770
Roburite..............................	12	0.833

As regards carbonite and firedamp dynamite, therefore, the proportion is much more favorable than that given above. That progressite has given unfavorable results is due to the fact that the explosive used in the experiments, taken from another box, had, as shown by the third experiment, a lower explosive power than that of the sample used in the first experiment. (According to the notice on the package, however, the composition of the present sample was the same as that of the former). The results obtained from the remaining explosives do not greatly differ from the earlier results. If, in the case of these experiments, no more favorable figures were obtained, this circumstance is to be attributed to the slighter difference in the widening-out of the hole, and partially also to the above-named non-uniform composition of the explosives. Now, whether the figures thus found may be directly referred to practice cannot be asserted without explanation. It would, however, be interesting to determine the value of these figures by exhaustive experiments carried out in coal. An important circumstance must, however, be constantly borne in mind, with which the results obtained by the lead block, as also in practice, are intimately connected—namely, the various density of charge, or the specific weights of an explosive.

For the same weight a specifically heavier explosive occupies a smaller space than the specifically lighter. Accordingly a greater weight of the first-named can be charged into a shot-hole of determined length than of the latter; and therefore the explosive power concentrated in this length, in the case of the specifically heavier. is greater in proportion. It is especially in practice that this circumstance will be manifested.

By accurately weighing the original cartridges, it has been attempted to determine the density of charge of the various explosives, with respect to their length and diameter, and also the weight of the case, as compared with gelatine-dynamite, in order to calculate, with its assistance and the above-named shattering values (Brisanz-Zahlen),

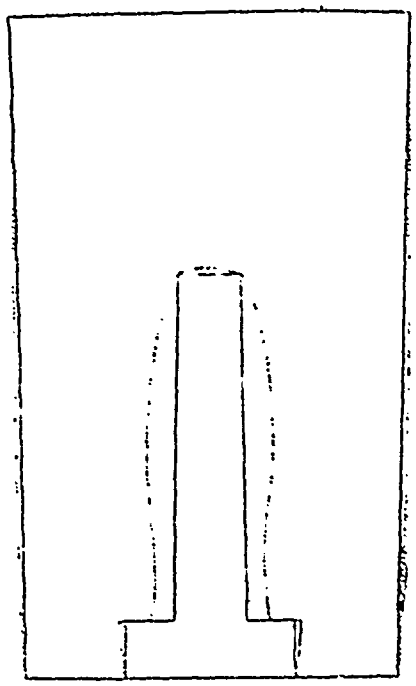


FIG. 5

that degree of explosive power which is developed in a given space, as compared with gelatine-dynamite. The following table gives the values obtained :—

	In Comparison with Gelatine-Dynamite Taken as 1.	
	Weight of the Same Bulk.	Explosive Power of the Same Bulk.
Gelatine-dynamite	1	1
Carbonite	0 73	0 339
Firedamp dynamite	0 95	0 559
Progressite	0.60	0 353
Westphalite	0.55	0 393
Dahmenite A	0 53	0.408
Roburite	0.61	0 509

The figures of this table are partially confirmed by the fact that the safety explosives, firedamp dynamite and roburite, which give the highest values, are employed almost exclusively in 23 mm. or 25 mm. cartridges, while the others, on the contrary, are generally put up in 30 mm. to 40 mm. cartridges. Moreover, they show clearly why, with the use of safety explosives in stone drifts, and especially in cross-cuts, no favorable results have hitherto been obtained. In getting coal the proportions are naturally different; and here it will even be desirable, in most cases at any rate, to distribute the action of the explosive over a greater length of bore-hole.

NOVA SCOTIA NOTES.

The Northup gold mine, which was purchased some time ago by American capitalists and after a considerable amount of litigation finally abandoned as useless, has been re-opened by Mr. Clarence H. Dimock, of Windsor fame, one of the original owners. There have been two crushings, producing 100 and 104 ounces respectively. The mine is reported to be looking well, and is likely to become one of our staple producers.

The Modstock mine (which, by the way, appeared in our last issue as the Woodstock, through typographical error,) has had its first crushing under the new management, the result being 169 ounces of gold from 123 tons of ore; this represents 10 days' working.

We had a call from Mr. J. D. McGregor the other day. He informs us that the gold mine at Fifteen Mile Stream is looking very well. The last month's yield was 380 oz.; this, following 409 oz. for August, which we reported in our last, shows it to be one of the best properties in the province.

Mr. R. McLeod brought in a brick of [illegible] oz. from the Caribou Gold Mining Co. (Ltd.) property at Caribou. This represents the September crushing; the August crushing yielded one ounce less.

Mr. Andrews reports the Richardson mine to be still doing well. This is a low grade property. A large belt is being worked at a fairly small cost.

William McLeod, a miner working in the Victoria coal mine, C.B., was killed on the 15th of October. He went down in the pit to his usual work and had only just started when a fall of coal occurred, killing him instantly.

We notice that letters patent have been granted, incorporating the well-known firm of I. Matheson & Co. The provisional directors are William Grant Matheson, James Carmichael McGregor, and James Matheson Carmichael.

A special general meeting of the Mooseland Gold Mining Co. has been called. There is a motion on the agenda for winding up the company.

A general meeting of the Dominion Smelting Co. has been called to consider whether the development which has been carried out on their property at Smithfield is sufficiently encouraging to warrant a further call on the shareholders.

The Coxheath copper mine and plant, including air compressors, rock drills, etc., has been sold by the sheriff, for $5,100, to Mr. Isaac P. Gragg, one of the former members of the company.

The New Glasgow *Chronicle* has the following item:—" We understand that Mr. James A. Fraser has purchased a gold mine in Country Harbor, consisting of 96 areas. The mine is said to be a valuable one; the formation of the rock is different from any other mine discovered in the province, the walls being of granite. The same company who constituted the New Glasgow Gold Mining Co. are owners of the new mine.

The Dominion Coal Co's new pier at Louisburg is finished. It is one of the most magnificent structures of its kind on the continent, and the company will now be able to ship all the year round.

Editorial matter of a mining nature must be at a very heavy premium in Halifax just now. The *Critic* has a leader in its last issue in reply to our comments respecting their remarks on the " South Kensington School of Mines." The following paragraph is sufficient to show up the whole editorial. " Metal mining is a comparatively easy matter, but with coal it is different, and it is not possible for a graduate of any mining school, who has not had at least five years' actual hard work about a coal mine, to call himself a coal-mining engineer."

The *Critic* has fallen into the popular error that any fool may manage a metal mine. They don't appear to grasp the fact that, because the product of a metal mine is more valuable than the product of a coal mine, it will more easily stand mismanagement.

The *Critic* finishes its editorial by saying they have no desire to run down the School of Mines, yet in the earlier part of it they try to bolster up their previous rotten theory. The logic of the whole article forcibly brought back to our memory a verse we learned in the days of our youth. It runs thus:

> " When a man who turnips cries,
> Cries not when his father dies,
> 'Tis a proof that he would rather
> Have a turnip than a father."

The many friends of Mr. A. M. Evans, M.E., formerly in charge of King Bros' Asbestos mine and for the past two years manager of the Dominion Coal Co's Gowrie mine, will be pleased to learn that he has been honorably acquitted of the charge of manslaughter arising out of the death of a brakeman on one of the company's coal trains. A. M. is now having a shy at the coroner for false arrest, the claim for damages being placed at $5,000. We wish him luck.

The returns from the Modstock mine for the month of September were 259 oz. o gold.

J. C. McDonald, the late manager of the Modstock mine, has purchased a property to the south of that mine for $15,000. There is a considerable amount of grumbling amongst the mine owners at the roads in this district, which are in a disgraceful state and considerably handicap the industry.

The Richardson Gold Mining Co. have purchased an additional 20 stamps, and will erect them at once, thus making their present mill into a 40-stamp one.

The Golden Lode mine produced 224 oz. of gold last month from about 22 tons of rock crushed.

With the exception of the General Mining Association, it is reported that the Cape Breton collieries are behind in their output compared with last year.

There has been extensive prospecting by various parties at the head of Lingan Bay, and it is expected that the result will be an extension of the coal field.

The Burchell Bros., at New Campbellton, who have been boring some time for it, are reported to have found the celebrated Sydney mines seam on their property.

The North Sydney Mining Company has completed a small pier and is ready for shipments.

The Intercolonial Coal Company's new coal-washing plant is in place.

The furnaces at Londonderry and Ferrona are running steadily. The Nova Scotia Steel Company is equipping its red hematite property at Belle Isle, Newfoundland, with working plant and will soon be shipping to its furnace at Ferrona.

