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THE Canadian MINING REVIEW

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The Canadian Mining Manual, 1890-91.

EDITED AND COMPILED

— BY —

B. T. A. Bell, Editor of the Canadian Mining Review, &c,, &c, &c.

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To Our Readers.

The present issue of the *Review* has been delayed in publication through an unforeseen mishap to our printing house.

The Iron and Steel Institute.

The members of the Iron and Steel Institute who are holding a Meeting conjointly with the American Institute, of Mining Engineers in New York, will pay a flying visit to the Sudbury mines and works during the month.

At the request of the Government we wired Dr. Raymond with the object of ascertaining if the Dominion could not be favored with a more extended visit, and in reply we were informed that the arrangements made precluded any definite answer until a later date. Dr. Selwyn will be in attendance at the Meeting, authorised by the Government to extend an invitation to the Institute to visit the Dominion. The visit by these eminent metallurgists and ironmasters would unquestionably result in much benefit to the country, and we trust that it is not yet too late to have them partake of Canadian hospitality.

Systems of Phosphate Mining.

In the earlier days of the Canadian Phosphate industry, mining was largely carried on by contract. The miners provided their own dwellings, tools and supplies, and the owner of the property incurred no outlay or expense, except to pay for phosphate won. This was usually paid for at the rate of six dollars a ton, the standard quality being seventy-five per cent. and any phosphate below that grade was liable to rejection. It was customary to pay monthly, at the rate of five dollars a ton, on a measurement of twenty cubic feet to the ton, one dollar's margin being reserved for a final settlement on the weight. An advantage of this system is that it avoids the investment of capital by the mine owner and saves him from all risk of loss in prospecting for shows or in working unproductive seams. It also secures an output that would not otherwise be made, as neighbouring farmers will occasionally put in a few week's work and produce ore at a rate that ordinary laborers would not accept as day wages. But the disadvantages of this method of working phosphate mines are many and have caused a general abandonment of the system, except for an occasional venture in a small way. The chief difficulty is to secure good quality. The miners build up walls with handsome blocks of apatite, within which they pile as much dirt as opportunity and conscience will permit, and the latter deterrant is not often operative. As payment has to be made monthly and every analysis by a chemist costs five dollars, expense debars the owner from securing accurate tests, and, as in the winter time the piles freeze into a solid mass, the difficulty of inspection is great. Many a cargo of contract mined phosphate, upon which great hopes of profit were based, has gone below guarantee in Europe and been rejected by the purchaser. Another objection to this system of mining is the bad condition in which the property is left. The contractor, intent only upon present gain, works his pits in a cheap and shiftless fashion, having as much debris as possible unhoisted and working in the smallest space in which he can move. He "gouges out" the seam and moves to a new surface show to repeat the operation, the consequence being that the property is soon covered with holes in the ground that require an outlay before they are workable. There is a strong moral objection to this system. It places men in a position where all their interest lies on the side of dishonesty and where there is every facility for its commission. Contract work in sinking shafts and running drifts is popular and safe and is largely resorted to at the Sudbury Copper Mines at present. The men in such case are paid by the fathom of excavation and their work is readily checked. But the conditions of phosphate mining are very different, and both materially and morally the contract system of mining as applied to it must be pronounced bad.

The usual system of phosphate mining is by day labor. The chief difficulty about it is the lack of incentive to the workman to render faithful and efficient service. If he can get through the day without rebnke from the "boss" the less he does for his wages the better it suits him. In large mines under good superintendance and strict oversight and where machinery is used a fair amount of effort is secured from the men; but when the work is scattered over a wide area or is under careless management the loss from neglect on the part of the laborers is very great. Many a small enterprise that properly managed might have grown to success has been ruined by loafers. The city owner makes a rare visit to the property and sees things going on briskly. On other days the manager takes his horse and buggy and drives to the neighbouring town for a bar of soap or a hammer and the men "take it easy." Over-estimated reports of output are given and it is not long since a company, that was supposed to have 500 tons of ore raised, discovered a weight of only 150 tons.

A remedy for the ills of these two systems of mining seems to exist in the form of co-operation or profit sharing. Experience shows that it is impossible to devise means to avoid loss by dishonesty and laziness under the contract or wages system. Some miners are dishonest and lazy and all have a good deal of "human nature" in them and it is natural for men to give as little work for the money as policy will permit. The only effective way to overcome this tendency is by stimulating self-interest. If the miner's pay was contingent on the quantity and quality of the ore raised, an inducement would exist for him to use his best exertions. With a shifting force such as is commonly employed in mines this method is not easily practicable, but where steady labor is employed and the men are residents of the region some system embodying this principle of co-operation seems to be feasible and it is to be hoped that it may be tried in the phosphate industry. It was attempted in one case a few years since, but as the mineral was scarce no amount of effort could secure a profit. In nearly every department of industry, associative work for common profit appears to be proving its fitness by favorable results; but the difficulty of its application to mining has so far afforded but little opportunity for the introduction of this humanizing system. If it could be tried under suitable conditions and the success of the enterprise was alike the concern and interest of employer and employee or a mutnal association of workers probably the results would be satisfactory to the pocket as well as elevating to the moral nature.

The Springhill and Wellington Strikes.

Reference has already been made in these columns to the strikes at Springhill and Wellington, the two extremes of the Dominion. So important, however, are the relations between labor and capital, and so widespread are the effects of any disturbance or quarrel leading to suspension of work that the subject may bear another reference. It is claimed and with a fair show of reason that Canadians are quite as well educated as their cousins south of the line, and rather more so than Europeans. This rule applies to our miners as well as to any other class, they being intelligent, quite capable of understanding their business, and usually newspaper readers.

Strikes among miners appear in many cases to arise from an accumulation of feeling that they are unjustly treated in some respect, a belief which is nurtured by their forming isolated communities, and by the ascendancy which is readily acquired by any of their number possessing the art persuasive, and by the gift of organisation. In many cases it has been found that masters have failed to meet their employees in a friendly spirit, and that changes however necessary have been carried out in an arbitrary manner. As the two elements of capital and labor are completely dependent on each other, common sense would dictate to both sides, a policy of forebearance, conciliation, and fair play. There are of course certain conditions which do not always admit of compromise or argument. A demand is made for an increase of pay or a lessened wage rate. If these cannot be conceded in any instance under consid-

eration, there is in the fair way of looking at business matters, nothing left but for the two parties to separate.

The general public suggest arbitration as an universal panacea. In Nova Scotia an arbitration Act was passed some years ago, and action taken under it by the Springhill miners; owing to technical defaults made by them the case never came to arbitration, enough however was done to suggest a new Act which was passed. As yet no case has been submitted to arbitration under it, and it can be understood that the Springhill miners smarting under their defeat when trying the first Act, hesitated to commit themselves to the later legislation. The Springhill strike was not directly one for higher pay, but for a readjustment of dockage for excessive amounts of stone in the coal sent out by the miners, as already mentioned in these columns, and some similar matters. The complaint against a long established system of dockage had gone on for some time, until a strike was resolved on as the best means of settling the question.

It is to be regretted that the matter was not submitted to arbitration, as it was a proper one for that method of treatment, and no doubt an award would have been given fairly meeting the requirements of the case. The matter being in fact the necessity of the Company having clean coal to furnish to its customers. This being common to the welfare of both the company and the miners, an admission to this effect on the part of the latter, and a promise to send up clean coal, would doubtless have paved the way to a ready compromise as to fines, dockages etc. Arbitration is perhaps better suited to meet disputes such as this, than to deal with abstract principles of wages. If a body of men believe that they should have an advance of pay conceded to them, no arbitration can convince them that they are wrong in their opinion. Where differences arise in details of work, employees more readily accept a solution differing from the one they had designed, for all are aware of the wide differences in mining conditions and practice in various localities, but no one has yet succeeded in convincing a man that his wages are a full equivalent for his days labor.

In the case of the Wellington strike the demand for an eight hour shift to count from the time of leaving the surface to returning to it is really one of wages, and the Company alone can say if they are in a position to grant it. If the profits of the operations permit of its being granted, there is a fair ground for a bargain, so that in return for the concession of a shortened period of labor the Company may have the support of the men in more regnlar work, and the discharge of men who are too fond of lay days. As to the second demand, the recognition of the men as a Union, there is a wide spread desire on the part of all employers to deal with their hands as individuals, and naturally so, for a lazy or stupid employee is often a direct source of loss. It has been noted that men of this class are not unfrequently allowed by their fellow workmen too much sympathy against their employers, which in the long run operates against the interests of the employed. There are, however, many colliery managers who not only recognize their employees "Union," but find it a help in prosecuting their business, and there can be no doubt that a mine manager, if he deals with the representatives of his men in a fair and friendly spirit, often enlists in them, their trusted representatives, efficient assistance in curbing the discontent of these men who always have a real or fancied grievance.

It is not quite clear what is meant by the third demand that a committee of the employed, or Union should investigate in all cases of dispute between masters and men. A committee could not be expected to act impartially when they are delegates of the parties interested. In any scheme of voluntary arbitration it is always open for either side to say whether the matter is not one for arbitration, and it has seldom been found that a steady adherence has been given to this method of solving disputes. The idea of compulsory arbitration has often been mooted, but the practical difficulty of compelling a body of workmen to abide by its decisions is at once apparent. No Government in the Dominion is ready to undertake the task of putting a thousand or so of workmen into jail, and as the Companies have available assets that can be attacked by fines, etc., such a method appears unfair whenever a Company demurred at obeying an unfavourable decision. It must be admitted that if a Company offers arbitration or is ready to act up to a compulsory arbitration, some assurance is due that the defaulting side should be coerced into accepting the results of a fair judgement.

The most feasible road toward the solution of these difficulties in reconciling the unceasing disputes between capital and labor appears to be the cultivation of a spirit of friendliness, and the untiring efforts of all concerned in or associated with industrial communities directed toward educating both parties into a sense of the unreasonableness and folly of cessation of work, and to inculcate in them the knowledge that outsiders, practically qualified, are almost invariably the best judges of what is fair between man and man. Business men continually find that their differences are most readily settled by arbitration, and in many cases law suits are resorted to as a form of arbitration rather than as a means of indulging in obstinacy or personal feeling.

Employees should endeavor to identify themselves as far as they can with the interests of the corporation they are engaged with as every good day's work done in an ungrudging spirit benefits the employer who is enabled to produce a better article, and to give his hands steadier work. On the other side it is unquestionable that a frank recognition of the daily toil of the workmen in any concern, and a desire for their advancement, coupled with some share in any profits over and above a fair return on the capital invested would lead to a better understanding and remove the idea too often pervailing among the employed that they are only tools to be flung aside when their usefulness is passed.

American Institute of Mining Engineers.

According to circular from Dr. Raymond, the fifty-seventh meeting of the American Institute of Mining Engineers will begin in New York on Monday afternoon, September 29th, at 2 o'clock. All sessions will be held at Chickering Hall, 130 Fifth avenue; hotel headquarters will be at the Park Avenue Hotel. The sessions of the Institute for the reading and discussion of papers will be Monday afternoon and evening, and on Thursday morning, afternoon and evening.

On Wednesday, Thursday and Friday mornings the sessions of the British Iron and Steel Institute will take place.

On Wednesday afternoon there will be an excursion of the two societies, and invited guests, up the Hudson River.

On Thursday afternoon, the Holley Memorial will be unveiled in Washington Square. The commemorative address will be delivered in Chickering Hall, previous to the open-air ceremony, by Mr. James Dredge, editor of London *Engineering*.

Other than members at the discretion of the general committee, may accompany the excursionists and partake of the entertainment *en route*, at the following rates, which cover railway fares and Pullman berths only:

New York to Pittsburg and return, $20.

New York to Pittsburg and Chicago and return, $30.

New York to Pittsburg, Chicago, and over the Northern or the Southern excurslon route and return to New York, $60.

Philadelphia or Pittsburg over either route and return to starting point, $60.

Applications for joining the excursionists, accompanied with check for the amount of fare, should be made to Charles Kirchoff, 66 Duane street, New York city.

The Cariboo Mining District

We publish in this number of the REVIEW an engraving and sketch of Mr. John Bowron, the gold commissioner of Cariboo District, kindly furnished us by a subscriber—a resident of Cariboo and an intimate acquaintanee of Mr. Bowron's. The Cariboo District ever since the discovery of gold within its limits in 1860, has maintained its superiority as the chief gold producing district of the Pacific province. The richness of some of her placer mines has been really phenomenal. The Diller Company on Williams' Creek (3 men) produced in April, 1863, within 12 hours, 104 lbs. weight of the precious metal, which is perhaps the highest

earning for the time occupied on record. But there were numerous instances of men jumping, within 24 hours, from poverty to affluence. Hitherto operations have been principally confined to placer or alluvial mining, from which source, it is estimated, some fifty to sixty millions of dollars have been produced. But the still greater wealth of this district in its quartz ledges is only now becoming apparent. The success which attended the working of a quantity of rock last season at the test works erected near Barkerville by the Provincial Government, puts the question of the value of the numerous quartz veins which intersect the country beyond a peradventure. Such, at all events, seems to be the opinion of the Government and Legislature, since, although the works were completely destroyed by fire last winter, they are already being rebuilt, and that upon a larger scale. English capital, too, is now seeking investment in the district, the result of an examination of the mines by an expert sent out from London last season. It is now also a matter of certainty that the district will soon have the advantages or railway communication, as two companies have been chartered and liberally subsidized by the Provincial Government, making the Cariboo mining region their objective point, or passing through it. This is at present the great want of the district, as, handicapped by fully two hundred miles of waggon road, over which all machinery and material for quartz mining must be hauled by freight teams, the advantages of carrying on extensive operations are serious. With the commencement of railway construction therefore we shall no doubt see the era of Cariboo's early prosperity renewed and perpetuated.

The Phosphate Corporation.

Throughout the Phosphate districts owners of Lots are cleaning out pits and fixing up shows in order to exhibit their wares to the experts of the General Phosphate Corporation who are now on a tour of examination with the purpose of buying up "all the Phosphate land in Canada." There will probably be a good deal of disappointment on the part of many who have been waiting for several months upon the promise of sale, for it is hardly to be supposed that any Company would buy more land than it can properly develop and work. It is to be regretted that some wealthy owners of lands who are abundantly able to work their properties do nothing but "fix them up" for sale at extravagant prices.