The Montreal *Gazette* publishes a tabulated statement giving the amount of coal brought to that port from Cape Breton collieries during the month of September. The Dominion Coal Company landed 84,250 tons at Montreal in September and the General Mining Association 14,190 tons. A large number of the G. M. A. shipments for September were delivered at Quebec and of course are not included in the above.

Captain Isaac P. Gragg, of Boston, principle owner of the Copper mines, was at Coxheath, arranging for some improvements to the plant at the copper mines. It is reported that the owners intend broad-gauging the railway track to the Intercolonial at Northwest Arm. It is also stated that work at the mine is to be vigorously prosecuted, as new life and capital has been secured.

The General Mining Association of London, Ltd., purpose constructing a piece of railway to run in a parallel direction from a point near the old pit to connect with the main line near No. 3. The movement is seemingly to avoid the heavy grades of the present line and the difficulties to contend with during the early winter season caused by heavy snow blockades.

MINING IN BRITISH COLUMBIA.

From a friend who has just returned from Trail Creek, we were glad to hear of the success of our old friend, J. D. Sword, of the Ingersoll Rock Drill Company of Canada. J. D. has been vigorously pushing the interests of the Ingersoll Company and has secured the plums of this year's business in the new camps. J. D's a rustler. "*He is!*"

Mr W. Pellew-Harvey, F.C.S., is putting up a very complete assay plant at his laboratory in Vancouver. When finished the works will contain, besides the usual furnaces, a chlorination plant, a stamp mill, and a one-ton water-jacket smelting stack.

The cave of a slab of gravel in the Cariboo mine at Quesnelle Forks this month caused serious but not fatal injuries to five men, Messrs. D. McRae, Joe Dunn, Brown, McNorton and another. The bank of gravel, which is about 300 feet high, was considered dangerous, and the sluice boxes near it were cleaned up only a short time ago. A watchman was on duty to give warning, while the men were at work blasting boulders in the pit. He gave warning in good time, and the gravel fell in such a way that would not seem to carry danger with it, but when it struck the bottom the mass broke up and slid outward to where the men were standing in apparent safety. They were badly bruised and knocked around. One man had his legs broken and another an arm, while McRae had his back severely injured. A surgeon was sent for and at last reports the men were as comfortable as could be expected.

The shipments of ore from the Trail Creek and other mines from June to the end of September, were as follows:—

	Tons.
Nelson	214½
Ainsworth	190
Trail Creek (gold ore)	8,748¼
Slocan *via* Nakusp	945
Slocan *via* Kaslo	16½
	10,114¼

The shipments of bullion during the same period were 1,160 tons. The shipments from this district from the beginning of the year amount to 21,928 tons of a value of $1,780,400.

The Omaha & Grant Smelting Co., acting through their representative, have bonded the Ruby Silver from W. P. Russell. Geo. Clarke, late superintendent of the Washington, is in charge. The price is reported to be $7,500. The same company has bonded the Ajax and Treasure Vault claims, situated near the Noble Five.

The Stevenson Gold and Platinum Hydraulic Mining Company is getting along well. About a mile of flume is built, while the grading and trestlework is about half a mile further ahead. The company purposes bringing in the first north fork of Granite creek, and this will give about 1,000 inches of water. When Mr. Hunter left Indians had been sent to pack the pipe to the grounds. This company has been reorganized under Dominion charter, with the name of Granite Creek Gold and Platinum Hydraulic Co., Ltd., and the affairs will soon be nominally transferred. Washing is expected to start in the spring.

"The site of the smelter for the Silver King mine," says the *Tribune*, "is a scene of activity. Ore bins are being erected, and excavating for the foundations of the smelter is being pushed; the railway spur is being graded and trestles built, and the tramway is almost completed. Men are shovelling earth, breaking stone, framing timbers, and bossing. In all, about one hundred men are employed. Most of the rockwork on the railway spur is completed, and foreman Kelly will soon have his men on the big side-cut on the bluff to the north of the smelter site. A bridge gang under the foremanship of Jake Serson is erecting the big trestle opposite the railway roundhouse The ore-bins are going up under the foremanship of Hugh Nixon. The excavations for the smelter buildings are being looked after by superintendent Johnson himself, with Mr. McIntyre as foreman. The tramway is under the control of the California Wire Works Co., of which E. I. Parsons is superintendent here. It is said that the smelter will be in operation by January 1st."

Mr. J. Kirkup, mining recorder and deputy gold commissioner of the Trail Creek district, states that there were about 500 claims recorded previous to his taking the office on the 20th of March of this year. Since that time 1,561 claims have been recorded and that there have been 650 to 750 transfers and bonds, 150 certificates of work and 25 applications for a Crown Grant.

The coal shipments for the month of September show an increase over August, being as follows:—

	Output. Tons.	Increase. Tons.
New Vancouver Coal Co.	17,233	7,907
Wellington Coal Co.	20,264	7,338
Union Colliery Co.	18,179	7,429

The Montana Ore Purchasing Co. of Butte City, Mont., is proceeding with the construction of the smelter at Trail. The *Trail Creek Miner* reporting on the work says: The equipment of the smelter is to be very complete, and of the most improved kind. There are to be two O'Hara furnaces, two reverberatory furnaces, circular furnace designed expressly for these works, and one water jacket stack. These comprise the essential features. There will also be very complete sampling works. The necessary adjuncts in the way of buildings, ore sheds, etc., will be of the most complete order. Mr. Heinze knows how to build a smelter. He has one in Butte which cleared nearly $100,000 last year and which is admirable in all its arrangements. The Trail smelter will accommodate about 125 tons of ore per day. Mr. Heinze has a contract with the Le Roi for 75,000 tons. This will be delivered to him probably at the rate of 100 tons a day or 36,500 tons a year. Therefore it will take at least two years to discharge this contract. Since he will have a capacity of twenty-five tons a day above the Le Roi ore it may be asked how is he to take care of the other ore which is to be offered from this camp. To this question he says he will double the capacity just as soon as it shall appear to be an actual necessity.

It is reported that the smelter at Golden is to be dismantled and the machinery and such other portions of the plant as are of utility will be removed to Midway, B.C., where a syndicate, represented by S. S. Fowler, M.E., of Chicago, and W. T. Thompson, of Fairview, will erect a smelter with a 50 ton plant.

J. S. Bell reports considerable activity in mining matters in Lillooet district. At the Bonanza mine there are already 500 tons of ore on the dump. Work is to be renewed shortly on the Vancouver Enterprise placer claim on Cayoos creek. Twenty-five men are at work for the Bridge River Gold Mining Company at Horseshoe Bend. New quartz stakes have been set on Anderson lake. An English syndicate is to run a $40,000 ditch to bring water from Cayoos creek to the McDonald & Hurley placer claims on the east bank of the Fraser.

Men employed at the Tam O'Shanter, on Kootenay lake above the Blue Bell, have been clearing up around the mine, and sorting the ore, with the result that about 30 tons are ready for shipment. Repairs have also been made to the wharf. Next week the force will be largely increased, another tunnel run for about 200 feet, and the mine worked for all it is worth The property is said to be a promising one, and under efficient management should be made profitable.

The owners of the Washington mine, Slocan district, have asked for estimates on a 60-ton concentrator and a 1,500-foot tramway for that property. It is the intention to run the concentrator by water-power, the water supply coming from what is locally known as McGuigan lake. The contract will probably be closed next week.

The War Eagle Company at Trail Creek has mined and shipped 7,015 tons of ore to date. The last 27 shipments, amounting altogether to 2,300 tons brought an average return from the smelter of $48.30 per ton. From this must be deducted $10.50 for freight and treatment, $2 per ton haulage to Trail, and $4 for mining, leaving a net profit of $31.30 per ton. A new tunnel is now being run in from below to tap the vein, which it is expected to reach in 1,800 feet. Two new boilers of 100 horse-power each are under order and are expected to arrive shortly. They will be used for driving from 10 to 12 drills.

MICA NOTES.

We are indebted to the Bureau of Statistics, Treasury Department, Washington, for the following returns of the imports of mica into the United States for the fiscal year ended 30th June, 1895:—

	Lbs.	Value.
France	1,315	$ 481
Germany	1,544	1,999
England	110,491	33,979
Scotland	359	207
Canada	546,905	36,401
British East Indies	148,056	48,731
Japan	12,000	2,194
British Australasia	312	292
Total for 1895	820,982	$124,284

NOTE.—The imports from England and Scotland are most likely entirely Indian mica. That from Canada is entirely from the Province of Quebec.—ED.

The imports for previous years by the United States were as follows:—

Mica and Mica Waste.

1884—Free	$28,284	1888—Free	$21,013
1885 "	28,685	1889 "	93,143
1886 "	43,107	1890 "	161,740
1887 "	63,480	1891 "	110,094

Mica.

	Lbs.	Value.
1891—Duty 35%	130,029	$21,750 01
1892 "	1,047,404	179,865 12
1893 "	930,707	214,679 99
1894 "	514,132	84,429 55

At the Wallingford mine, in East Templeton, the owners are working a small force and laying up stock. The mine is being carefully and judiciously worked, and by no means to its full capacity. During the past season a steam hoisting plant was added. About six or seven tons of large mica of an excellent quality, ranging from 4 in. x 6 in. and upwards were on hand at the date of our correspondent's visit. Rumor has it that an English syndicate have made an offer for the property.

At the Vavasour mine, Cantley, mining is being steadily carried on with returns satisfactory to the owner. The quantity and quality of the output has been up to the standard of the past three years, which is saying a good deal. An addition to the cutting shop at the mine was recently made.

The Phosphate King mine, Templeton, owned and operated by Mr. T. J. Watters, is producing mica of excellent quality, and the deposits are reported to be steadily enlarging as the work progresses. Steam drills and hoist are in operation here.

The old Blackburn phosphate mine, Templeton, under direction of Mr. H. C. Baker, Ba. Sc., a recent graduate of McGill, is being steadily worked for mica, the bulk of the product being obtained from a pit down 180 ft.

McLaurin mine, East Templeton. A small gang is employed here and a good quality of mica is obtained. The pit shows crystals cropping out bottom and sides.

The Lalardeau mine, East Templeton, together with all the lands and property of the Canada Industrial Co., has been acquired by American people. Two pits operated by steam drills are worked. At last report it was the intention to move the working plant to another portion of the property.

The Canadian Mica Co. has acquired the following properties:—

Chubbick lot, Wilson's Corners, Que.
Mulvahill lot, Cascades, Que.
Perth lot, Burgess, Ont.

Work will be commenced on these properties at once. At the Dacey property, Cantley, a force of 18 men are employed night and day shifts, producing mica for shipment to England. The output is reported to be satisfactory as to size and quality. The Brown lot at Cantley, recently acquired by the company, is also being opened up, a small force being employed. At Murray Bay, the company's properties will be worked all winter.

A correspondent writes: "The demand for mica for electrical purposes is steadily growing, the bulk of the Canadian product going to the United States for consumption by street railways and manufacturers of electrical machinery. A notable feature, too, is the attention our Canadian amber is receiving in England and Europe, there being a very marked increase in the shipments to those countries.

"Prices for Canadian have not been very satisfactory to the producer, the average sales realizing but a comparatively small margin of profit when the uncertainty of many of the deposits and the necessarily high cost of mining and dressing is considered. The mica pedlar, too, is a growing nuisance and should be suppressed. He is generally some small farmer, owning a stump and rock farm in our mining country, who finds a small show of mica, and retails the crystals much in the same way as he does his cabbages and turnips. His prices vary. In the morning his mica is worth about $1 a pound; no takers; about noon he is hungry and his price drops to 50 cents per pound; still no takers; about 4 o'clock it is time to be on the homeward tramp and the mica drops to 10 or 15 cents per pound and is generally purchased by one of the consumers who holds his purchase over the regular miner and dealer and tells him how cheaply mica can be bought."

The last pack-train to Kamloops brought 1,500 pounds of mica from the Tete Jeune Cache mines, Canoe River district, B.C., operated by Mr. J. F. Smith, of Kamloops. This shipment is reported to be excellent quality, large enough to furnish clear sheets squared to 12 x 18 inches, and should bring good prices.

One of the features of the exhibition in connection with the recent Street Railway convention at Montreal was the display of micanite by the American Insulating Company. There were also one or two exhibits of the product of our mines, but when the consumption of the mineral by the electric street railways, particularly in the United States, is considered, it seems that our mica miners should have made a much better representation. The Mining Bureau at Quebec and the Geological Survey also should have been represented. A golden opportunity was missed of extending the mica trade of the country by this oversight.

ASBESTOS NOTES.

The Journal of the Imperial Institute in a recent issue gives some information to its readers respecting the Canadian asbestos industry from which one would gather that the output of the mines had declined. This impression is entirely erroneous there being during the past two years a very marked activity in the production of this mineral. The production in 1880 amounted to but 380 tons, valued at $24,700, while in 1890 it had reached 9,860 tons, of a value of $1,260,240. Since then the shipments from Thetford, Black Lake and other stations on the line of the Quebec Central Ry. as per official returns furnished to the REVIEW were:

	lbs.
1891	14,672,180
1892	8,674,560
1893	10,677,900
1894	14,683,055

These figures do not include important shipments *via* the Grand Trunk Railway from the Jeffrey mine at Danville, or the exports from Ottawa County, Quebec, and Hastings, Ont. We are glad to see that a number of our companies have sent exhibits to the Institute, for the permanent collection, but the list is far from complete. Canadian operators who have an eye to extending their trade relations with the mother country, will find a good representation of their various grades at the Institute a remunerative advertisement.

Mr. F. Cirkel, M.E., Ottawa, has a force at work culling the dumps of property formerly owned by the Templeton Asbestos Co., and is meeting with fair success.

The International Asbestos Co. of Newark, N.J., has been working steadily all summer on their property in the Township of Low, Ottawa County, and the shipments are reported to average about 75 tons per month. The mineral produced, though short in fibre, is of very fair quality.

Mr. A. W. Stevenson and Mr. R. T. Hopper were in Templeton the other day making arrangements for the opening up of the promising show of asbestos on the Stevenson property.

From the Eastern Townships mines there is nothing very worthy of note. The usual quantity of asbestos has been moving, and the principal mines have worked steadily throughout the season, that is to say, Bell's, Johnson's, King Bros., Anglo-Canadian and United. The American Company at Black Lake has simply had a few men working on contract in a quiet way, while the Beaver Company has remained closed down entirely, many being of the opinion, for diplomatic reasons. The Ross-Ward and Glasgow and Montreal mines have also been closed. There appears to be an increase in the consumption of asbestos and the trade is steadily reviving although prices are still far from being as good as the producers would like.

The Anglo-Canadian Asbestos Company will continue work throughout the winter. On this property a very promising deposit of chromic iron has been uncovered, extending over an area of two or three acres, and a considerable quantity of the mineral is being mined.

Messrs. W. T. Costigan and others have been doing considerable grinding of short-fibred stuff at their Montreal works. Their improved "Cyclone" mills, quite a number of which have been sold to the mining companies, are proving an excellent separator, and save large quantities of material that in former years went to the dumps.

The Danville Slate and Asbestos Co., as mentioned elsewhere, are pushing the development of their Jeffrey mine with great activity, a force of some 400 men finding employment in their various enterprises. The property has been thoroughly equipped with a first-class plant and the output of mineral is considerably larger than in former years.

GOLD MINING IN QUEBEC.

Mr. Chalmers of the Geological Survey, who has spent the summer in an investigation of the surface geology of the Quebec gold fields, is reported to be greatly impressed with the possibilities of successful mining in the old river beds of the Chaudiere and other localities. He also reports the discovery of quartz veins containing gold at Dudswell as authentic.

Mr. John Hardman, S. B., of Halifax, for many years associated with the Oldham, West Waverly, and other successful gold mines in Nova Scotia, has commenced work on his property at Slate Creek near St. George's. Capt. George MacDuuff an Australian miner with many years experience in quartz and alluvial mining in the antipodes, is in charge of the work of exploiting the property.

Milling Arizona Gold-Ores with a "Colorado" Stamp-Mill.

By WILLARD S. MORSE, Prescott, Arizona.*

Referring to Mr. Rickard's paper on "The Limitations of the Gold Stamp-Mill" (*Trans.*, xxiii., 137), and the discussions that have followed, and without entering into any controversy as to the relative merits of the "California" and "Colorado" types of stamp-mills, I wish to give the results obtained on ores from Lynx Creek district, near Prescott, Arizona, with a stamp-mill of the Colorado, or, more precisely, the Gilpin county, Colo., type.

The mines of the district have been worked for nearly thirty years, yet in that time very little, if any, work has been done on the veins below the line where the oxidized or "free" ores end, and the sulphide or "base" ores come in, except in a few cases where the sulphide ore was high enough in value to ship to smelters. The surface or oxidized ores have been worked in arrastras and stamp-mills, but few attempts have been made to mill the so-called "base" ores. About thirteen years ago a smelter was built in the district by Mr. John Howell to smelt these ores, but was abandoned on account of the high transportation charges on fuel and bullion.

The saving shown in this paper is not claimed to be high, and the history of the district has been given to show that heretofore, at least, the ores have not been considered suitable for stamp-milling.

The ore from which the results are given was extracted from below water-line (100 to 250 feet from the surface), and is a quartz carrying zinc-blende, iron pyrites, galena, and a small percentage of copper and arsenical pyrites.

MILL.