Statements, more or less incorrect, have recently been prominent in several of our local papers respecting the value of the stock taken up by the public in the Corporation. In some cases it is broadly stated to have collapsed; in others to have been partially successful. As a matter of fact the Company was *underwitten* before being offered to the public to an extent which assured it a fair start; and while only a comparatively small amount of stock was taken up by the public we have the assurance of the chairman, Lord Stalbridge, that 20,000 shares have been alloted, equal to a capital of £20,000. As matters now stand the Corporation is on a distinctly better working basis and if judiciously operated should prove a success. A notice of the first meeting of the Corporation is given in another column.

The Phosphate Season.

Notwithstanding high prices and the accession this year of seven or eight new companies to the ranks of our Phosphate producers, it is apparent that the exports for this season will compare very unfavorably with those made in 1889 and in former years. A careful estimate points to 18,000 tons as a probable limit to the quantity that will go forward to Europe, while shipments to American and Canadian points, will in all liklihood not show any advance—if they equal last year's returns. Altogether we estimate that the aggregate shipments will not exceed 20,000 tons. This regretable state of affairs must not, however, be in any way accounted to scarcity of ore, but rather to the temporary suspension of production on the part of the Emerald and North Star mines. The North Star will be remembered to have contributed by far the largest proportion of the entire output of last season, but pending certain negotiations for its transfer to new hands, but little work has been done this season. The new Companies did not start in until the season was well advanced and therefore could not be expected to compensate for the falling off in the other two. With a continuation of good prices, improved working plants, and the acquisition of the outputs from the new producers we think there is very good prospect of ample amends being made in the coming year for the unavoidable shortage in the yield for the present season.

A New Phosphate District.

Considerable interest has been excited by the report of phosphate discoveries in the district of country fifty miles northwest of Peterborough, Ontario. Mr. William Watt of Perth, one of the most experienced phosphate miners in Canada, has lately visited the region and spent a fortnight in making a thorough examination of it. He visited over one hundred phosphate lots and found the mineral on all of them. He states that it occurs in the form of crystals in a mixture of lime with small crystals of mica and he did not see a seam, vein or bunch of phosphate rock in any locality. A company has been working one property all summer and have secured a few tons of crystals. The country is described as consisting of long and high mountains covered with hardwood, offering a supply of fuel that seems inexhaustible. There is a great deal of pyroxene such as accompanies phosphate in the mines of Quebec and Eastern Ontario, and the region is what a miner would pronounce "likely ground," although as yet no discoveries of economic value have been made.

Sublime Gatherings of the Pundits.

If, as Carlyle used to maintain "the most reverend phenomenon" in the universe is man, then what could exceed in sublimity a gathering of the very flower of men, the two thousand odd pundits who compose the British Association for the Advancement of Science. Surely the most irrepressible cynic will be awed into reverend silence when he reads in *Nature* Professor Tilden's account of the organization and productive performances of some of the sections of this great institution.

"As a sectional secretary I have read papers (other people's) at three o'clock in the afternoon to an audience consisting of a vice-president impatient to follow the president to lunch, two reporters who were not listening, and my wife making signals of distress from a back bench. As a sectional president I have sat at the same hour, luncheonless and weary, while a paper which seemed as long as discursive as the story of the Ancient Mariner, was droned forth by the author to an audience of about three persons fidgeting like the belated wedding guest. I wonder whether this sort of thing is supposed to be of any use to anybody. I think, further, that something should be done to reduce the cost of a meeting to the town visited by the Association. The gorgeousness of the entertainments given, and the demands made upon provincial pockets, have become so extravagant that none but wealthy or ambitious towns can face the luxury of a visit of the British Association."

It would seem to be true that nothing is perfect in the world, not even the British Association.

LETTERS TO THE EDITOR.

The Tariff Question.

Truro, N.S., Sept. 19th, 1890.

The Editor:

SIR,—I am glad to see that you are championing the cause of the gold miner. If any industry in our Dominion required assistance in order to develop our great resources gold mining is the one. I thought the Act passed last session would assist to some extent this hazardous business, but such an interpretation has been put on the Act that it is practically a dead letter. Now, Mr. Editor, I do not believe for one moment it was ever intended to be the delusion it has so far proved to be. Why should copper plates, either plain or silvered, not be admitted free for gold mining? Why should the Gates ore-crusher not be admitted? The Gates ore-crusher is wanted by our gold miners, but the duty shuts them out. As you are on the ground I hope you will keep at the Government until they either interpret the Act to be of service, or abolish it. We are either entitled to have gold mining machinery, which is not manufactured in the Dominion, admitted free, or we are not; therefore I say let us have the answer, free or dutiable, then we will make no mistake in our calculations in that line.

My principal business is that of manufacturing gold mining machinery and I personally would have preferred leaving the duty as it was, but the Government having decided to change it, let us have some benefit from it as gold miners. I am largely interested in the business, and at the present time need for one mine in which I have invested, a Gates ore crusher. Hoping you will succeed in showing the matter in its true light and continue to assist in furthering the development of our rich mineral areas,

Yours, etc.,
GOLD MINER.

[We have submitted the whole matter to the Hon. C. H. Tupper and Sir John Thompson, who have promised to lay it before the Government. Both these gentlemen take a lively interest in the welfare of the miners of their province, and we may therefore rely upon their best endeavors to have this matter adjusted.—EDIT.]

Our Portrait Gallery.

[A series of portraits and biographical sketches of Canadian mining engineers, mine managers, inspectors, geologists, explorers, etc.]

No. 5

Mr. John Bowron, Gold Commissioner for the Cariboo District, B.C.

Mr. John Bowron, Gold Commissioner for the famous Cariboo District, British Columbia, is the youngest son of a gentleman prominent in the history of Lower Canada during the first half of the century, and a brother-in-law of Lieut.-Col. McEachren, C.M.G., of Ormistown, Quebec. His father, Wm. Bowron, Esq., a Yorkshireman by birth, emigrated when quite young to New York State, where he engaged extensively in lumbering and mercantile business; but on the breaking out of the war of 1812 removed to Quebec Province and became an active participant in the stirring events of the time. In the year 1818 he married Sarah Odell, only daughter of Col. Odell, of Odellstown, Quebec, and was for a time engaged in wholesale business in Montreal, but subsequently accepted a lucrative appointment from the then Governor General as Crown Lands Agent for that part of the Province now comprising the Counties of Huntingdon and Chateauguay. Having removed from Montreal he founded and settled in the Town of Huntingdon, which for a long time was known as Bowronsville. Here, at the pretty homestead of Island Villa, on the banks of the Chateauguay, the subject of our sketch was born on 10th March, 1837, and here in 1852, full of years and honours, the old "Squire" died of apoplexy, which had first attacked him some two years previously at the very time he was about to lay the corner stone of the well known Huntingdon Academy, many of whose graduates are now prominent in the public life of the Dominion. It was at this academy that the subject of our sketch received the best part of his early training. Having removed to the Western States he there took up the study of law, but upon the discovery of gold in the Cariboo District he, with his nephew W. R. Schuyler, of Huntingdon, joined the first large overland party bound for the then far-off gold fields. This party, which numbered 136 men and one woman (a Mrs. Schuber, now of Ashcroft, B.C.,) assembled at Fort Garry, now Winnipeg, on the 3rd June, 1862, and with an outfit of 96 ox carts, travelled slowly and wearily over the "Great Lone Land" to Edmonton. Here, of course, they had to abandon their carts, and packing their animals they crossed the Rocky Mountains to Tête Jaune Cache, on the Fraser River. At this point the party separated, some going south to the head waters of the Thompson, while the others continued down the Fraser in canoes or rafts. The small party known by the expedition as the Huntingdon party, with which the subject of our sketch was more immediately connected, built a large raft in which, with nine of their animals, they made an eventful trip down the Fraser to Quesnell mouth, which they reached on the 11th September. Were it not foreign to our present purpose it would be interesting to relate the adventures of this first overland party, which comprised a number of the now prominent residents of the Province, as for instance, Mr. Mara, M.P., Mr. Tunstall, Gold Commissioner for Kootenay, Mr. Fortune, of Enderby, Mr. McMicking, and others.

Mr. Bowron being advised against going up to Williams' Creek so late in the fall, continued his journey to Victoria, where he spent the winter, returning to Cariboo in the early spring of 1863, where he has ever since resided, and been prominently identified with the progress and development of the mines, as well as every other enterprise calculated to promote the material or social well-being of the community. Mr. Bowron was appointed Postmaster in 1866, holding the position for 10 years; he became Mining Recorder in 1872; Government Agent in 1875 and Gold Commissioner in 1883, all of which offices he has filled with acceptance to the Government which he represents, and to the general satisfaction of the community in which he resides. He was one of the founders of the Cariboo Library in 1864, as also of the local Amateur Dramatic Club, and he represents the Government as Chairman of the Royal Cariboo Hospital Board. Mr. Bowron has in the early days done his share of practical work in the mines, and has always taken a deep interest in the development of the mineral wealth of the district, in prospecting, which he has spent his resources freely. His confidence in a prosperous future for the mines has been constant and unbounded, which confidence recent developments in quartz seem amply to justify. On the bench as Gold Commissioner, Mr. Bowron finds his early training in law and his practical experience as a miner of decided value, and this qualification, with his well known impartiality, renders his decisions in mining disputes generally acceptable to litigants. Mr. Bowron was married in 1869 to Miss Edwards, of Michigan, and has two sons and two daughters.

Mining in the Cariboo District, B.C.

Dr. G. M. Dawson, Asst.-Dir. Geological Survey of Canada.

The Cariboo district, entered by the miners in 1860, has ever since produced the greater part of the gold of the Province of British Columbia. It has proved to be one of the best placer-mining camps ever discovered, and though most of the heavy runs of gold on bed-rock, so far found, may now be considered as worked out, its capability as a field for placer-mining of one kind or other is by no means exhausted, and the very limited area within which some of the richest finds have occurred encourages the belief that no great difficulty will eventually be found in tracing these alluvial deposits to their sources.

The fifty-third parallel of north latitude passes through the centre of the Cariboo mining district, which may be described as a mountainous region, but is, perhaps, rather to be regarded as the remnant of a great high-level plateau, with an average elevation of from 5,000 to 5,500 feet, dissected by innumerable streams which flow from it in every direction, but all eventually reach branches of the Fraser River. These streams, falling rapidly about their sources over rocky beds, descend into great V-shaped valleys, and, with the lessening slope, the rock becomes concealed by gravel deposits, which increase in thickness and extent till the valleys become U-shaped or flat-bottomed, and little swampy glades are formed, through which the stream flows tortuously and with gentle current. The steep-sloping banks of the valleys are densely covered with coniferous forest, of which comparatively little has been destroyed by fire, owing to the dampness of the climate at this great altitude. The surface of the broken plateau above is often diversified by open tracts, affording good pasture in summer; and the whole country is more or less thickly covered by drift or detrital matter, concealing the greater part of the surface of the rocky substratum. As in all new gold-mining districts, the shallower placer deposits, and gravels in the present stream-courses first attracted attention, but with the experience of California and Australia it was not long before the "deep diggins" were found to be far the most profitable. Williams and Lightning creeks have, so far, yielded the greater part of the gold of Cariboo. They were known from the first to be rich, but have been found specially suited for deep work, in having a hard deposit of boulder-clay beneath the beds of the present water-course, which prevents the access of much of the superficial water to the workings below. By regular mining operations the rocky bottom of the valley is followed beneath 50 to 150 feet of overlying clays and gravels, the course of the ancient stream being traceable by the polished rocks of its bed, and the coarse gravel and boulders which have filled its channel. In the hollow of the rocky channel the richest "lead" of gold is usually found, but in following the rock-surface laterally, side-ground, rich enough to pay well, is generally discovered for a greater or less width. The old stream-courses of the Cariboo district are found to have pursued very much the same directions that their present representatives follow, crossing often from side to side of the valley with different flexures, and occasionally running through below a point of drift material projecting

into the modern channel, but never, I believe, actually leaving the old valley or running across the modern drainage system, as is so often the case in the deep placers of California and Australia.

The most important deep work was carried out in the old pre-glacial and buried channels of Williams and Lightning creeks, where it has now practically almost ceased. As the methods employed are, however, of interest in illustration of the mode of occurrence of the richer gold deposits, and may yet be applied to other valleys even in this district, the following description is included. It will serve as a general description of this class of mining, and is substantially the same with that given in the previous publication on the mines of British Columbia, and refers particularly to the work in progress at the time of my visit to Cariboo in 1876.

To reach the buried channel, on which it is generally impossible to sink directly through the superposed loose and watery materials, a shaft is usually sunk at the lower or down-stream end of the claim, on the sloping side of the valley, where, after having gone through a moderate depth of clay or gravel, the slaty rock of the district is reached. The shaft is then continued through this till a depth supposed to be sufficient is attained, when a drift is started at right angles to the course of the valley, and if the right depth has been chosen—either by rough estimation, or calculation based on that required in other neighbouring workings—the old channel is struck in such a way as to enable the subterranean water collecting in it from the whole upper part of the claim, to be pumped to the surface by the shaft. On driving out of the slate rock, however, into the gravel, so much water is frequently met with that the pumps are mastered, rendering necessary a cessation of work till the latter part of the season, or the application of more powerful machinery. When the drift is not found to be at a sufficient depth to cut the bottom of the old channel it is generally necessary to close it, and, after continuing the shaft to a greater depth, to drive out again.

The old channel once reached, and cleared of water, is followed up its slope by the workings, to the upper part of the claim, and where paying side-ground occurs this is also opened.

The richest pay is generally obtained in the actual channel of the old stream, but where this is much contracted the force of the water is often found to have swept the gold away to those places where its width is greater. The harder rocks still preserve their polished and water-worn forms, but most of the slates are rotten and crumbling to a considerable depth, and in cleaning up in the bottom, a thickness of one to two feet is frequently taken out with the pick and shovel, and sent up to the surface with the overlying gravel, for treatment. In the side-work, as in the central channel, the greater part of the gold is found lying directly on the bed-rock, though, in some cases, particularly on Williams Creek, paying layers occur in the gravel several feet above it. The side-ground is worked up from the channel in succesive breasts parallel to it. The lowest layers of gravel generally contain many large boulders of quartz and slaty fragments not much water-worn, which must have come down from the hill-sides; the appearance being that of deposit by torrential waters to a depth of four to six feet in the channel, above which the gravel is generally better rounded, and more evenly spread, though still mixed with clayey matter.

In consequence of the unconsolidated nature of the gravel, the pressure on the supports of the workings is often excessive. The sets of timber are, in some places, only a few inches apart, and the whole of the workings have, in some cases, to be lined with complete lagging. The timber used is usually massive, being from one to two feet in average thickness, and consisting of the spruce of the country, simply barked and sawn into lengths. Its cost delivered at the mine at the date mentioned was eight cents per running foot, all suitable sizes being taken at the same rate. The lagging, which is merely split out, four feet long, five inches wide, and two thick, cost $7.00 a 100 pieces. With every precaution, the timbers are frequently crushed by the pressure, or the uprights even forced downward into the slate. Where large boulders are removed from the sides, or 'slum' is found, spruce brush requires to be extensively used behind the lagging, and in many places the water streams from the roof like a heavy shower of rain. The whole of such deep workings were, as a rule, annually filled with water at the time of the spring floods, and it was sometimes not till late in the summer or autumn that the pumps again acquired the mastery.

The following are particulars referring to the Van Winkle mine on Lightning Creek, which was the most successful in operation at the time of my visit in 1876:—

The claim covered about 2,050 feet in length of the valley, the deepest part of the old channel of which had been cleared out to a length of between 1,600 to 1,700 feet in October of 1876. Much side-ground, however, yet remained, and the workings sometimes attained a width of from 200 to 300 feet in following this up as far as it could be made to pay. The claim yielded the first dividend in December, 1873, $40,000 having been expended before gold was reached in the channel. It afterwards paid handsomely, having produced in one week gold worth $15,700, and on other occasions at the weekly 'clean-up,' sums of $14,000, $12,000, etc. At the date above mentioned the total product of gold had amounted to the large sum of $500,965.

In the Van Winkle mine the average depth of the workings was about seventy feet only, the lowest shaft being placed 300 feet from the stream, on the opposite side of which the rock rises to the surface, forming steep cliffs. The water was raised to within forty feet of the surface, when it was discharged into an adit 3,000 feet long, which was also used by other claims. There were two pumps, ten inches in diameter, the power being supplied by an eighteen-foot breast-wheel. This did not, however, represent the total volume of water pumped, as the ground of this claim was partly drained by others lower in the series, in which work could not be carried on till late in the season. In October of 1876 the following companies on Lightning Creek were driving their pumps day and night, the Van Winkle being the only mine clear of water:—

Costello Claim.—Pump, twelve inches diameter, nine-foot stroke, making ten strokes a minute.

Vulcan Claim.—Pump, twelve inches diameter, six-foot stroke, making eighteen strokes a minute.

Vancouver Claim.—Pump, twelve inches diameter, nine-foot stroke, making ten strokes a minute (double acting).

Van Winkle Claim.—Pumps, ten inches diameter, fourteen-foot stroke, making ten strokes a minute (two pumps).

The quantity of water being raised at this time would, therefore, amount to about 13,870 gallons a minute, or 19,874,000 per diem.

In many cases the machinery and appointments used in mining on the deep channel were very creditable, and almost the whole of this work was paid for by the miners of the district itself. Money gained in one enterprise was usually invested in another, and the shareholders in a mine were frequently to be found themselves at work in it. On Lightning Creek the old deep channel has been followed and worked out to a length of about 16,000 feet in all, and in addition a number of rich bench claims and tributary creeks have yielded good returns. In endeavoring to "bottom" the old channel further down the valley very great difficulty is encountered in consequence of the quantity of water and the increased depth of the sinking required. The Eleven of England is the lowest claim in which the old channel has been reached, and though evidence was here found in the finer character of the gold, of increasing distance from the main sources of supply it is probable that still lower portions of the valley may be proved to pay with improved facilities.

It is impossible to present complete returns of the amount of gold obtained from the old bed of Lightning Creek, but the following approximate statement to November 1st, 1875, published in the report of the Minister of Mines of British Columbia for 1875, is still of interest in showing how large this amount, in the aggregate, must have been. The claims are here arranged in their order following down the creek:—

Campbell and Whitehall	$ 200,000
Dutch and Siegel (now Perseverance)	130,000
Dunbar	30,000
Lightning	153,962
Discovery and Butcher	120,000
South Wells	141,531
Spruce	99,908
Point	136,625
Van Winkle	363,983
Victoria	451,642
Vancouver	274,190
Vulcan	56,955
Costello	20,476

It would probably not be an exaggeration to state that the deep channel, for the portion of its length above referred to, with the adjacent side ground worked at the same time, has yielded throughout gold to the value of over $200 to the running foot.

On Williams Creek, on which the towns of Baskerville and Richfield are situated, the chief workings have been in a space of about two miles and three-quarters in length. In this the deep channel has been worked through, and also as much of the side-ground as would pay at the time at which the mining took place. Many of the lateral creeks and gullies here have paid remarkably well; and the hill-sides, in some places to a height of a hundred feet or more, have proved to be sufficiently rich for the hydraulic method of working, which is now profitably carried on.

Though Williams Creek has produced in the aggregate the greatest amount of gold, Lightning Creek showed for a time a larger annual yield.

The Canon between Barkerville and Richfield divides Williams Creek into two parts. For about half a mile above it the ground was shallow, and has been worked open to the bed rock. Further up deep drifting was practised in former years, and hydraulic work is now carried on. Below "The Canon" all the work has been deep; in the old channel, although "pay-streaks" were sometimes found after getting down about twenty feet, these were usually disregarded in early days. In the Cameron claim, however, half a mile below Barkerville, the dirt paid nearly to the surface, and was worked in stages from below after the old channel had been cleared out. The workings were about sixty feet deep at Barkerville, only thirty-five feet at the former site of Cameronton, and at the Ballarat claim—three-fourths of a mile below Barkerville—eighty feet. This is one of the lowest claims in which the old channel has been bottomed, and most of the gold obtained was light and scaly. The valley is here wide, the present stream turning abruptly to the west, while a wide, low hollow, known as Pleasant Valley, runs off in the opposite direction to Antler Creek. It is supposed by many that the main channel of the ancient water-course turns off in this direction, but, owing to the great quantity of water and loose character of the ground, neither this nor the present valley of Williams Creek below the Ballarat has yet been proved, though much money has been expended in the attempt. The Lane & Kurtz Company went to great expense in importing machinery, and erected very complete works some years ago, but did not succeed in proving their ground, and have since abandoned the attempt. The place at which this work was carried on is known as "The Meadows," the valley here opening out and becoming wide and flat-bottomed. The company held a Concession covering about four miles in length of the valley, but succeeded in reaching a depth of 125 feet only, and in drifting out found that they were still too high for the deep channel, while the volume of water was greater than their pumps could master.

As showing the great local accumulation of gold in the deep channel of Williams Creek, and indicating its local origin, the following approximate statement of the value of gold obtained in various claims, covering certain lengths of the channel, is important. All these claims were below the Canon, but they do not form a consecutive series, no such details being available for many other claims:—

Adams	100	feet	$ 50,000
Steele	80	"	120,000
Diller	50	"	240,000
Cunningham	500	"	270,000
Burns	80	"	140,000
Canadian	120	"	180,000
Neversweat	120	"	100,000
Moffat	50	"	90,000
Tinker	140	"	120,000
Watty	100	"	130,000
	1,340	"	$1,440,000

In Cariboo district, even to the present time, the prices of labour and supplies have never been lowered to a point at which it would be profitable to work any but the richer deposits, which in the nature of things bear a small proportion to those capable of yielding a moderate or small amount of gold; and in working over the deep ground in early days much was left that would even now pay handsomely, but cannot be found or reached on account of the treacherous nature of the moved ground, filled with old timbering and water. On both Williams and Lightning Creeks, but particularly in the former, there must be a great quantity of gold in ground of medium richness even yet. To render this gold available, however, and to prove successfully the lower and more difficult parts of the valleys, greater and more exact engineering knowledge, better and larger machinery, and, above all, cheaper labour and supplies, dependent on greater facilities of transport, such as would result from railway connection are required. The most important works of a general kind, which have so far been carried out in Cariboo District, are the Bed-rock Drain and Bed-rock Flume, on Williams Creek. The first of these is a tunnel which runs through all the old deep workings, beginning at the lower end of the part of the creek called "The Canon" (about 1,000 feet above Barkerville) and running out in "The Meadows." The total length of this tunnel is about one and one-eighth miles, and the cost of its constructfon is estimated at about $100,000. The flume, constructed in 1865, begins about 1,000 feet above the head of the drain, at the upper end of "The Canon." It is a cutting averaging about twenty feet in depth and a mile in length, and is estimated to have cost about $250,000. Into it the small flumes of the various companies working along the creek discharge, and it has also served for the working of the ground belonging to the Flume Company. By means of the free drainage afforded by these works a great part of the later mining has been rendered possible. As an illustration of what might be done in this way, it may be mentioned that it has been suggested that by cutting a flume to Antler Creek—part of which would require to be a tunnel—free drainage of the whole upper part of Williams Creek would be obtained, and, if the grade should prove to be sufficient on survey, it would enable the valley, from its sources to

the flume level, with all its old workings, and the great depth of tailings holding more or less gold which has accumulated, to be completely stripped by extensive hydraulic works.

In the above general notes on Cariboo district, Williams and Lightning Creeks have been particularly referred to as exemplifying the conditions there found, and the methods employed in working the old deep channels.

These two creeks have, besides, yielded by far the greater quantity of the gold, and on them the pre-glacial channels have been found to be continuous, and, though deep, specially well adapted for working. Underground drifting on old channels has, however, been practised, as well as several other creeks, of which Keithly, Harvery, Grouse and Mosquito creeks may be specially mentioned. There are besides a number of creeks which have yielded much gold by surface work or in open sinking of moderate depth, portions of which still remain, which it is confidently believed by miners would prove rich in deep ground if properly explored. Antler, Cunningham and Jack-of-Clubs creeks, with Willow River, are supposed to be specially promising from this point of view, and, though attempts have been made from time to time to test the deep ground on several of these, it has not yet been successfully accomplished. On Antler Creek in particular the Mason Company has been at work with this object for a number of years, and has not yet abandoned the efforts.

Approximate statement of value of gold produced by Cariboo District from 1874 to 1888 :—

1874 (partial)	$ 700,000
1875	1,075,237
1876	646,000
1877	411,402
1878	380,535
1879	500,000
1880	564,000
1881	610,737
1882	471,525
1883	457,787
1884	423,855
1885	347,700
1886	288,300
1887	247,673
1888	250,377

The amounts above assigned to the various years are merely approximate, particularly for the earlier years of the series, the returns for which are extremely imperfect. The table as a whole, however, illustrates the large amount continuously afforded by the Cariboo district from a period beginning more than ten years subsequent to its discovery, and after the most productive years had passed. It also evidences the gradual falling off in yield, which has been nearly continuous since the richer portions of the deep channel of Lightning Creek have been worked over.

The Capelton Chemical and Fertilizer Works.

Leaving Sherbrooke by the 9 a.m. B. & L. train (which, by the way, is not remarkable for rapid transit but, as the genial conductor says, it teaches patience) we proceed towards our destination. Nearing Capelton we see in the distance the extensive chemical works of Messrs. G. H. Nichols & Co. comprising Sulphuric acid, Fertilizer and Smelting works, occupying the site of the old G. W. Brooks' farm-house. We are struck by the practically entire absence of sulphurous gas which is usually seen emanating from establishments of this character. Getting off the train at Capelton station we walk to the spacious offices of the company, only 100 feet away. We notice with pleasure the convenient arrangement and neat finish of these offices. Here we find everything that conduces to health and comfort, combined with excellent facilities for conducting the business of the various departments— characteristic of the regard which the Messrs. Nichols have for the comfort and convenience of their employees in charge of their extensive establishments. Away in the distance up the hill we can just see the towers, smoke-stacks and roofs of the substantial mine-buildings of the company, of which we intend to give our readers a description at some future day.

Accompanied by the Superintendent we gain admittance to the sulphuric acid works. The first building we enter is the burner-shed, where is the handsomest and largest battery of burners of the Melétra-Herreshoff style, in America. Here the green-ore (the product of the Albert mine) is burned ; the fumes, which pass off in the form of sulphurous acid gas going directly into an improved style of Glover tower, the invention of Mr. J. B. F. Herreshoff, A.M., Superintendent of the Laurel Hill chemical works,—the property of the company.

From the Glover, or concentrating tower, the burner gas passes into the great leaden chambers, where all the sulphuric acid is made. In this weak condition it is known as chamber-acid, which, for commercial use, must be further concentrated and purified.

Dr. Lungé says : "The introduction of lead chambers is, by general consent, ascribed to Dr. Roebuck, of Birmingham, who, in 1746, built such a chamber six feet square, and a few years afterwards constructed a factory in order to supply acid for bleaching linen."

At the present day these lead chambers are erected of immense size, some of them having a capacity of one hundred and forty thousand cubic feet. Here, at Capelton, we find a dozen or more of these huge lead chambers, looking like great boxes, formed, top, bottom and sides, of heavy sheet lead, rolled specially for the Messrs. Nichols, and supported by heavy wooden frames.

Sulphuric acid, which, at the close of the eighteenth century, cost for commercial use, in large quantities, upwards of fifteen cents per pound, is now turned out and sold in car-load lots here at Capelton, in quality unexcelled, for about one-ninth of that price.

This is partly due to the fact that up to the last fifty years only brimstone was used (principally from Sicily), while at the present time pyrites forms one of the principal sources of the sulphur used in sulphuric acid manufacture, and partly to the great strides that have been made in the art.