The mill is a typical "Gilpin County" stamp-mill of 10 stamps. No rock-breaker or self-feeders are used, the ore being fed by hand. I do not wish to be understood as advocating this method of feeding. It was adopted as a matter of economy in the first cost of plant, as the attempt to mill these ores was regarded as an experiment, in view of the history of the district.

The weight of stamps when new was as follows:—

	Pounds.
Stem	265
Tappet	35
Head	225
Shoe	85
Total	610

The stamps dropped 15 inches, 36 times per minute, in the following order: 1-5-2-4-3.

Fig. 1 shows a section of the mortar.

* Trans. Am. Inst. of Mining Engineers.

The mortars are provided with copper amalgamating-plates, the front plate being 5 inches, and the back plate 10 inches wide. Both plates extend the full length of the mortar, and have an inclination of 45°.

The outside plates (one for each battery of 5 stamps) are 96 by 52 inches, silver-plated (1 ounce to the square foot). These plates are set with an inclination of 1⅜ inches to the foot.

CONCENTRATORS.

For concentration of the tailings after amalgamation, two Gilpin county bumping or percussion tables are used. The beds of these tables are made of cast-iron. The cam-shaft of the table is run at 78 revolutions per minute, giving the table 156 strokes or bumps per minute.

CALCULATIONS.

The calculations presented are based on the following data:

Tailings.—A sample of tailings running from the mill is taken every half-hour by diverting the entire stream of tailings through a swinging trough, which discharges into a galvanized iron tub. This trough is operated by a cord from the battery. The sample thus collected, containing the proper proportions of slimes and sands, is decanted after completely settling and evaporated to dryness. Two such samples are made daily and assayed, and the results given below are the average of 503 samples and assays.

Concentrates.—The weights, assays, and analyses of concentrates given are from smelter-returns.

Bullion.—United States mint returns are used for contents of bullion.

Ore.—The assay-value of ore has been determined by calculation based on the weight of ore and concentrates and the contents of bullion, concentrates and tailings.

RESULTS.

The following are the results obtained from the milling of 2,432.9 tons of ore of an average assay-value of 0.763 ounce of gold per ton, which varied in a monthly run from 0.574 to 1.18 ounces per ton:

Amalgam.—Total amalgam recovered, 5,711.6 ounces. Of this, 70.2 per cent. was from inside battery plates, and 29.8 per cent. from outside plates.

Retort.—Weight of retort, 2,024.45 ounces, or 35.4 per cent. of weight of amalgam.

Bullion.—Weight of bar, 1,854.38 ounces. Loss of weight in melting retort, 8.4 per cent. Assay of bullion, gold, .636 fine. Contents of bullion, gold, 1,180.148 ounces.

Concentrates.—Net weight of concentrates, 605.149 pounds avoirdupois, or 12.4 per cent. of weight of ore. Assay and analysis of concentrates, Au, 1.347 ounces per ton; Ag, 6.93 ounces per ton; Pb, 6.34 per cent.; SiO_2, 9.9 per cent.; Fe, 30 per cent.; Zn, 6.85 per cent. Contents of concentrates, 407.6972 ounces of gold.

Tailings.—Weight of ore, 4,865,822 pounds; weight of concentrates, 605,149 pounds; weight of tailings, 4,260,673 pounds. Assay of tailings: Average of 503 samples and assays, 0.1271 ounces of gold per ton. Contents of tailings, 270.8327 ounces of gold.

Calculation of Saving and Loss.

——	Ounces Gold.	Per cent.
Bullion	1180.1480	63.5
Concentrates	407.6972	21.9
Tailings	270.8327	14.6
	1858.6779	100.

The highest results obtained by amalgamation was on a lot of 332 tons, assay-value of ore 1.134 ounces of gold per ton, which was:

	Per cent.
By amalgamation	76.3
In concentrates	14 1
Lost in tailings	9.6

Sizing of Tailings and Concentrates.

Mesh of Screen used on Battery.	Material.	Coarser than 60-mesh.	Through 60-mesh and remaining on 80-mesh.	Through 80-mesh and remaining on 100-mesh.	Through 100-mesh and remaining on 150-mesh.	Through 150-mesh and remaining on 200-mesh.	Finer than 200-mesh.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
30	Tailings	5.4	3.9	15.6	12.3	11.0	51.8
30	Concentrates	2.8	2.4	7.8	16.	19.4	51.6
40	Tailings	6.6	5.	10.8	13.6	6.8	57.2
40	Concentrates	1.9	1.1	5.9	16.5	22 1	52.5
60	Tailings	......	2.	3.	14.5	9.5	66.
60	Concentrates	......	2.	3.4	10.4	20.	58.2

Tests made by panning weighed quantities of tailings and weighing and assaying the concentrates thus recovered, showed that about 60 per cent. of the gold lost in tailings could be accounted for in this way. The concentrates thus saved, however, invariably assayed much lower than the average of the concentrates that were saved on the concentrating-tables, and were very fine, 90 per cent. passing through a 200-mesh screen.

Sized samples of concentrates, each size assayed separately, invariably show that the finer concentrates assay less than the coarser sizes.

The following results on a sample of concentrates assaying 1.8 ounces of gold per ton will serve as an illustration of one of many such experiments that have been made:

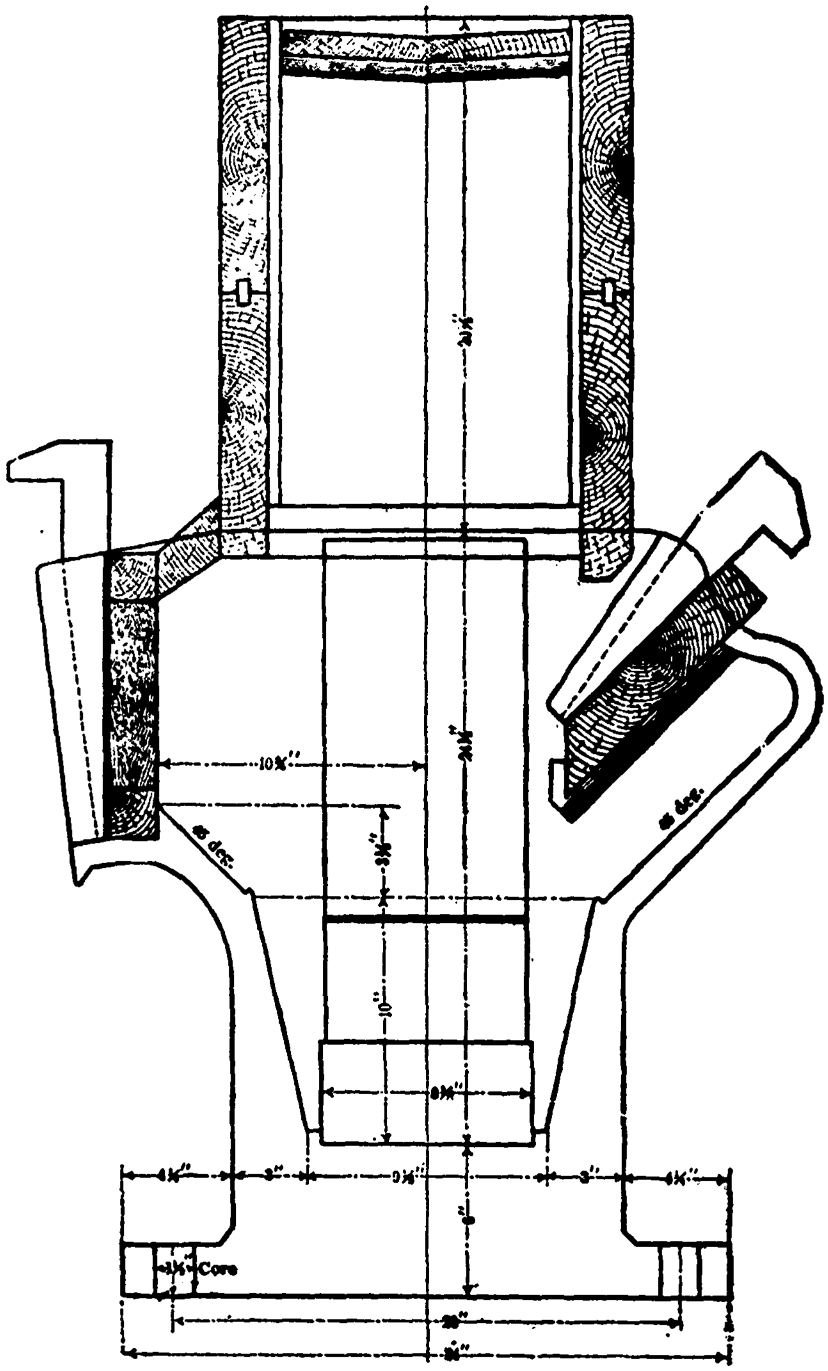
Size and Assay of Concentrates.