It is conceded by noted European authorities that the appliances used and the methods pursued by the Messrs. Nichols at their factories, represent the most advanced state of the art of sulphuric acid manufacture in the world.

Many of our readers will doubtless ask what is sulphuric acid, and what is it used for in such large quantities ?

To the first question we would answer briefly, and avoiding technical terms, that it is a combination of oxygen, sulphur aud hydrogen.

To the second, we would reply that a few of the most important applications of sulphuric acid, are, for making muriatic acid, soda-ash, bleaching powder, soap, glass, for making superphosphate and other fertilizers, for preparing nitric, phosphoric, hydrofluoric, carbonic, chromic, oxalic, citric, acetic, and other acids. For cleaning sheet iron to be galvanized, for working galvanic cells, for making many organic coloring matters, for purifying many mineral oils, for effervescent drinks, for destroying vegetable fibres in mixed fabrics, for drying air (principally in the laboratory), for making shoe blacking, for dissolving indigo and for numerous other productions. Indeed so largely does this acid enter into the arts and manufactures, that one of England's greatest statesmen, Lord Beaconsfield, better known as Benjamin D'Israeli, has said that the state of a country may be very well judged by the amount of sulphuric acid it consumes.

From the chambers the remaining gases pass into large circular tanks called Gay-Lussac towers after the famous chemist of that name.

In the burner-shed are situated the platinum stills, in which the concentrating of the acid is done. These stills, unique in style, are also the invention of Mr. Herreshoff.

From the stills comes a limpid stream of chemically pure acid, running rapidly, yet one is inclined to think that it is glass, so clear and steady it is, reminding us of its commercial name, "oil of vitriol. From the stills the acid is conveyed in pipes to enormous tanks, where it is stored ready for market.

Immediately west of the burner-shed is the stock room, where acid of different grades is kept, and where the old fashioned carboys and drums are filled ready for shipment.

The favorite method of putting up the acid for transportation is to run it into large tanks on platform cars, thus obviating the expensive handling of a hundred carboys, which are so fragile that, notwithstanding the most improved methods in use and care in packing, breakages occasionally occur.

Adjoining the burner-shed on the east, stand the smelting works, to which the ore from the burners—now deprived of its sulphur—but still containing the copper, is carried by a series of conveyors and elevators of improved design.

The cupola is a Herreshoff water jacketed furnance. By this smelting process the resulting matte carries about fifty per cent. of copper ; the other principal constituents being iron and sulphur. This matte or regulus, is at present shipped to Great Britain, where it is made into ingot copper. The furnance above referred to, is compact, symmetrical, and very efficient. At night the smelting works possess peculiar attractions. As the steady stream of molten slag pours over into the iron pots placed to receive it, it casts a ruddy glow on the faces and brawny arms of the workmen and the whole building is aglow with the same enchanting light. Presently we hear the furnace men cry out "copper !" This is the signal for a few minutes of exciting work. It means that the copper matte has collected in the well or fore hearth to that height at which it is drawn off. One of the workmen dons a heavy leather coat to protect him from the sparks and tiny pieces of melted matte that dance and fly in all directions on coming in contact with the least moisture. Two other men seize heavy sledges, while a third snatches up the tapping-steel, which he holds against the clay that keeps back the metal, while the men with hammers drive in the steel ; a fifth man runs back to a large iron pot to receive the matte, as it belches forth in an incandescent stream, sending sparks in all directions.

The "slag," or dross (the principal constituents of which are, iron, silica and alumina), runs from another outlet into large iron pots called buggies, and is wheeled away out of the building, where it is dumped in the molten state, solidifying as it cools, into one compact concrete light mass.

A few hundred feet south from the Chemical Works, close to the main line of B. & L. Railway, stand the Fertilizer Works, where are compounded the several grades of complete plant food, so well and favourable known to our farmers. One of the principal ingredients, the phosphate of lime, or apatite, is brought here from the North Star mine in the Buckingham district, Que. Here it is first dried, and ground in a large Griffin mill, an ingenious machine in which centrifugal force and rotary motion combined, are utilized. The apatite, after it has been ground to an almost impalpable powder, is conveyed by machinery to another part of the buildings, where it is treated with sulphuric acid. This process renders available a very high percentage of phosphoric acid. To this acid-phosphate are added the other chemicals that conduce to the growth of plants as may be required to adapt the complete manure to different soils. After passing through various mills and mixing machines, it is put up in sacks of 200 lbs. each, neatly branded.

The machinery, which is of the most improved design in this building, is admirably adapted to the work.

So thoroughly satisfied are agriculturists who have used the manures made here, that it is quite unnecessary for us to extol the merits of any of them.

Having now "done" the establishment, we stop for a moment to get an adequate idea of the proportion of the business of these chemical works.

Few of our readers know how important that little post village, Capelton, is ; and to give a rough idea of the huge scale on which operations are carried on there we will put down some figures.

In the construction of the buildings, which are well designed and thoroughly substantial, upwards of three-quarters of a million feet of lumber were used.

The floor space in the various departments amounts to upwards of two acres.

All the buildings are clapboarded and painted.

The surface painted amounts to over one and one-half. The lead-work which we have described comprises about 500 tons of this metal.

The company are now doubling their capacity, but already their acid works are three times as large as anything of the kind in the Domlnion, and their capacity is sufficient to supply the demands of this now rapidly developing country.

Only three years ago the site on which these works are erected was almost a mudhole, and to-day it is the scene of one of the greatest and most important industries in Canada.

Messrs. G. H. Nichols & Co. are, and have for some years, been the leading manufacturers of sulphuric acid in America, and their works at Laurel Hill, Long Island, N.J., are the largest and most complete of the kind on the continent.

Masonry Supports in the Tilly-Foster Iron Mine.

Mr. L.G. Engel has published a very elaborate paper on this subject. The method of working the deposit, he states, was formerly by stalls driven along it, with pillars left to support the roof ; but a cave occurred, compelling the adoption of a new system of mining. At intervals of 100 feet levels are driven from the shaft completely round the ore body, with the foot or hanging wall forming one side of the level. Stalls are driven through between the level at the foot wall and the level at the hanging wall, and they are then raised until they are within 25 feet of the level above. The hanging wall is 80 to 160 feet from the foot wall, and is supported by pillars representing 75 per cent. of the deposit. The plan adopted to support the hanging wall, while the pillars are being removed, is that of building with concrete raised on arches thrown from the wall, to an extent sufficient for the support of the hanging wall. The severity of the frost in winter will not permit concrete to be made at the surface. The concrete consequently is mixed underground and raised to its position when the arches are built. The first arch built had a span of 90 feet, with a rise of 15 feet. It was built of brick and made 3 feet in depth. A shaft is left in the arch and concrete above, through which materials are raised by steam power from the mechanical mixer placed under the arch. In order to avoid the interference with the workings of ore in the lower levels, the first pillars were built above the 300 foot or highest level off the shaft ; but a continuous pillar will afterwards be raised from the 500 foot level up under one already built, thus forming a solid mass of concrete 300 feet in depth, and 1,700 feet in horizontal sectional area over an arch at the 500 foot level. The estimated cost amounts to 46 cents per ton of ore recovered.

The new Dressing-Works of the St. Joseph Lead Company, at Bonne Terre, Missouri.*

By H. S. Munroe, School of Mines, New York City.

The dressing-works of the St. Joseph Lead Company were destroyed by fire, February 26th, 1883. Within about four months, or on July 5th, 1883, the new mill, with a capacity of 500 tons per day, was built and in active operation. The capacity of the new mill has since been increased to 800 tons per day.

The old mill was built in 1867, by Mr. C. B. Parsons, the present superintendent. It was a curious rambling old structure, which had grown with the demands of the business; a few jigs having been added in one place, a table or two in another and wings and sheds added to the main buildings, from time to time as it was found necessary to increase the efficiency or the capacity of the mill. The old mill was, moreover, a most interesting place to the student, a perfect "museum of ore-dressing." Nearly every form of dressing apparatus known to the art had, at one time or another, found a place under its roof, jigs of many kinds, concave, convex, side-bump and stationary tables, tyes, buddles, dolly-tubs, etc , etc. The method of dressing followed in the main the lines of English practice, but with many modifications, both in the machinery and the methods of working, due to the inventive genius of Mr. Parsons. At one time, however, the mill was surrendered to a German expert, of acknowledged ability, and the Continental system of dresstng was given a fair trial, with its numerous sizing-drums and jigs with varying speed and stroke adapted to each ore-class. Different forms of crushing apparatus were tried and the best method of handling the ore and the different products of the mill, was carefully worked out.

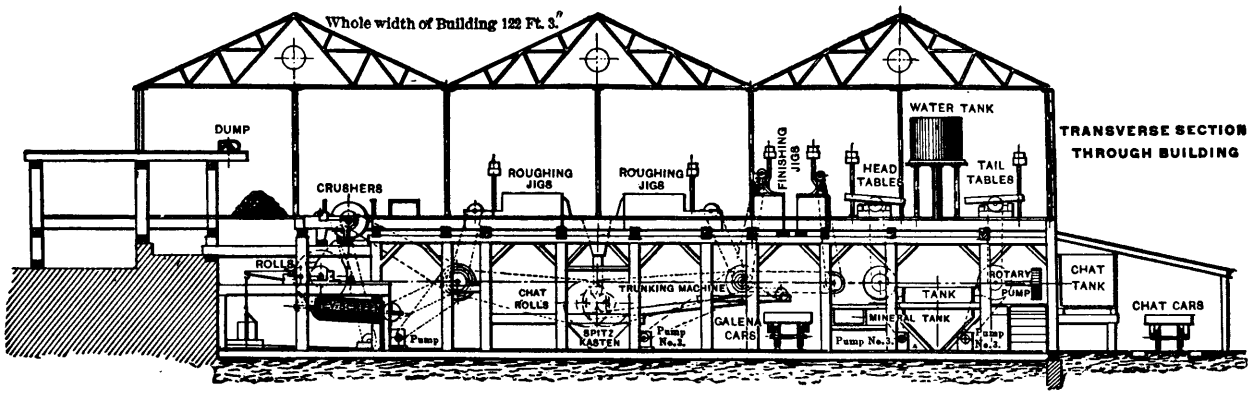
The new mill represents, then, the results of fifteen years' study and experiment in the old structure, and is a shining example of the "survival of the fittest" both in apparatus and in methods of treatment.

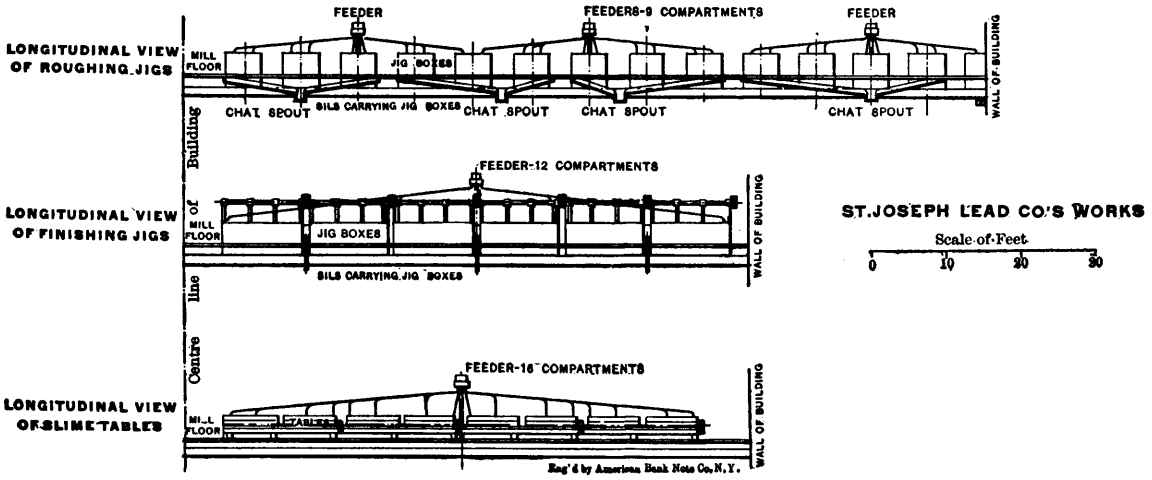
The salient features of the new mill are: first, the method of treatment, which follows English rather than German precedents; second, the dressing apparatus, which has many novel features; and third the construction and arrangement, and the methods of handling the ore and mill-products, which are quite unique.

The work of dressing is carried on at Bonne Terre under special difficulties. For many years the only water-supply has been the rainfall of a basin about a square mile in area, the water being collected and stored in a reservoir formed by a dam across the little valley. The water is used over and over again, the portion heavily charged with slime being allowed to escape into a small settling pond, from which it is again pumped into the mill. The only water lost is that carried off in the wet sand and that lost by evaporation. This loss is made good by drawing small quantities from time to time from the reservoir.

The disposal of the waste sands or "chats" is also a matter of some difficulty. Until recently the company had no dumping ground available near the mill, which fact, with the lack of water, made it impossible to run off the sand by launders in the usual way. Resort therefore was had to the plan of carrying off the sands in railroad cars designed for the purpose. In the old mill these cars were loaded by bucket-elevators, but in the new mill special "chat" tanks have been introduced for the purpose. The water which drains from the cars runs into the settling-pond and is saved. The "chats" are used for grading, for railroad embankments and ballast, and recently in the construction of a new dam made necessary by the undermining of the old reservoir. The bulk of the sands are dumped in the valley above the dam, so that the water which they still retain drains out and eventually finds its way into the reservoir. By a recent consolidation, these disadvantages have been removed in part. The company now owns a large pumping-plant on Big river, about three miles away, and only the additional water-supply so gained has made it possible to continue work through the severe drought of the past season. A more convenient dumping-ground for the waste sands, also has been secured.

PLATE II.





The ore is galena, associated with some iron pyrites carrying traces of nickel and cobalt. The mineral is disseminated in a magnesian limestone in irregular segregated deposits of large size. Formerly it was supposed that these deposits occurred in definite "ranges" and at certain horizons only, but further exploration with the diamond drill has proved the existence of ore-bodies over the whole area prospected, nearly a square mile, and through a thickness of over three hundred feet of limestone. The deposit is worked by enormous chamber-workings, supported at intervals by heavy pillars. Underhand stoping is employed and the ground is broken with machine-drills and high explosives. Formerly small diamond drills were used for boring the blast-holes, and very deep holes, thirty feet and more, and heavy charges of explosive were employed. The recent advance in the price of diamonds has made necessary the introduction of percussion-drills; and the excessive amount of block-holing, incident to the large blasts, has caused the employment of blast-holes of more moderate depth. Owing to the large size of the workings, the cost of breaking ground is quite low. The rock is loaded in small iron cars, hauled by mules, and brought to the surface through vertical shafts.

The main shaft is close to the mill, and the cars are run by the launders into the dumping-cradles above the crushers. The minecars from the more distant shaft are brought to the mill on special platform cars by switching-engines. These platform cars hold twenty mine-cars each and there is a sufficient number of them to avoid delay.

Outline of Method of Treatment.

The method of treatment may be outlined as follows: The ore is crushed by jaw-crushers and rolls, and screened dry through a 6 mm. screen. The sands passing through the screen are thoroughly mixed with water and elevated by centrifugal pumps to distributors and divided among the Parsons jigs, without any previous sizing or classification. The tails ("chats") after passing over the two sieves of these jigs receive no further treatment, and are conveyed by launders to the "chat-tanks." Coarse galena and raggings are skimmed by hand from the jigs at intervals, leaving always a sufficient bed to ensure good hutchwork. The hutchwork which comes through the sieves of the Parsons jigs pass through a series of spitzkasten. The heavy galena, mixed with some sand and slime, settles in the first box of the series from which it is fed to a trunkingmachine. The pure galena from this machine falls into railroad cars and goes to the smelting-works. The tails from the trunking-machine, together with the sands settling in the second box of the spitzkasten, are elevated by centrifugal pumps and divided between the Hartz three-sieved jig. The tails of the Hartz jigs receive no further treatment, going directly to the chat tanks. Galena and pyrites are skimmed from the sieves of these jigs. A bed of galena is, however, maintained on all three sieves so as to ensure a rich hutchwork. The hutchwork of these finishing-jigs is nearly pure galena, and goes to galena-boxes on the lower floor, which are emptied from time to time, and the galena loaded on cars to go to the smelting-works.

The fine slimes settling in the third and fourth boxes of the spitzkasten are united and raised by centrifugal pumps to the distributors feeding the first row of Parsons Rittinger tables. The middlings from these tables are treated on the second row of tables. The tails from all the tables flow into the chat tanks, and the heads run into galena-boxes on the lower floor from which they are loaded into cars.

The raggings, containing from 12 to 20 per cent. of lead, which are skimmed from the Parsons jigs, are recrushed by fine rolls and elevated without screening to a line of Hartz three-sieved jigs. These raggings contain considerable pyrites.

Arrangement of the Mill

Plate I. gives a general plan of the mill and Plate II. a transverse section. The mill is a two-story structure. On the main floor are the ore-bins, the roughing-jigs, the finishing-jigs, andthe tables. All the work requiring abundance of light and careful supervision is concentrated

on this floor. The entire absence of overhead machinery, screens, shafting and belting, classifying-tanks and launders is very noticible. There is nothing to intercept the light falling on the jigs and tables, and the whole floor is so open that supervision is rendered much more effective. The roof is a mere umbrella of corrugated iron, with light iron trusses and supported on slender columns. All the heavy weights and jarring machinery are as near the ground as possible. The roll screens, centrifugals, pumps, spitzkasten, chat-tanks and galena-boxes are on the lower floor near the ground. The shafting, gearing, pulleys and belting are all below the main floor.

This arrangement has many advantages. It is cheap; the heavy framing being confined to one story. It is strong and durable; the jar of the moving machinery, crushers, jigs, and tables having but little effect on such a low, flat and strongly-braced structure. All the classifying-and settling-tanks, with the enormous weight of water which they contain, rest directly on the ground. Finally, the absence of overhead machinery and apparatus, besides increasing the light and facilitating superintendence, lessens materially the risk from fire, there being absolutely nothing to burn above the main floor of the mill.

The main disadvantage attending the arrangement of the mill in two floors, as described, is the necessity for elevating the material to be treated several times. This is accomplished, at Bonne Terre, by the use of centrifugal pumps by which the sands are elevated *with the feed-water* required for the proper working of the various jigs and tables. It should not be overlooked, however, that the bulk of the material is elevated but once. After passing over the roughing-jigs, 600 tons of waste sand go at once to the chat tanks. Of the remaining 200 tons, 74 tons are mineral and raggings, and 20 tons escape with the overflow of the spitkasten, leaving only 106 tons to be elevated again. The average lift of the 800 tons raised by the centrifugal pumps, including that which has to be elevated a second time, is less than thirty feet. If a mill of several stories like an anthracite breaker, or one arranged in steps or terraces like the Lake Superior mills, had been built at Bonne Terre, it would have been necessary to deliver the ore at a level at least forty feet higher than at present, involving a much more expensive building, and increased cost of hoisting, forty feet instead of thirty, for the whole 800 tons, merely to save the elevating of 100 tons a second time.

Again, if the mill had been built in several stories both the wash-water and feed-water for the different machines would have to be raised about twenty feet higher than at present, and as twenty-nine tons of water are required to treat one ton of ore, this additional lift would be a serious matter.

In round numbers the saving by the present arrangement amounts to about 520,000 foot-pounds per day, or over 20 horse-power.

Lighting of the Mill.

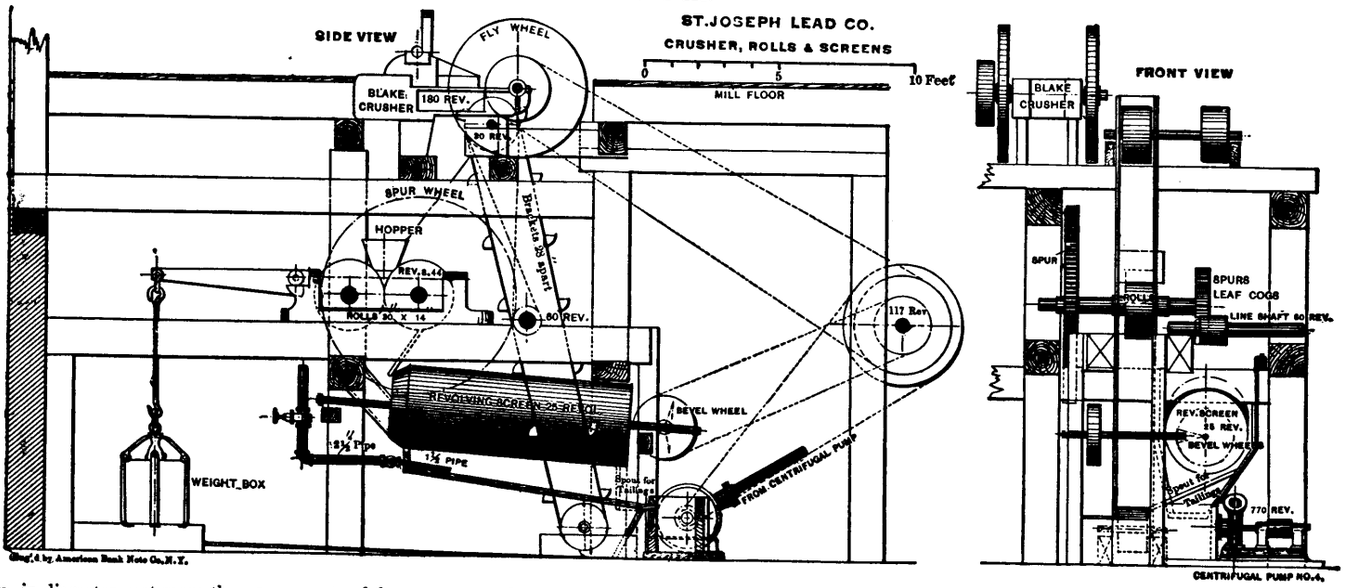
The mill is lighted by numerous large windows in the side walls, and by nearly one hundred large sky-lights of heavy glass inserted in the roof. At night the necessary light is furnished by numerous incandescent electric-lamps, those near the feeding platforms, which are liable to be struck by flying bits of ore, being protected by heavy wire-cloth.

Crushing of Ore.

There are tens sets of crushing and screening apparatus in the mill, each crushing about 80 tons in twenty-four hours, consisting of a 7" x 15" Blake crusher, lever pattern, with corrugated jaws; a pair of Cornish rolls, 14" x 30", with chilled tires; a revolving screen, 3 feet diameter by 8 feet long, with 6 mm. perforated steel-plates, a bucket-elevator for the material coarser than 6mm., and a centrifugal pump.

The jaw crushers are set to crush to about 38 mm., or 1½ inches, and the rolls to crush to about 16 mm., or ⅝ inch. Of the material passing through the rolls at any time, about one-third is too coarse to pass through the screen, consequently the ore passes through the rolls one and a half times. While the perforations of the screens

PLATE III.



are 6 mm. in diameter, not more than 2 per cent. of the screened product is coarser than 4 mm.

The crushers are fed by hand, one man to each machine. Care is taken to have the feeding regular, as on this depends the amount of material going over the jigs, tables, etc., which must be kept uniform.

Some interesting data were obtained as to the fineness of the ore at different stages of crushing, samples having been sifted through sieves of different mesh and the percentage of each size computed.

Size.	Average of Ore from Mine.	Product of Blake Crusher, crushing		Product of Rolls.	Screen'd Ore Average
		Rich Lumps.	Lean Nut Ore		
Above 38 mm.	61.3	.....	.....	.....	.....
16 mm. to 38 mm.	23.2	67.7	75.2	.....	.....
4 mm. to 16 mm.	7.5	20.7	18.9	.....	.....
1 mm. to 4 mm.	4.9	8.6	4.4	35.2	2.0
¼ mm. to 1 mm.	1.6	.8	.4	64.8	41.0
Below ¼ mm.	1.5	2.2	1.1		27.0
	100.0	100.0	100.0	100.0	100 0

It will be seen that of the ore coming from the mine, nearly 40 per cent. is as fine as if it had passed through the jaw-crushers, 15.5 per cent. is as fine though it had passed through the rolls, and 8 per cent. is fine enough for the jigs. This latter portion is very rich, containing over 20 per cent. of lead, while the average richness of the ore is about 8 per cent.

Two experiments were made with the Blake crusher; the first with large lumps of rich ore, the crushing of which should give a maximum of fine stuff; and the second with small pieces of lean ore, which should yield a minimum of fine stuff. The jaws were set to crush to 38 mm. or 1½ inches. About one-third the product in first case, and one-quarter in the other was as fine as though it had passed through the rolls. But little fine stuff, less than 1 mm., was made in either case.

The figures in the last column show the average composition of the crushed ore after it has passed through the 6 mm. screen, and as it goes to the jigs. It will be seen that the rolls produce a large proportion of fine stuff. The losses in the treatment of this fine stuff are very great. Its production could, perhaps, be lessened somewhat by some changes in the arrangement of the crushing machinery, but it is evident that some better form of crushing-apparatus than rolls, is urgently needed for such fine comminution as is required at these works.

Of the 30 per cent. of stuff, less than ¼ mm., there is produced:

In the mine	1.6 per cent.
By the crushers	.8 per cent.
By the rolls,	27.6 per cent.
Total (as above)	30.0 per cent.

The experiment of using coarser screens than 6 mm. has been tried without success, the losses from included mineral being much larger. It is proposed to make a trial of othe forms of crushing-apparatus, the results of which will be of great interest. Since a machine for fine crushing, that will produce a minimum of slime, of large capacity and economical, is much needed, a promising field is open to inventors.

In crushing 224,203 tons of rock in 1886--1887, an average of 8 sets of crushing apparatus being in operation, the following new parts were required:

For the crushers:	
12 levers at $25.00	$300.00
9 jaw-plates at $15.00	139.50
12 jaw-plates at $12.00	144.00
Toggles, check-plates and sundries	247.80
Total	$831.30

or an average of about $100 for each crusher. This does not include the cost of babbitting the bearings nor labor in making repairs.

For the rolls:	
7 pairs tires at $120.00	$ 840.00
Gear-wheels and pinions	335.00
Total	$1,175.00

or about $147 for each pair of rolls. The tires of the rolls used for coarse crushing are not turned when worn, but are replaced by new ones. The tires of the fine rolls are kept in good condition.

For the screens, 21 sets of perforated plates at $60.75, equal to $1,275.75, were required, or an average of 2.6 sets per year for each screen.

The average life of the wearing parts of a jaw-crusher is therefore about 8 months; each set of chilled tires on the rolls lasts about a year; and a set of screen plates about 4 months.

Centrifugal Pumps.

The centrifugal pumps, used for elevating water and sand together, are made under the Heald & Cisco patents, by the Morris Machine Works, Baldwinsville, New York. They are made somewhat heavier than for ordinary work, the metal in the pan, for example, being ¼ inch thick. No attempt is made to repair the pumps. Usually the pan and shell are worn out in about the same time. The work of replacing an old pump by a new one takes an hour to an hour and a half. When the centrifugal pumps were first used for pumping coarse sands, a new pump lasted about three weeks, but by increasing the thickness of the wearing parts the life has been prolonged. It is possible that by lining the pumps with rubber, as is sometimes done in the case of centrifugal machines of the type used for dredging, the pumps might be made still more durable. The average life of one of these pumps is 100 days.

The smaller pumps (3-inch) used for elevating the fine sands and slimes last much longer.

An incidental advantage from the use of centrifugal pumps is the very thorough mixing of water and sand, a matter of some importance, because the ore is crushed and screened dry and only mixed with water just before entering the pump. By this thorough mixing the percentage of float-mineral is undoubtedly diminished.

The sand and water is conveyed to the distributors feeding the jigs by 4-inch extra heavy gas pipe, which lasts about two years. Any change in direction is made by bending the pipe with as long and gentle a curvature as possible. The 3-inch pipes, conveying the fine sands and slimes, have been in use over four years, or since the building of the new mill, and are apparently still in good condition.