Size.	Assay. Ounces Gold per ton.
Coarser than 60-mesh	2.6
Through 60-mesh, remaining on 100-mesh	2.2
Through 100-mesh, remaining on 150-mesh	2.2
Through 150-mesh, remaining on 200-mesh	2.
Finer than 200-mesh	1.5

CONCLUSIONS.

From more than 80 assays made on specimens of the various characters of ore found in the district, the following conclusions have been arrived at:

1. That the gold is contained in the quartz and "free," or else is associated with the iron, copper, or arsenical pyrites, and that a large percentage of that, associated with the pyrites, can be extracted by amalgamation with very fine crushing.



SECTION OF MORTAR.

2. That the zinc-blende, as a rule, carries very little gold value, and that in cases where any considerable quantity of gold has been found in the blende, it was very "free," and easily extracted by amalgamation after fine crushing.

3. That the galena, as a rule, assays low in gold and high in silver.

NOTES.

Screens.—40-mesh burr-slot screens are used as a rule, and last about three weeks.

Shoes and Dies.—Cast-iron shoes and dies are used, and the actual wear of iron per ton of ore is: for shoes, 1.122 pounds; for dies, 0.692 pound.

Crushing-Rate.—The average crushing-rate of the mill for nine months, based on actual running time, is 3,335 pounds per stamp per twenty-four hours.

Water Used in Battery.—Water used in the battery, 21,000 gallons per twenty-four hours, or 1,252 gallons per ton of ore crushed.

RESULTS ON ORE HIGH IN ZINC.

The results on a small lot of ore selected for high zinc-contents may be of interest. The assay and analysis of the ore are calculated from contents and analysis of concentrates and tailings, weight of ore, and concentrates and contents of bullion.

Ore.—Assay-value of ore, 1.393 ounces of gold per ton. Analysis, Pb, 2.90; SiO_2, 59.0; Fe, 8.8; Zn, 9.7 per cent.

Amalgama ion.—The ore yielded by amalgamation 0.9 ounce fine gold per ton.

Concentrates.—One ton of concentrates was made to 3.8 tons of ore. Assay and analysis of concentrates: Gold, 1.54 ounces; Pb, 7.4; SiO_2, 9.8; Fe, 21.6; Zn, 19 per cent.

Tailings.—Assay and analysis of tailings: Gold, 0.12 ounce; Pb, 1.3; SiO_2, 76.6; Fe, 4.3; Zn, 6.5 per cent.

From the above data the following calculation is made:

—	Contained in Bullion.	Contained in Concentrates.	Contained in Tailings.
	Per cent.	Per cent.	Per cent.
Gold	64.5	29.1	6.4
Lead	....	67.	33.
Zinc	....	51.	49.
Iron	....	64.2	35.8
Silica	....	4.4	95.6

Distribution of Power in Collieries.

By LLEWELYN B. ATKINSON, A.M.I.C.E.*

The present position of the coal mining industry in the United Kingdom is one deserving of the most thoughtful consideration by all who are interested in the future commerce of the country, and the object of the present paper is to point out how some of the difficulties under which this industry at present labors may possibly be met. The difficulty to be contended with at present may be briefly stated. The possible output, indeed the output at which a reasonable profit can be earned, is greater than the demand at present prices; and even this demand is threatened by the decreasing price of foreign coal. From whatever point of view it is looked at, the question resolves itself into stimulating demand, and this can only be effectually done by lowering the selling price, which cannot at present be done without extinguishing the profit.

To decrease the cost at the collieries there are broadly three courses:—

(1) To decrease the payment per ton to the mineral owner.

(2) To decrease the wages cost per ton raised.

(3) To decrease the fuel expenditure per ton raised.

The first of these is a matter outside the scope of this paper, the second will be briefly touched upon, and the third will be dealt with in some detail.

In the course of the last eight or nine years the author has been in close contact with mining operations in various parts of England and Wales, and the opinion has gradually been forced upon him that there is a very large margin of economy in wages and fuel to be effected. This arises from the fact that economies in labor and fuel which are studied and insisted on in engineering and manufacturing industries are hardly considered in coal mining, at all events in the majorfty of instances. This broad fact mnst appeal to every mind that, whereas in almost every manufactvring process or industrial operation the product per man has nearly doubled and the consumption of fuel been halved within the last fifteen years; in coal mining the product per man has been practically stationary, and the cost of fuel per ton raised probably nearly so. This is frequently attributed to the stringency of mining legislation, but legislation has largely affected other industries also, and the results cannot be altgether attributed to this cause.

It would be a long task to enumerate the causes which, in the author's opinion, contribute to this result; but, broadly, it appears to him that what is required, is to do in mining what has been done in every other department of industry, and to lower the cost of wages and material per ton by increasing the product per man and per pound of fuel by the following means:—

(1) Improved organization, both in the working, and more especially in the original laying out of the scheme of working a colliery.

(2) More superintendence and supervision underground by thoroughly well informed mining and mechanical engineers.

(3) The greater use of mechanical power instead of human and horse labor, and a more economical production of that power.

In short, substitute brains and mechanical power for human labor.

It has been already stated that the immediate object of this paper is to deal with the question of the economical production of power, but a few remarks on the subject of mechanical power in collieries may be useful.

The getting of coal resolves itself into cutting and filling and hauling to the pit bottom.

In the great majority of collieries both cutting and filling are done without using any mechanical power whatever, and the progress made in introducing mechanical coal cutters is slow, at all events in this country. A considerable experience extending over some years with coal cutting machines in various collieries and various parts of the country justifies the author in saying that there are hardly any seams under 3 ft. 6 in. in thickness that could not be more cheaply worked by mechanical coal cutters than by hand labor, and with a better product of round coal, but that in probably not 5 per cent. of the collieries of the country is the existing organization of the filling and haulage sufficiently good to enable machines to be worked with that regularity which will make them pay.

This is the secret of the otherwise unexplained fact that some few collieries have been and are worked by machinery with marked success, whilst the reverse holds good of the majority of cases in which it has been tried. Organization and superintendence, those are the only secrets of success in cutting coal by machinery; till they are forthcoming, mechanical assistance in this direction must be postponed.

In thin seams much might no doubt be done to apply mechanical power to reduce labor and breakage in filling the coal, but the same remark applies as to coal cutting.

The use of machinery in the coal face would so much reduce the length of face under work for a given output that the roads on to the face being less in total length, could without increased cost be kept in a condition enabling mechanical haulage to be used right up to the face, doing away with horses and ponies altogether. There are some of the directions in which mechanical power may be looked for to profitably enable the output per man to be increased. But before this can be done much will have to be done to improve the general organization both above and below ground. And this may well be commenced by the economical laying out and conduct of the arrangements for the generation of power above ground.

Consider the conditions under which this is at present carried out.

Generally speaking, when sinking operations are completed, a winding engine is put down. Subsequently as the workings extend, haulage is considered, and some plant, either steam, compressed air, or electrical, is provided for this. Later, perhaps, pumping becomes necessary, and again a plant (perhaps on another system) is put in. There are various engines at the surface for the screening, repairing-shop and other purposes. All these are of uneconomical types; so there ensues, at every point, waste of heat, waste of steam, particularly when, as in some cases, separate boilers are put down for each plant. And the answer to any criticism generally takes the form: "Oh, fuel is so cheap at a colliery that it does not matter." Why is the fuel so cheap, that is, of such low value? Because it is so small—smashed in hewing, smashed in filling, smashed on the screens, due to imperfect methods and appliances at every point. But, at any rate, it is worth at least 2s. 6d. per ton, and it is generally estimated that from 5 per cent. up to even 10 per cent. of the total output by weight of the collieries is consumed at the surface, and this means, even taking the lower figure, about 9½ million tons, worth about £1,190,000 per annum.

It has been stated by Mr. Foster Brown,* that the probable consumption of coal in colliery engines, taking an average, would be not less than 6 lbs. per h. p. hour. Taking this to refer to indicated horse-power, it is possible to produce the same power with 1½ lbs. of coal, or even less, hence it may be fairly said that there is a possible saving to be effected of 75 per cent., worth annually nearly £900,000. It would probably be well within the mark to say that the saving to be effected in labor of handling and in the maintenance of boilers and appliances for consuming this, would be worth, in addition, say 65 per cent. of the above sum, showing a possible economy of, say 1½ millions sterling per annum, a sum equal to over 2 per cent. on the total value of the coal raised, or about 3¾ per cent. of the whole wages annually paid in the mining industries; and if the coal were raised unbroken, so that its value was equal to the average value of the coal sold, these figures would rise to 3 per cent. of the value of the total coal raised, or 6 per cent of the wages paid.