The Parsons Feeder.

A simple and effective device, shown on Plates IV. and V., is used to sub-divide the sands or slimes, elevated by a single pump, among a number of machines, jigs or tables. A satisfactory method of doing this, so as to secure an equal and uniform distribution, without any concentration or classification of the sands on one machine at the expense of the others, has been for a long time a great desideratum in dressing works. The ingenuity of Mr. Parsons has furnished a very satisfactory solution of this difficult problem. The feeder or distributor is a casting at the top of the pipe from the centrifugal pump, divided by partitions into a number of radial boxes, which surround the delivery pipe and are connected therewith by vertical slots of uniform size. By increasing the number of radial partitions the streams of sand or slime can be sub-divided to any desired extent. From the bottom of each of these boxes a pipe conveys the sand or slime to the jig or table.

When it is necessary to shut off the supply temporarily from one jig or table, its box in the distributor is filled and the opening closed with a piece of cloth, which for convenience in handling, is fastened to an iron rod with a loop-shaped handle. The distributors are made of cast iron, and are quite durable. Those now in use have required no repairs since the mill was built, 4½ years ago. The pipes leading from the distributors to the jigs must be renewed occasionally.

Roughing-Jigs.

Plate IV. shows the details of the Parsons jig, used for the preliminary jigging. It is a two-sieve under-piston jig, each sieve 24" x 39" (or 22" x 27" in the clear.) The piston is vertical 15½" in diameter, and moves in a short horizontal cylinder, 4½" long in the partition between the two jig-boxes. The piston-rod is horizontal and enters through the stuffing-box. For convenience the jigs are made double, *i.e.*, four sieves or two jigs, are united in one machine. One great advantage of this form of jig is the small floor space occupied by a large number of machines, the whole area of the jig-box being available for jigging. The stroke of the piston is 2 inches, and the number of strokes per minute one hundred and fifty. The quantity of under-water required is about two cubic feet or 16 gallons per minute. The consumption of feed-water is 16 to 18 gallons per minute, containing about 13 pounds of sand (dry weight). There are nine jigs, 4½ machines, for each set of crushing apparatus. Each jig treats, therefore, about 9 tons per 24 hours, or less than one-third the capacity of a jig of equal area according to data given by Rittinger, so that the mill has ample jig capacity.

In the Lake Superior copper mills the tendency, of late years, has been to increase the number of jigs, in the attempt to lessen the losses in the tailings. The St. Joe mill has, however, a larger jig capacity, in proportion to the rock crushed, than any of the Lake Superior mills. For the treatment of 800 tons of material per 24 hours there are 252 jig-sieves. The best equipped mill in the Lake Superior region would have on the same basis, but 224 sieves. The rough sands at the St. Joe mill are divided between 90 sieves, or 9 tons per 24 hours to each. In the Lake Superior mill alluded to there would be but 60 sieves for the same mill capacity. At Lake Superior, however, about 45 per cent. of the ore is separated in the classifyers as slime, and goes directly to the tables. This reduces the average amount of sand treated on each jig to 7½ tons per 24 hours. On the other hand, the sands are very unequally divided, so that some of the jigs treat over 10 tons per 24 hours, and others as little as 5 tons. These latter jigs treat very fine stuff, and at 5 tons per 24 hours are really worked to their full capacity. The loss on these jigs is fully as large as on the coarse jigs, notwithstanding the greater fineness of the material, and the smaller quantity of included copper present.

Experiments made by the writer, about two years ago, at one of the Lake Superior mills, seemed to indicate that the capacity of the mill could be increased fully 50 per cent., and this without increasing the losses, simply by making but two grades of sand in the classifyers instead of four. The practice at the St. Joe mill, when no attempt is made to classify the material before jigging, and when, consequently, sands and slimes are treated together on the same jigs, represents a further and extreme step in the same direction. The results obtained by this novel procedure are opposed to our preconceived ideas and accepted theories on the subject of jigging, and the St. Joe practice is certain to have important influence in modifying jigging methods in the future. The results obtained, it is true, are not wholly satisfactory, the loss of galena in the very finest slimes being large. In other respects, however, the method has many advantages, and the loss in the fine stuff can be brought within reasonable limits by simple modifications in the methods of treatment, which will be discussed further on.

During the past year the writer has had the opportunity of studying very carefully the working of these jigs. A large number of samples were taken, and several hundred assays made under his direction. In order to determine the action of the jigs on the coarse and fine grades of sand and slime, samples of the material treated, of the tailings, and of the hutchwork were subdivided by sifting, and the different portions assayed separately. From the results of the sifting and from other data, it was possible to estimate the proportion of sand and slime of different grades passing through the jig-sieves into the hutch-work, and the proportion of each size which passed over the sieve and into the tailings under different conditions.

The following table contains typical assays of the material treated and of the products of jigging :—

Size.	Percentage of sand of each size.	Lead in Ore. Per cent.	Lead in Hutchwork Per cent.	Lead in Raggings. Per cent.	Lead in Tails. Per cent.
1 mm. to 6 mm.....	41.1	6.32	....	16.20	1.06
¼ mm. to 1 mm.....	29.6	9.10	74.0	7.97	.96
⅛ mm. to ¼ mm.....	9.3	13.81	19.2	....	.71
1-12 mm. to ⅛ mm..	1.5	12.93	14.8	....	1.09
1-20 mm. to 1-12 mm	2.2	7.84	8.8	....	1.74
Below 1-20 mm.....	16.3	12.22	16.4	....	6.07
Average.....	100.0	8.93	22.3	16.54	1.53

From the assays of the different portions of the ore it will be seen that the stuff less than ¼ mm. is richer than the average, while the portions coarser than ¼ mm. are poorer. This is due to the friability of the galena, which is crushed finer than the gangue.

The hutchwork is quite poor, containing but 22.3 per cent. of lead. This is due to the large proportion of partially concentrated fine stuff, less than ⅛ mm., about two-thirds of which passes into the hutchwork. This fine stuff is separated by the trunking-machine and the pointed-boxes, and concentrated on the finishing-jigs and tables.

The assays of the several portions of the jig-tailings show very closely the limits within which the jigs are doing good work. It will be seen that the amount of lead in the tailings decreases with the fineness of the sands down to ⅛ mm. A careful examination of these coarser sands will fail to show any free mineral, the lead being present as included galena. The finer the comminution the smaller the amount of such included mineral, and consequently the poorer the sands. Below ⅛ mm. the tailings increase in richness, which is due to the presence of free galena. The loss from this cause is not serious, save in the portion finer than $\frac{1}{16}$ mm.

It will be seen that the plan of jigging sands and slimes together, makes it possible to treat very much finer material with success than has heretofore been supposed possible. The limit for successful work on jigs is generally placed at about 1 mm. The successful jigging of stuff ⅛ mm. and less, marks a decided advance in the art of dressing. The coarse grains form the interstitial channels* in which this very fine stuff can be concentrated. It is well known that any attempt to treat stuff finer than 1 mm. by itself results in a very imperfect working of the jigs, the losses being large, and the capacity of the jigs small.

The great advantage of this system of jigging is the large proportion of sands successfully treated and finally disposed of by the roughing-jigs alone. Out of 800 tons per day, only 136 tons require further treatment, viz., 30 tons raggings, crushed and treated on the three-sieve jigs, 66 tons fine sand, also treated on three-sieve jigs, and 40 tons of slimes treated on the side-bump tables.

The sole disadvantage lies in the difficulty of forcing all the very finest slimes to go through the jig-sieves. Under normal conditions about 40 per cent. of the stuff below $\frac{1}{16}$ mm. passes off with the tailings. Even this very fine stuff is somewhat impoverished by the action of the jigs, and of that which escapes, a very large proportion is too fine to be saved by any form of apparatus, so that the final loss from this cause is not as serious as might at first appear.

The jigs are run with a long stroke, and with as little feed-water and under-water as possible, in order to carry the larger proportion of the fine stuff through the jig-sieve.

It is possible, by lessening the amount of feed-water and under-water, to cause a larger proportion of this fine stuff to pass through the jig-sieve, but at the expense of forcing through, at the same time, much coarser materia, and thus sending to the finishing-jigs material that can be treated successfully on the roughing-jigs. The following table shows the effect of reducing the amount of water used in jigging, the percentage of hutchwork and tailings with the normal and with reduced quantities of feed-water and under-water being placed side by side for the different sizes :—

	Above ¼ mm.		⅛ to ¼ mm.		1-20 to ⅛ mm.		Below 1-20 mm.	
	Normal.	Reduced.	Normal.	Reduced.	Normal.	Reduced.	Normal.	Reduced.
Hutchwork.....	26	39	68	94	67	93	60	83
Tailings.....	74	61	32	6	33	7	40	17
	100	100	100	100	100	100	100	100

It will be seen that in each case the maximum percentages of sand pass through the sieve between $\frac{1}{16}$ and ⅛ mm., and between ⅛ and ¼ mm. This indicates that the grain of maximum velocity is about ⅛ mm. in size. This agrees closely with the size called for by theory. The theoretical limit* of successful work on these jigs is therefore about $\frac{1}{16}$ mm.

It would be possible to classify the sands before jigging and to send all this fine stuff directly to the tables. This would necessitate the use of a large volume of water to effect the classification and would involve a large increase in the number of slime-tables.

Experiments are now being made, with every prospect of success, to reduce the loss in this very fine material, without sacrificing the advantages of present method of treatment.

Spitzkasten.

The hutchwork of the roughing-jigs goes through a series of spitzkasten, respecively 1½ x 7½ feet, 4 x 6½, feet, 8 x 12 feet and 8 x 12 feet in thorizontal cross-section and 2 feet, 7 feet and 10 feet deep. These boxes are built between the posts supporting the main floor of the mill. Their position is indicated in Plates I. and II.

Trunking-Machine.

The material settling in the first box goes to the trunking-machine. This machine consists of a semi-cylindrical iron trough in which revolves a screw conveyer. The trough is divided into two sections, respectively 14 feet and 10 feet in length. The screw conveyer in the lower and longer section is made up of fan-shaped blades of castiron, about 4¼ inches wide, with a space of about 2 inches between them, breaking the continuity of the screw. The material to be treated flows through rubber hose from the settling-box into this trough ; being introduced about midway. The revolution of the shaft forces the galena toward the upper end. The water flows out at the lower end of the trough, carrying with it all the light sand. Wash-water is admitted through a line of spigots at the side of the trough. The upper section of the trough simply serves to convey the galena into the car.

Mineral coarser than ¼ mm. or ⅜ mm. is very perfectly concentrated by this machine and delivered to the car as nearly pure galena. Mineral finer than ¼ mm. is carried off in the tails. The tailings from this machine are united with the product of the second box of the spitzkasten and go to the three-sieve finishing- jigs.

Finishing-Jigs.

The three sieve Hartz jigs used as finishing-jigs, as well as for the treatment of the crushed raggings, are of the ordinary side-piston type, and are not figured. They do not require special description. They are run at a speed of 270 strokes per minute ; strokes ¼ inch in length. The jigs treating crushed raggings are run slower, 210 strokes, ⅝ inch long, per minute. The jig-sieves are of No. 8 wire cloth (No. 17 wire).

The following table gives the results of typical assays on samples subdivided by sifting :

Size.	Per cent of sand of given size.	Lead in sands treated Per cent.	Lead in Hutchwork. 1st sieve. Per cent.	Lead in Hutchwork. 2d sieve. Per cent.	Lead in Hutchwork. 3d sieve. Per cent.	Lead in tailings. Per cent.
Above ¼ mm	8.9	40.99				3.94
⅛ mm. to ¼ mm..	43.6	16.76	79.69	70.34	41.80	1.07
1-20 mm. to ⅛mm.	13.3	16.40				.62
Below 1-20 mm...	34.2	32.58				11.97
Average	100.0	24,75	Average three sieves, 74.00			5.24

The material treated on the finishing-jigs is very rich containing about 25 per cent. of lead, and the losses are quite large. The material treated is also very fine, over 90 per cent. being less than ¼ mm. The losses are confined to the stuff below $\frac{1}{16}$ mm., above that limit the tailings are poor, with the exception of the stuff above ¼ mm., the quantity of which is small (about 3 per cent. of the tails). It will be seen that these jigs treat successfully finer stuff than the roughing-jigs, probably because of the finer jig-cloth and smaller interstitial channels. It is proposed to treat the tailings of these jigs, or at least the finer portions of the tails, on round or side bump tables.

Parsons-Rittinger Tables.

The Rittinger side-bump table, as modified by Mr. Parsons, is shown in detail on Plate V. The tables are built in pairs, and each table is made double as usual. They are small, each half the double table being about 3 feet by 7½ feet. Instead of being hung from rods the table is supported on four cast-iron feet or "guides," which slide on horizontal steel rods. The latter rest in cast-iron "saddles, bolted to the heavy sill-timbers which run under the whole row of tables. Light spiral steel springs around two of these rods give motion to the table. The tables bump against each other, the blow being taken by a joist of hard wood lying loose between them (not shown in the drawing). The tables are forced apart, against the tension of the springs, by a spiral wedge-shaped cam; 150 bumps, ⅜ inch long, are given per minute.

The surface of the table is covered with the black enameled duck, sometimes used for desks. This covering is cheap and easily renewed, and furnishes a surface well adapted for the exceedingly fine material treated. The tables are inclined 4½°. There are 16 pairs of double tables in th mill, or 64 table in all. Of hese, 32 are head tables and 32 are used for treating middlings. They are not worked to their full capacity, the head tables treating but 1¼ tons each, or 2½ tons to the double tables per twenty-four hours. The material treated is exceedingly fine, 70 per cent. being less than $\frac{1}{16}$ mm.

The following are typical assays of the stuff treated and the resulting tailings. The samples, as before, were subdivided by sifting.

Size.	Percentage of sand of given size.	Percentage of Lead in stuff treated.	Percentage of Lead in tailings.
⅛ mm. to ¼ mm...	9.0	2.50	.82
1-20 mm. to ⅛ mm..	19.4	2.65	.40
Below 1-20 mm.....	71.6	15.52	2.74
Average.....	100.0	11.75	2.45

Loss in Dressing.

For the year ending May 1st, 1887, the yield of the ore treated was 5.65 per cent. The loss in the tailings is about 2.13 per cent., or 27.4 per cent. of the total amount of lead in the ore. The losses in the Lake Superior copper mills range from 28.5 per cent. to 31 per cent., treating material much more easily saved than this galena. The losses in each case are due to include mineral in the coarser sands, and to finely divided mineral in the very fine slimes. At Bonne Terre an unusually large part of the mineral exists in the ore in an exceedingly fine state of division, as is shown by the large percentage of included mineral in stuff as fine as $\frac{1}{16}$, ⅛ and ¼ mm. This necessitates very fine crushing, and consequently involves the production of a large amount of very fine stuff, much of which contains galena too fine to be saved.

Cost of Dressing.

The cost of dressing for the fiscal year ending May 1st, 1887, was 36.4 cents per ton, divided as follows:—

Labor	13.4
Repairs	10.0
Supplies	3.5
Coal	9.5
	36.4

This compares favorably with the very best Lake Superior practice, the cost of dressing at the Atlantic mill for the last few years being per ton of rock:

	Cents.
1881	42.54
1882	37.07
1883	35.35
1884	38.95
1885	30.36
1886	26.5
1887	27.5

The cost at the Atlantic mill (for 1885) can be subdivided as follows:—

	Cents.
Labor	10.86
Fuel	14.52
Supplies, etc	4.98
	30.36

At the Atlantic mill, the water is supplied through a launder above the level of the mill-floor and is not pumped. The ore also is delivered to the mill at a higher level than at St. Joseph and need not be elevated in the mill. This rock has also been previously crushed by jaw-crushers at the rock-house, the cost of which crushing properly belongs to the cost of dressing, but is not included in the published figures, Finally, the sands are carried off with the water in the waste launders and do not have to be loaded into cars. At least 10 cents per ton, therefore, should be added to the Atlantic mill figures in making comparisons of cost at the two places.

The amount of rock treated per ton of coal consumed is as follows:—

St. Joseph mill, 1887	33.59 tons.
Atlantic mill, 1886	28.34 tons.

The advantage in favor of the St. Joseph mills would be even more striking if an allowance were made for the fuel consumed in elevating water and ore.

The limestone crushed at St. Joseph is probably not as hard as the amygdaloid rock treated at the Atlantic mill. Somewhat finer screens are used at the Atlantic mill, but the average fineness of the ore is almost exactly the same.

	(1887). St. Joseph mill. (Rolls).	(1886). Atlantic mill. (Stamps).
Above 1 mm	43.0	41.6
¼ to 1 mm	27.0	27.6
Below ¼ mm	30.0	30.8
	100.0	100.0

These figures indicate that it is cheaper to crush by rolls than by steam-stamps; and that the rolls produce quite as large a proportion of slimes as the stamps. The cheapness of the crushing and the large amount of slime, however, are both due in part to the friability of the ore.

It will be difficult to find two mills, either in this country or abroad, treating ore at equally low cost; and the above figures furnish a powerful argument for the English method of concentrating without size classification.

The losses in the treatment of the very fine stuff are large both at Lake Superior and in Missouri. The remedy in each case will doubtless be found in better methods of crushing and in extending and perfecting the slime-treatment.

*Trans. Am. Inst. of M. E.

* "Movement of Solid Bodies in Water," "Theory of Jigging," by the writer. See *School of Mines Quarterly*, vol. ix. Nos. 2 and 3.

* *Loc cit.*

Canadian Peat Fuel.

Peat occurs in great abundance in many places in the Dominion, but has never been much worked, except in a few localities south of the River St. Lawrence, more particularly at St. Hubert, in Chambly County, about ten miles from Montreal, and at St. Brigide, about ten miles from the town of St. John, on the Richelieu river. It is also known to exist in large deposits in New Brunswick, in other parts of Quebec, in Ontario, and in the North-West Territories. The utilization of peat for fuel has occupied the attention of economists and others for many years, but hitherto, none of the many schemes brought forward have been sufficiently practical and economical to bring it into general use. Mr. David Aikman, of Montreal, who has given much time and consideration to the subject has, however, produced a fuel from peat which is in many respect superior to coal. Its heat-producing power is as great as coal, and can be easily understood from the following analysis:—

Moisture	3.84
Fixed carbon and volatile matter	89.26
Ash	6.90
	100.

Analysis of Coal.

Moisture	4.59
Fixed carbon and volatile matter	89.49
Ash	5.92
	100.

It burns with a clear white flame, after all the volatile matter is consumed, leaving a bright red coal which will last for a long time.

Owing to its freedom from sulphur and its specific gravity being equal to coal, makes its invaluable for use on locomotives. Air-dried peat was used on the Grand Trunk railway. Taking one trip as an axample on Engine No. 158, five feet driving wheels, sixteen inch cylinders, and twenty-six-inch stroke, d awing twelve loaded cars:—

Distance run per ton of 2,240 lbs. of fuel	40.33 miles.
Fuel used per mile	55.44 lbs.
Greatest pressure of steam	140 "
Least " "	100 "

During the experiment fuel was put on in small quantities; no smoke issued from the stack; a steady brilliant white fire was kept up and steam generated with great rapidity. The damper was kept closed, and air admitted through a slot in the furnace door. Not an atom of ash or cinder was left in the smoke box, ash pan or upon the wire guage or spark catcher. The bottom of fire box was scarcely ever covered with the fuel, the steam being generated too rapidly too allow of a large quantity of fuel being put into the furnace. For all kinds of steam boilers it can be used to advantage, also for smelting purposes, as it stands a very strong blast. It is also the cleanest and most economical fuel which can be used in grates and stoves, for heating and cooking.

The fuel is made by machinery carried on a scow which is made to float in the bog, the peat is excavated by a pair of large screw augers which work in front of the bow and deposit it in a well where it is submitted to the action of steam taken from the exhaust of the engine, it is then brought by an elevator to the squeezer, where it is deprived of about 33 per cent. of water, after which it is broken by revolving teeth, passed through a dryer of a special construction invented for the purpose and delivered into the press in the form of dry dust, which by the action ot heat and the screw is brought into a pasty condition, the tar or resin naturally contained in the peat being set free, under the pressure it becomes partially carbonized and issues from the press in a continuous stick of peat fuel ready for use, it may be two, three, four or more inches in diameter. The whole process is entirely automatic, and only takes about twenty minutes from the time of excavation from the bog to the time it is delivered from the press. We will suppose the scow as described with excavator, and peat-making machinery, all ready to start, and the line on which she is to work decided upon. It will be necessary to clear away in front of her a space, the width she is intended to cut, (it may be 14, 16, or 20 feet), if the bog is soft this can be done by men on a gangway made on purpose so as to move along without sinking, the fibre moss, etc., lying on the surface must be cleared off, this can be laid on one side to form a pathway, which will become solid as soon as the drainage operation begins. The machine can then move forward in the usual way, and will cut about 3,000 feet in a week, converting the peat excavated into good solid fuel, available for any purpose for which coal is used at the rate of about 550 tons for the 3,000 feet advanced, if the cut is 20 feet wide and leaving behind a canal full of water which must be kept up to its level, in order to allow the machine to continue her operations. When the water ways are all made, discharges can be cut to allow the water to drain away which it will do very quickly, smaller cross drains can then be cut cross-ways as the bog gets more solid. In a short time, it will easily be seen, that by this system bogs or marshes which are now almost inaccessible and waste, can be converted into solid ground available for agricultural purposes. In this country where our peat operations have been carried on, the surrounding lands which were so wet that nothing could be done with them have been all reclaimed and are now cultivated and bearing crops. The entire cost of one machine with complete outfit for drainage and peat making purposes in Canada is about $9,000. If it was only intended for drainage purposes the cost would be about $4,000. The material excavated could then be deposited as a road bed alongside of the canal and be made available for transport etc.

The special advantages claimed for this fuel are:—

(1) That it can be produced at a less cost than coal, and that a great saving can be made in transportation, because it is more uniformly diffused over all the country compared with coal.

(2) That it is more economical.

(3) That it is free from sulphur.

(4) That it does not make clinkers.

(5) That it lengthens the life of fire-boxes, grate-bars, fire-bricks, grates, stoves, etc.

(6) Saving a cost of repainting railway coaches through absence of cinder sparks, etc., comfort of passengers.

(7) That it is superior for making iron and steel.

We understand that a company is now being organized in Canada and that the work of utilizing peat lands for fuel will shortly be an accomplished fact.

MINING NOTES.

Nova Scotia.

(From Press Committee Gold Miners' Association.)

Beaver Dam.

Reports from this district are to the effect that Mr. D. S. Turnbull is pushing the construction of the twenty-stamp mill as fast as possible, in the hope of starting it before cold weather comes.

Chester Basin.

Since the closing down of the Neptune Co.'s mine in the Spring little or nothing has been done in this district. A few prospectors are at work, but no pay lode has as yet been found.

Gay's River District.

The Coldstream Mining Co. are at last beginning to work. The excavations for the proposed fifty-stamp mill have been begun, and a large boarding-house is in course of erection. Work on the mining property proper, however, is yet in its inception, and the company has not yet got down to real development work. It is expected, however, to increase the working force of miners this month.

Renfrew District.

The "Free Claim" property here has resumed active mining work. During the summer the owners have rebuilt the ten-stamp mill, putting in new foundations and mortar, and entirely rebuilding the water-wheel.

The Empress Co. are rebuilding the engine-house and shaft-house recently destroyed by fire, and the new machinery for pumping out the old Ophir lode has been completed and started up. The owner, Mr. C. H. North, of Boston, paid the property a visit last week.

South Uniacke District.

A representative of the Thomson-Houston Electric Co. has recently contracted with Messrs. Thompson & Quirk to supply their mine in this district with one of the company's new electric percussion drills. The agent, Mr. Medbury, proposes to set up the drill in Halifax and operate it for a week or so, in order that mining men may have an opportunity to see the drill at work and judge of its merits.

This will be the first installation of an electric drill in Nova Scotia, and will, in fact, be the first drill put upon the market by the Thomson-Houston people. The results will be carefully watched by our gold mining men, and a detailed account of the drill and its success or non-succees will appear in the REVIEW.

Stormont District.

In the matter of the Palgrave Mining Co. *vs.* J. McMillan *et al.*, a hearing was given before the Commissioner of Public Works and Mines on the 11th inst., at Halifax, on the petition of the Palgrave Co. that it be allowed entrance on lands claimed by McMillan and others for the purpose of working its mineral property, under sec. 44 of the Revised Statutes. No decision has yet been given by the Commissioner.

It is greatly to be desired that some new legislation be introduced at the coming session of the House of Assembly which shall have for its object the settlement of one of the evils of the existing laws, viz., the uncertain relation existing between the owner or claimant of the land and the lessee of the mineral rights. To this uncertain relation are traceable the source of much litigation whenever the mineral rights prove to be of value.

Waverley District.

Up to the 16th instant the fine new mill of the Lake View Co., at this place, which was to have been completed the 1st. of August, and then the 1st. of September had not dropped a stamp. It is now announced that the mill will not be running before October 1st. The mine is yet idle.

Tangier District.

The property of the Brunswick Gold Mining Co., at this place, was sold on September 13th by the Sheriff at public sale and was bid in by Mr. Parker, solicitor, for the sum of $8,500. It is rumored that Mr. Parker bought for New York parties who intend re-opening the property.

Montague District.

There is little that is new to report from this district; work has been rather slack, and the working mines have apparently come into a temporary lean streak. Rumors of a sale in the district for a large figure cannot be traced to a reliable source.

(From Our Own Correspondent.)

Cumberland County.

The sale of the Joggins coal mine is stated to be definitely closed, the price named being $230,000. It is reported that the purchasers are interested in the Canadian Pacific Railway.

The Boston Coal Mining Company having neglected to pay the annual rental, its leases have been declared forfeited. The property had not been worksd for some time.

Cape Breton.

The Sydney and Louisburg Coal and Railway Company is stated to have found the Carrol seam underlying several square miles of its territory. Further details as to its size, quality, etc., are not yet available.

The Mullins seam of North Sydney is reported as yielding five feet six inches of good coal, and already extensive rights have been secured along its line of outcrop.

Pictou County.

Mr. John Douglas, who has been coal prospecting for the Black Diamond Company, has suspended operations, believing that nothing of any value can be found in that section. Prospecting by other parties at a point four miles north-east of where Mr. Douglas was at work have also proved unsatisfactory.

Messrs. John Muir & Sons have had a siding constructed into their workings, which will connect them with the Vale railway and give them a more profitable outlet for their coal than heretofore.

The re-opening of the Food pit continues satisfactorily.

Twenty new coke ovens have been added to the plant of the Drummond colliery. These are understood to be giving good satisfaction, but no reliable figures of the quantity manufactnred have yet been made public.

In General.

The next regular monthly meeting ot the Gold Miners' Association will be held at the Halifax hotel on Friday, 3rd October next, at two o'clock in the afternoon. A full attendance is particularly requested.

Mr. Joseph R. Wilson, son-in-law to Mr. Thomas Shaw, M.E., inventor of the Shaw Mine Signalling apparatus, has been giving an exhibition of his machine in Halifax, at Stellarton, and other points in the coal district. The owners of the patent on this new machine are evidently leaving no stone unturned to create a sentiment in favor of its adoption. The *Colliery Engineer* and several of its readers are protesting against its introduction in the collieries of Pennsylvania, claiming that it is impracticable. We should, however, be glad to have the views of some of our colliery engineers on its merits.

According to the official returns there has been a decline in the importation of American coal into Canada during the twelve months ending 30th June last, as compared with the corresponding period ending 30th June, 1889. The figures stand 1,372,225 tons, value $5,366,643 for 1889, and 1,305,671 tons, value $4,768,549 for 1890. According to these figures the average price was $3.91 in 1889, and $3.65 in 1890.