It may be stated at once that to realize these economies the power required must be produced by compound or triple expansion condensing engines, appliances almost unknown in colliery work, and to do this there is no doubt that the whole power required at the colliery must be produced in one or, at most, two engines, and distributed with as little loss as possible to the points where power is required. There are various methods of distributing power, but some of them are only applicable to particular cases, or in particular circumstances; the only two of general applicability are compressed air and electricity.

Of these, whilst under favorable circumstances compressed air can be made to give a favorable efficiency, its application in mining is discounted by two important considerations of economy. To utilize compressed air with efficiency—(1) The pipes must be free from leakage, (2) the air must be heated before being used. These two conditions are practically unrealizable, and hence the efficiency of air transmission in collieries is and must necessarily be low. The cost of plant and extended air mains is also high.

The advantage, therefore, in point of view of first cost and efficiency as a means of distributing power rests with electricity, the economy of the cables compared with air mains, and the facility for extension and alterations to the position of the machinery make electricity an ideal means of distributing power.

There is, however, a question to which I must refer—viz., that of safety. This question of safety is one which has, from the first introduction of electricity in mining, been prominently before engineers; though it may be noted that among those who have had practical experience of its use in mines the objection is rarely raised. In a paper read in 1891 before the Institution of Civil Engineers by the author, in conjunction with Mr. C. A. Atkinson, this question was somewhat fully dealt with, and certain conclusions were arrived at which time and experience have gone to confirm, but, as this question is to some minds still an open one, and as additional experience has added to the knowledge of the subject, it may be well to deal with it again at some length.

There are two distinct questions:

(1) The safety of an electric motor, which may spark at the commutator.

(2) The safety of a system of cables, which may be ruptured while carrying an electric current.

Dealing with the first of these, it has been shown from theoretical considerations and by practical test that the amount of sparking which exists with electric motors of good construction is unable to ignite firedamp, owing to the fact that the temperature is never sufficiently high, and it is only therefore in exceptionally abnormal circumstances, such as a brush falling out of its holder or becoming displaced absolutely on the commutator, that the inflammation of firedamp can be effected; and it has also been shown conclusively by experiment that there are in the market methods of enclosing either the whole machine or the armature and commutator, or the commutator alone, which, even under these abnormal circumstances, entirely prevent either the access of firedamp or the ignition of firedamp outside the machine.

Practical experience is in accord with the experiment and with the principle named, and the author knows of no recorded instance where there has been an accident from the use of an electric motor in a coal mine. In connection with this, reference may be made to the question of commutatorless motors worked by multiphase alternate currents. As the principles on which these motors work are little understood, the author has appended to this paper some notes on the subject; but a few points are especially worthy of consideration. The first is that although such a motor may have no commutator, if it has to be regulated as to speed, or to start with the load on, it must have brushes and current collecting rings, in which case the displacement of the brushes under abnormal circumstances may have in a modified proportion the same result as in an ordinary motor. Another circumstance in connection with such motors as at present constructed is that the maximum turning moment they will give has a limiting value, beyond which it decreases as the load increases, even although the current increases, and that at any other than the normal speed the efficiency rapidly falls. Curves are given (Plate 21) showing the maximum turning moments given at different speeds, and the efficiencies are shown. For comparison similar curves are given (Plate 20) for a motor in which the speed is controlled by varying the strength of the magnetic field, using continuous current. A further point is that with such motors the losses in the cables and the dynamos, which with continuous currents are proportional to the power transmitted, are not proportional in the case of alternate currents, whilst in addition, as 250 volts alternating will give the same shock as 500 volts continuous, which is generally treated as the maximum advisable in a colliery, the cables have to be of about twice the area of section for the same power; hence these various considerations contribute to this, that the advantage of such motors at full load and full speed are to be balanced against their disadvan-

*Paper read before the South Wales Institute of Engineers

* See Address, British Association, Mechanical Science Section, 1891.

tages at less than full load and at other speeds, and in the particular case of colliery transmission these points are large factors.

Returning now to the second point in the question of safety, viz: the possible breakage of a cable. This may be at once overcome if the cables are buried below the surface, but as this method has the disadvantage of expense, and frequently of deterioration of the cable, we may consider the case of a cable hung from the walls or timbers.

In this case if the cable does break the ends are quickly parted, the spark may continue for the fraction of a second, but it has been shown by the experiments of Messrs. Wullner and Lehmann at Aix-la-Chapelle, which experiments were accepted as conclusive by the Prussian Firedamp Commission, "that even violent sparks from rupture of the current, accompanied with the explosion of fragments of iron in a state of combustion, had no effect on the inflammation of firedamp."—(*Colliery Guardian*, Feb. 20th, 1891.)

Considerable light has, in the author's opinion, been thrown on this question by the facts recently stated by Professor Vivian B. Lewis. It appears that the ignition of firedamp arises in most cases, not from the raising of the temperature to the ignition point of firedamp, which is very high, but by the raising of it to the point of its decomposition with evolution of hydrogen, which, becoming ignited, eventually ignites the firedamp. This requires two things: (1) Time (and Professor V. Lewis states that 10 seconds is in some cases necessary); (2) The maintaining of a particular mass of gas in contact with the point where the heat is developed long enough to effect the operation quoted. Neither at the commutator of a motor, nor at the point of rupture of a cable are these conditions fulfilled. In the face of the facts and experiments and experience now at disposal, those who raise the objection to electricity in mining on the ground of safety ought, in the author's opinion, to bring some proofs of that danger if it is to receive consideration. Notwithstanding the extended use of electricity, these causes of accidents do not occur, and, in the opinion of many well qualified to give it, the danger arising from electricity is less than that arising from safety lamps, and enormously less than that arising from almost any explosive agent now in daily use.

Havin· ·ealt with this question, it remains to be asked, is the present position of power di· ·.·ation by electricity such that we may use it with confidence for the whole of the power required at a colliery? The author's answer to this is, yes. In support of this may be given the following facts.

The largest engine at a colliery is the winding engine, and suppose this to require to be capable of developing power at full speed of 1,000 h.p., which is an outside figure, this could be well replaced by two motors of 500 h.p., one on each end of the shaft of the drum, without gearing. There are numerous cases of dynamos and motors of this power working with ease and satisfaction and giving no difficulty whatever, and operated by ordinary mechanics with no more trouble than an ordinary steam engine. Motors of smaller sizes are in use all over the world, with universal satisfaction as to ease of manipulation and low cost of maintenance.

Are the claims made for efficiency of electric distribution of power realized? On this point the author has examined carefully tests made by himself and by others on electric power plants, and has arrived at this conclusion: whilst the efficiency of distributing electric power and its utilization in the motors does come up to that claimed, the efficiency of the production of electricity is not as a rule as high as is claimed or as high as may be realized, and the reason is this: sufficient account is not taken of the fact that the average load is considerably less than the maximum requirements, and the curve given (Plate 22), which is taken from an actual test of a direct coupled engine and dynamo, will show how this operates. Whilst the efficiency of electric generation, that is, the proportion between the electric power delivered to the cables and the indicated horse-power of the engine, is as high as 86 per cent. at full load, it falls to 74 per cent. at half load and to about 58 per cent. at one-quarter load. The reason for this is to be found in the power the engine takes to drive itself. The engine is generally arranged to work with an economical cut-off at the full load of maximum power, and consequently is larger than necessary for all smaller loads. It should be arranged to work with an economical cut-off at the average power, then at a larger power; although the consumption of steam per i. h. p. would be somewhat greater, the mechanical efficiency would be so much better at the average load, that considerable economy, and, indeed, the best possible result would be obtained. The moral is to use engines with automatic expansion valves, permitting the engine to work with a cut-off as late as ½ or ⅝ of the total cylinder volume when developing the maximum power, and working with a more economical grade of expansion at the average load.

To apply the principles advocated in this paper, the method to be adopted should be as follows: When a colliery is opened an estimate must be made of the power which will ultimately be required for the whole colliery. It need not be all provided for at once, but the arrangements must be such that what is provided will be worked at an economical load, and that by simple duplication it may be increased.

An example is given below which may be considered to represent an average case where there is no very heavy pumping:—

TABLE OF POWER REQUIRED AT A COLLIERY.

	Maximum Power. H.P.	Average Power. H.P.	Minimum Power. H.P.
Winding	700	225	0
Fan engine	60	60	60
Pumps	50	50	50
Haulage	200	100	0
Lighting	20	10	10
Screens	20	20	20
Shops at surface	20	5	5
Capstans for waggon handling	20	10	10
Total	1,090	480	155

The power required by the windi[illegible] and haulage engines are what would probably be required in a colliery drawi[illegible]00 tons per day, and the maximum power required by the winding engin[illegible]reckoned on the assumption that the weight of the ropes is unbalanced, and the average on the assumption that the winding takes 40 seconds and the unloading and loading 25 seconds. Variations will correspondingly affect these points, and must be made to suit each case.

These powers set down are those required at the separate machines, and if we take it that the loss in the cables at full load is 5 per cent., which will be ample, as the bulk of the power is not far from the source, and that at the average load and upwards the indicated power is as shown on the curve (steam dynamo efficiency, plate 22), that is, $\frac{100}{86}$ of the power delivered to the cables, we get the following as the indicated power required at each load, which, assuming that the electric motor will transform only as much electric power into mechanical power as a steam engine would convert of indicated power into mechanical power, gives a direct comparison between the actual indicated power required if all the engines were worked direct from the boiler, or by the distribution thus to be effected:—

INDICATED H. P. OF GENERATING ENGINES.

Maximum.	Average.	Minimum.
$\frac{100}{86}\times\frac{100}{95}\times 1{,}090$	$\frac{100}{86}\times\frac{100}{97.5}\times 480$	$\frac{100}{64}\times\frac{100}{95}\times 155$
1,330	572	265

Now it will be observed that the average power is 572 i.h.p., as compared with 480 i.h.p. actually required at the engines. But taking the former Mr. Foster Brown's figure of 6 lbs., and for the latter 1½ lbs., the economy resulting is found from the fraction:—

$$\frac{6}{1.5\times\frac{572}{480}} \text{ or } \frac{6}{1.78} \text{ or } \frac{100}{29.6}$$

Not far differing from the possible economy spoken of early in the paper.

That such figures are realizable in practice is shown by the figures givenin apaper read before the North of England Institute of Mining Engineers by Mr. Alexander Siemens, and published in vol. 8, part 2, of the Transactions of the Federated Institution of Mining Engineers.

Tests are there recorded where, with a plant considerably smaller than that here considered, a consumption of 2.62 lbs. per e. h. p. hour, equivalent to 2.25 lbs. per i. h. p. hour, were obtained; and in the discussion on the same paper reference was made by Mr. D. B. Morison to a plant using 2 lbs. coal per e. h. p. hour, equivalent to 1.72 per i. h. p.

The writer is aware that in thus advocating the generation of the whole of the power in one engine or pair of engines he is advising a very radical departure from existing and well-tried methods; but the advantage in economy is so great that in his view a revision of method must take place, and in any case the subject is well worthy of consideration and discussion.

Metal Mining.

Extracts from a presidential address delivered by Mr. J. H. COLLINS, before the Institution of Mining and Metallurgy, London.

Local demands for special products and by-products.—Such demands may often determine the mode of treatment of an ore. Thus, where there is a local demand for sulphate of copper, or where dilute acids are cheap, a wet process of extraction may be more advantageous than a dry one, or than mechanical concentration; and in such cases it may even be preferable to turn a finished product like copper bars into the less simple form of sulphate. Whether sulphuric acid shall be made or not; whether attempts shall be made to condense arsenic, sulphur, lead, or zinc fume; whether sulphate of iron shall run to waste—the answer to these and a hundred similar problems must depend upon local conditions more than anything else. Basic ores and concentrates may sometimes be sold for prices far in excess of their metallic contents, and in such cases it will often be best to sell in a somewhat crude state rather than to concentrate and refine to a high pitch. Ignorant attempts have been made to smelt tin ores direct to metal in a blast furnace without previous "dressing," but the results, as might have been supposed, were altogether unsatisfactory, unless alloys of tin and iron being produced, much tin at the same time passing into the slag. In many places there may be a demand for slag for cement making, building purposes, railway ballasting, road making, and similar purposes, and the good mine manager will not fail to take such requirements into consideration.

The kind of labor available must be considered by the mining engineer. In old mining countries skilled labor is usually abundant, while the reverse is generally the case in new countries. Anyone who has had to sink a shaft in heavy ground, or to "spill" through running ground with "green hands," will understand the importance of skilled labor in mining, will duly value the services of such born miners as the Cornishman and the Mexican, and will sympathize with the man who finally decides upon driving a long tunnel, or even opening up a great quarry, so as to avoid the initial difficulty, even though it may entail greater difficulties upon those who come after—probably at a time when the new camp has become an old one and skilled labor is no longer rare. Similar considerations will often lead the thoughtful and well-instructed engineer to prefer a crude process of ore treatment to one which, though far more perfect and effectual in skilled hands, would be for him, and under existing circumstances, undesirable, if not altogether out of the question. It was the comparative rarity of skilled furnace-men in the United States which led to the extended use of water-jacketed furnaces; for these, though somewhat expensive at first cost, and rather wasteful in fuel, are easily handled by comparatively unskilled men, and very economical and easy to repair.

Considerations of Climate.—As a general rule, it is no doubt recognized that processes requiring much water are not suited for dry climates, unless there is some abundant natural supply available. On the other hand, some dry processes are at a great disadvantage when operated in very moist climates. One of the best illustrations of climate influences is observable in connection with tin dressing. As there must be a series of operations, and the ores must be mechanically concentrated to a high degree of purity before smelting, this requires cheap and fairly skilled labor, and plenty of water, so that a moist and mild climate is a great advantage. It is not generally known that a really dry state of the atmosphere renders the dressing of fine tin ore a most difficult operation, for, if once the particles get really dry, there is always a heavy loss of float tin.

Possible Scale of Operations.—It is obvious that the administration expenses and other standing charges, and even some of the working expenses, will be much lessened in proportion as the scale of operations is enlarged. But small-scale operations are often the only ones possible, and if the manager is an all-round man the disadvantage may not be so very great after all.

Pilfering and Robbery.—Pilfering is naturally more common in the case of rich than of poor ores and products, and in some cases it exists to such an extent as to seriously affect the financial results of an enterprise. Thus it is that an extensive mine of low grade ores has often an advantage over one of less extent, where the natural concentrations have been more complete. Ores are generally more easily pilfered than ingots; in fact, these latter, when of considerable size, are extremely difficult to steal, and often difficult to realize when stolen.

Transit Facilities.—In general terms it may be said that the transit cost (and insurance) of the precious metals is insignificant as compared with their value; that of ingots of "base bullion" is more noticeable, but still of little importance; that of ordinary ingots of metal or sacks of matter more considerable; that of ores so considerable as often to be prohibitive. As regards supplies, such as timber, fuel and iron, these are often prime necessities, and required in large quantities; while considerable weights of salt, bricks and other commodities are also frequently required. Obviously the advantage of good roads, railways, shipping ports, and other modern transit facilities will be in direct proportion to such requirements of supplies from external sources, other things being equal; while, for want of such facilities, many essentially good mineral deposits are, and must for the present remain, unworked. But although good transit facilities are an advantage as a general rule, there are some important exceptions, more particularly in connection with the precious metals. Thus, a mining region which can itself furnish the necessaries of life and the principal mine supplies, such as fuel and timber, and which only sends away a product of great value in proportion to its bulk, may be much better without a railway. Horse and mule labor is often very cheap and effective in such places, while wages are always low when the food of the laborer is cheap.

Financial Considerations.—The amount of working capital actually available is the real crux of most mining adventures in their initial stages. Both mine and mill are often crippled for want of money, and the manager has to do as he can, and not as he would, so that makeshifts, costly in the end, are frequently unavoidable. But even where money is not actually unobtainable it may happen that a high rate of interest will lead to a modification in the character of the plant at first proposed. In countries where 12 per cent. or more is the normal rate of interest, it will often pay better to employ more unskilled labor; on the other hand, if money can be borrowed at three or four per cent., more and better machinery can be provided with advantage.

Electrical Haulage at Earnock Colliery.

By Robert Robertson, B. Sc., M. Inst. C. E.

Some time ago an electric plant was installed at Earnock colliery for the haulage of coal hutches in parts of the mine near to the working faces where horses had hitherto been used for that purpose. The colliery is situated in a coal field extending to about 1,000 acres, near Hamilton, in Lanarkshire, Scotland, and has been in operation for about 15 years. Five seams are being worked, and in all the haulage has hitherto been accomplished by steam hauling engines, horses and self-acting inclines. From the results of working during about 18 months since the installation was completed, the following is a close approximation to the saving which has been effected. Taking the present output by the two electrical hauling engines at 600 tons in 10 hours it is estimated that, even if the same work could have been done by horses, it would have required 40 horses and 40 men (in addition to those at present bringing the coal from the working faces), to do the same amount of work. The horses of the class employed cost about £30 per head. Renewal and depreciation at the rate of 15 per cent. per annum gives an annual charge of £180. The cost of feeding, etc., is about £30 per annum per horse. The wages paid to the horse drivers is about 5s. 6d. per day. The annual cost of working with 40 horses is therefore:—

Depreciation and renewal of 40 horses, 15 per cent. of £1,200	£180
Keep of horses, 40, £30 per annum	1,200
Wages of 40 men at 5s. 6d. per day for say 250 days	2,750
Total	£4,130

The annual cost of working and maintaining the electrical installation is:—

One electrical engineer at 10s. per day for 250 days	£125
Twelve men at 6s. per day for 250 days	900
Coals, oil, stores, etc	500
Upkeep and depreciation:—	
Building, say, 5 per cent	30
Machinery, pulleys, ropes, etc., 15 per cent on £2,900	435
	£1,990

Deducting the cost of working and upkeep of the electric haulage plant from the estimated cost of doing similar work by horses, shows the substantial saving of £2,140 per annum to be effected by the electrical installation.

The steam is obtained from existing boilers at the colliery, and no appreciable difference has been observed in the consumption of coal since the new machinery was started; but in making such a comparison as the above, the probable cost for coal should be assumed as if the steam were supplied from a separate boiler. From experiments to test the efficiency of the plant, the following information was obtained: The loss in the engines is about 16 horse-power; in the shafting about 0.45 horse-power; in belt and dynamo friction, 3.4 horse power; and in exciting the dynamo, 2.2 horse-power. These losses, approximately constant for all loads, amount to about 22 horse power, and constitute the engine room losses. The loss in the engine is large on account of the available steam pressure being low—only 50 pounds per square inch.—*Proceedings Institute Civil Engineers.*

Shipment of Canadian Phosphate.—A shipment of 300 tons of phosphate was made this month from the High Rock mine, near Buckingham, Que.

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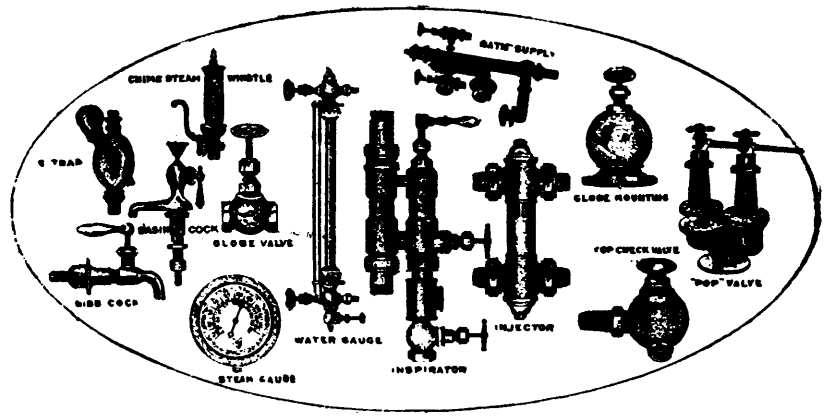

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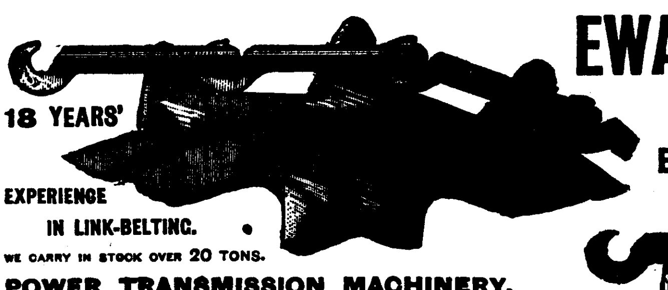

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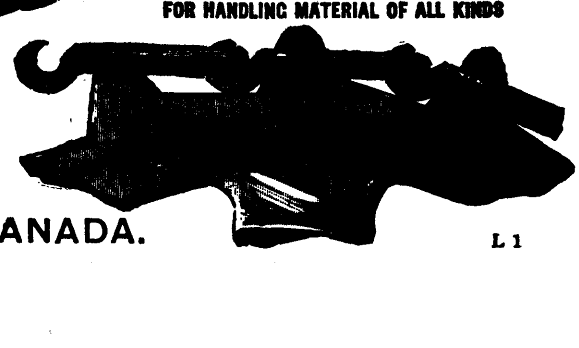

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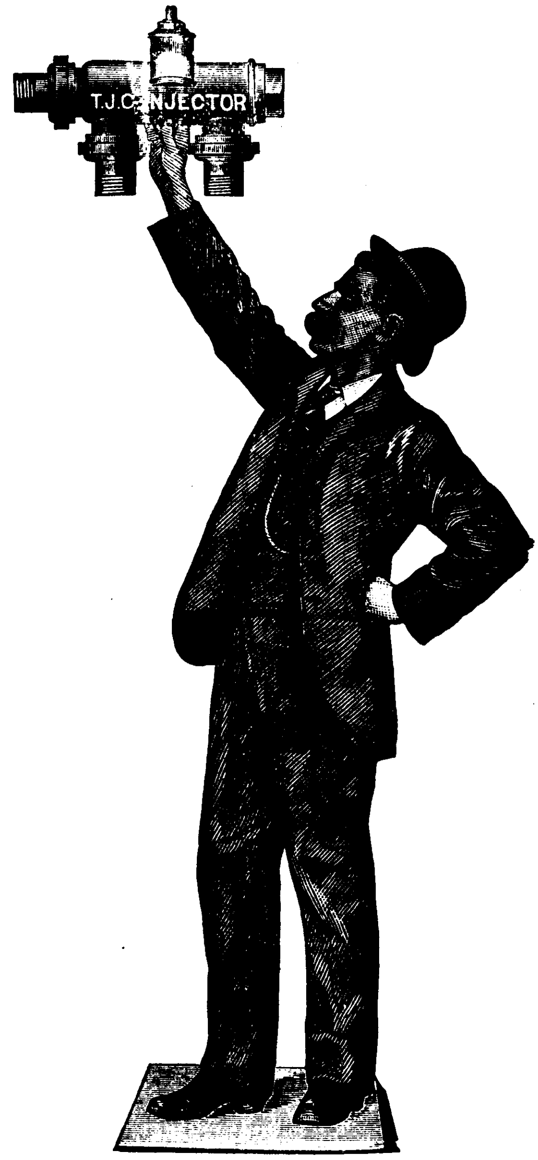

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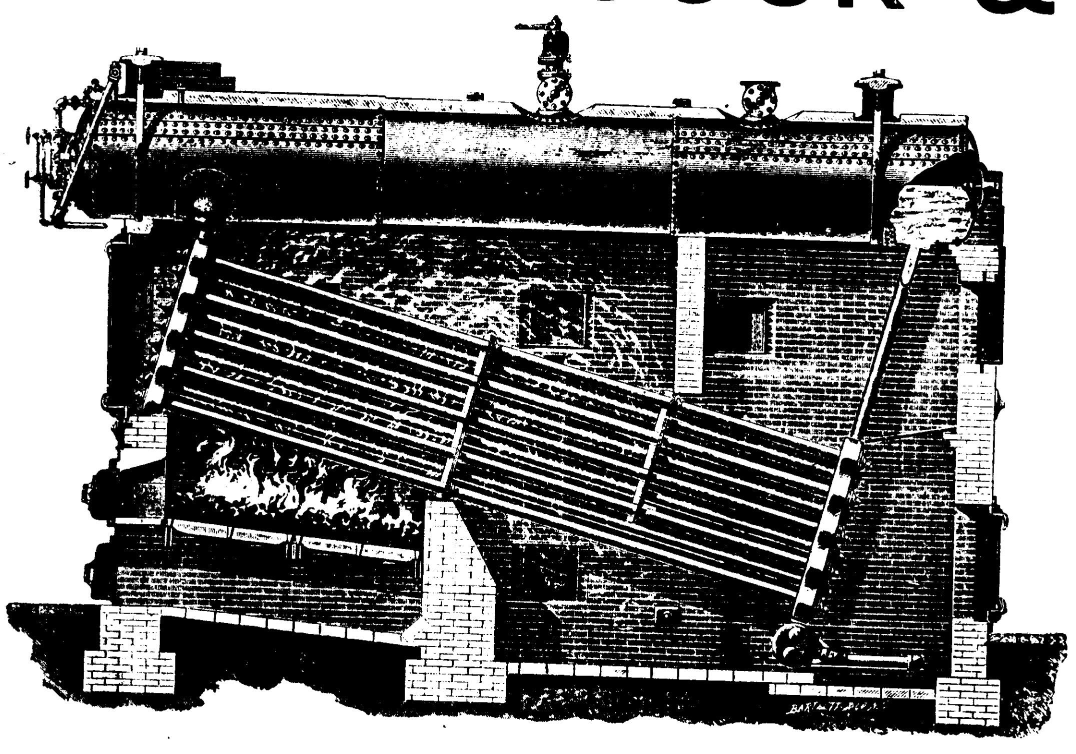

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