Reflecting the views of the Dominion Government on the question of reciprocity in coal, the London *Free Press*, the special organ of the Minister of Agriculture, says :—"Every pound of hard coal that we use is admitied free of duty, but we will wait in vain for the United States to offer the freedom of 'the markets of sixty millions' to the soft coal yielded from our mines. As they have built a wall against our great Nova Scotia industry, in the interest of Pennsylvania, it is but natural that similiar protection should be afforded to our own people, hence the Canada duty of sixty cents per ton against the United States duty of seventy-five cents, and with that arrangement all parties in this country are very well content. Nova Scotia is selling more coal in Quebec that she ever sold before, not even excepting the year when the United States took our coal free of duty, and in return they take from the upper provinces the stores of provisions which formerly came from New England. The coal duties are not so oppressive to Canadians, but the duty levied by the United States is a serious burden on their own people, especially to the shipping of both the Atlantic and Pacific. Every pound of coal used by the steamships of San Francisco is brought from the mines of British Columbia. It would be a great relief, therefore, to abolish the duty there, but if they choose to tax themselves in that quarter, it is but little spite to the British Columbia miners."

The Halifax Mining and Prospecting Company is the name of another new company which was been granted a charter on the 16th inst. Directors—Charles Annand, Halifax, N.S.; Geo. E. Forsythe, Halifax, N.S.; B. F. Pearson, Halifax, N.S. Capital, $250,000. The chief place of business will be at Halifax.

Application for incorporation is made by "The Napier Mining Company, Limited." Capital, $120,000, divided into 1,200 shares of a value of $100 each. Directors—W. J. Fraser, Halifax; Frederick Taylor, Lowell, Mass.; John E. Hardman, Oldham, N.S. The chief place of business of the new company will be at Oldham.

Quebec.

A large force is at work at the Temiscamingue mines. The shaft has been put down to a depth of 75 feet and is still in first-class galena ore.

Templeton District.

The Blackburn, McLaurin, and other phosphate mines in this district are working steadily and a good force is employed at each.

The asbestos property, owned by American capitalists, is also being developed. A force of 19 men was put on last month, and at last reports the veins had widened to four inches and were yielding in good quantity. Asbestos of good quality has been mined.

Ottawa Valley.

Mr. E. Packard, Chairman, and Mr. C. C. Hoyer, Millar, visited the mines of the Canadian Phosphate Company during the month and report themselves much pleased with the result of the operations at the pits. The production for the month has been larger than for any previous period since mining was begun by the company. The Directors have declared an interim dividend of 6d. per share, payable on 1st November.

The representatives of the Phosphate Corporation (Limited) are now on a tour of the phosphate mines in this district. We are informed that the properties so far acquired consist of the Ross Mountain Lot, from the Hon. J. C. Abbott, the Murphy Lot in Templeton, and the Stewart Lots near the High Falls, Lievres River, in all about 2,000 acres. Mr. J. Lainson Wills and Mr. George Attwood, M.E., are acting for the company. Mr. Knud Sando, one of the principal promoters, and Sir George Baden Powell, one of the directors, arrived in Buckingham on 30th inst. on a visit to some of the properties now before the company for purchase. They both condemn the high prices asked by vendors.

Eastern Townships District.

Dr. James Reed has placed an order with the Ingersoll Rock Drill Company for a plant similar to that put in at the American Asbestos Co., the United and King Bros. mines. Lots 27, 28, 29, in Range A Coleraine, are to be worked extensively. These lots give good promise of becoming large producers of asbestos.

All the mines at Thetford and Black Lake continue working steadily, and managers are pleased with their outputs. The production of asbestos for this season will show a decided lead over any previous years' operations.

The American Asbestos Company are putting in a cable derrick to carry off their waste rock from working ground.

The Anglo-Canadian Co.'s output still continues to lead the other Black Lake mines, and at the end of the year will be found to be nearly double the company's production for the same period last year.

The United Asbestos Company's turnout for last month was extremely satisfactory, a goodly portion of the output being No. 1.

Messrs. King Bros. are opening out their Black Lake Lots under direction of Mr. A. M. Evans.

The Excelsior Copper Company are testing undeveloped portions of their Harvey Hill property with the Diamond Drill.

Ontario.

The Provincial Natural Gas and Oil Company are busy laying their pipe line from the wells at Welland to Buffalo, where the line will be assumed by the Standard Oil Company.

A small force of men is employed opening up a promising deposit of iron ore on the Desbarats location, 35 miles east of Sault Ste. Marie on the line of the C. P. R.

The Sebastopol Phosphate Syndicate, Limited has been registered in London, September 1st, 1890, by Leslie, Antill and Arnold, 1, Gresham-buildings, E.C., to acquire any phosphate or other mines, and to work and develop the same. Capital, £5,000, in shares of £1 each. First Subscribers—G. J. Wells, of Chester; G. C. Lomer, 4, Fenchurch avenue, E.C.; and five others, each taking one share. This is a new company to be under control of Messrs. Lomer, Rohr & Company, Montreal, and to operate a phosphate property at Sebastopol.

Perth District.

The Anglo-Canadian Phosphate Co. continue their system of day work at the Otty Lake mines, near Perth, Ont, under charge of Mr. Robert Cordick, and during the summer have opened up over thirty of the old contractor's pits besides discovering several new shows. A force of about twenty-men is employed and 250 tons of high grade phosphate is now ready for shipment, besides a quantity of seventy per cent. ore. The phosphate has been sold for shipment to London.

Work has been resumed at the Bob's Lakes mines, Bedford, Ont., by the Anglo-Canadian Phosphate Co. This property has been worked for the past two years under the contract system, but will now be operated by day labor. Over one hundred seams of phosphate have been opened up by the contractors on a small portion of the property, a good deal of which remains to be explored.

Port Arthur District.

(From Our Own Correspondent.)

THE BADGER SILVER MINING COMPANY.—This company shipped a car load of high grade smelting ore, valued at $15,000, to Geo. W. Robinson, 91 Wall street, New York, on the 10th inst. This ore has all been taken from No. 4 vein, (Porcupine) since Aug. 4th, together with about 350 tons of milling ore. They have another car load of high grade ore about ready, taken from No. 2 vein, within the same period, which will be shipped about the 15th inst. No. 1 Adit level is still in bonanza ground both ways, which taken with the body of ore at the bottom of the shaft, makes a certainty of No. 4 vein being a great producer. The mill is kept in full blast night and day, breaking 35 tons of ore daily. The Badger is going to exceed the highest expectations formed of it at the beginning of the season. Supt. Shear estimated that he would be able to ship a car load of high grade ore monthly, and he will have two car loads to his credit for September.

THE BEAVER MINING AND MILLING CO.—This company shipped a car load of high grade ore and concentrates, valued at $17,000, to Messrs. Balbach & Son, Newark, N.J., on the 10th inst. They have another car load ready for shipment, but teams have been scarce lately, that they have been unable to have it transported to Murillo. The Beaver looks remarkably well, all the slopes being in high grade ore. The production is averaging over $40,000 per month. A new vein carrying good milling ore at the surface has been opened on the North Bluff; Capt. Hooper has a gang of miners employed opening it out. It is improving in richness as development proceeds and gives promise of being a good producer.

THE KING.—This property is composed of the north half of lot No. 12, in third concession of the township of Strange, and comprises 320 acres. There are six parallel veins on the property, only one of which has been partially developed. This vein was two feet wide at the surface; at a depth of eight feet it had widened out to four feet, from which point it has maintained a uniform width to the bottom of the shaft, which is now down 26 feet. The pay streak is 18 inches wide. At a depth of eight feet the vein gave assays from 40 to 3,000 ounces of silver to the ton of 2,000 pounds. No assays have been made below that point, but the vein has become richer and more heavily mineralized, and on assay will, no doubt, carry much higher in silver than near the surface. The Whitefish river runs along the south boundary of the property and has a fall of 125 feet in passing from the west to the eastern limits of the property, which will furnish ample power for all necessary works in treating the ore. The Port Arthur, Duluth and Western Railway runs within two miles of this property, and when it is completed to that point, which will be about November next, the first shipment of higher grade ore will be made and all necessary machinery taken in to operate the mine. The owner, Mr. Bonfield, of Petrolea, Ont., intends to thoroughly explore and develope all the veins on the property.

THE BLACK RIVER AND TERRACE BAY GOLD MINING CO.—Capt. Andrews and W. Roland, M.E., have just completed tests and examinations of the different mineral lodes on this property and all arrangements for future operations are now about completed. The results of the tests made and the exploratory work done, show that these veins carry from $9.50 to $17.50 per ton in gold, and from three to thirteen ounces of silver to the ton of 2,000 pounds. While concentration tests made at the Beaver Mining and Milling Company's mill by C. Romer, Ch., go as high as $500 per ton. Over twenty new veins were discovered on the property during the course of the exploratory work by Capt. Andrews and Mr. Roland. The property consists of four locations of 400 acres each. It is well timbered and has a magnificent water power at the Bridal Veil Falls on the Black River which runs through the property. It is easily accessible by the Canadian Pacific Railway or by steamer from Lake Superior.

THE STAR MINE.—Drifting is being proceeded with from the bottom of No. 2 shaft, the vein is holding out in width and richness. As soon as machinery can be transported in over the Port Arthur, Duluth and Western Railway, opeaations will be carried on, on a more extensive scale.

THE OGEMA.—Professor Hillé, M. E., has made an examination of this property which is situated in the township of Dorion, in the Black Bay district. A high range of granite bluffs traverse the property, the vein occurs about half way up the bluff, along the contact of the granite and gneiss, which forms the valley below. The outcropping is about eighteen inches in width, nearly solid galena, twenty feet below an adit has been run in to cut the vein, here it is double the width that it was at the surface, and the galena assays from 62 to 64 per cent. Assays from samples taken at the surface, showed it to carry 24 ounces of silver to the ton of 2,000 ponnds.

Manitoba and N. W. T.

The track of the Galt railroad is now laid to a point 30 miles north of the boundary line. It will probably be completed to Lethbridge by the 20th inst., and be formally opened to the public by an excursion from that place to Great Falls on or about October 1st.

A special general meeting of the Alberta Railway and Coal Company will be held at their offices 37 Old Jury, London, Eng., on 15th October. The purposes of the meeting are:

1. To authorize the purchase and to accept the transfer of the property and assets of the North Western Coal and Navigation Company (Limited);
2. To authorize the issue of mortgage bonds and share capital both preferred and ordinary required for the purposes of the company;
3. And generally to consider and adopt all measures incident to or arising out of the agreements with the North Western Coal and Navigation Company, Limited, with the Great Falls and Canada Railway Company and with the Lethbridge Construction Company;
4. To approve the head office of the company in London;
5. To receive the report of the directors and pass the accounts of the company, and to fix the remuneration of the directors.

The average monthly output from the Lethbridge collieries since 1st January, 1890, has been 11,000 tons. 650 men and boys are employed.

The Canada North-West Coal and Lumber Syndicate are raising about 100 tons of coal per day. A force of 75 men and boys employed.

Sir Alexander Galt, who has been upon a tour of inspection of his railways and coal interests in the Northwest has returned East. At Great Falls, Montana, connection is made with the new railway connecting the Great Northen road of Montana with the Galt coal mines at Lethbridge. This road is 198 miles long, o which 150 miles are completed. Over this distance Sir Alexander and party travelled on an engine, reaching the spot to which the track had been completed ten miles this side of the boundary. This new connection will prove of mutual benefit to the people of Montana and the Galt mines, giving the former their coal at much cheaper rates than is now possible and the latter an enlarged market for its merchandise. The mines are now producing about 11,000 tons per month, but this will be materially increased shortly. Three new shafts have been recently sunk, two of which are now yielding coal, and the third is expected to be worked very shortly. The extention of these mines has built up Lethbridge in a wonderful manner.

A demand of assignment has been made by Mr. James Baylis, merchant, of Montreal, a creditor to the extent of 33,794 dols., on The Stair Coal Mine and Manufacturing Company, Limited. The petition for a winding-up order was granted by Justice Wurtele, sitting in the Superior Court, and Mr. George H. Patterson, accountant, was appointed provisional liquidator. The exact liabilities of the company have not yet been filed but are supposed to be heavy.

British Columbia.

The captain of the steamer Empire, which recently arrived at San Francisco from Nanaimo, B. C., reports that there is no change in the condition of affairs at the mines. The miners still hold out, and the Dunsmuirs will not give in. The steamer Wellington is tied up at the wharf and the crew has been discharged. On her last trip from this port the Wellington took up thirty men who had been engaged to work in the mine. When they arrived at Nanaimo all the men joined the strikers, save three. There are sixteen men at work in the mine, and these can just turn out enough coal to supply the Vancouver tugboats. When the strike took place, over 400 men walked out. Of this number about 150 were single men. The latter have left the island and obtained work in Vancouver, Seattle and Tacoma. The married men are supported by contributions from the other miners. All the men employed in the mines belong to the Union, and every man who is at work is assessed 10 per cent. of his wages. The troops sent from Victoria and Vancouver, to quell any riot that might arise, are to be sent home There is no chance of a settlement, and it will be several months before any Wellington coal arrives in San Francisco.

Six striking miners, on trial on a charge of intimidating miners working at the Wellington collieries, have been found guilty. The Chief Justice bound each of them in $200 to appear for sentence when called, remarking that the full effect of their act was probably not yet developed. In rendering judgment he said: "I suppose you never think, read or write, or if you do you get newspapers edited by men just as ignorant as yourselves, who only write what they know you will buy." The strike is still unsettled.

Cariboo District.

The Black Jack—a one stamp mill—started last year, with satisfactory results, is still pounding away, and the company hopes to increase its capacity in due time.

The Golden Mining and Smelting Co. have almost completed their works and will be shortly ready for ore; in fact, they are now making advances on all ore shipped them.

The Forks of Quesnelle, is enjoying something of a boom in the way of alluvial mining. Various new locations have been recorded within a few weeks, and strong companies organized to work them. The gold taken out is coarse, and the prospects are remarkably good; but it will take a considerable expenditure of capital to realize them.

The Island Mountain Company's quartz mill has now been running steadily for two or three weeks, and the results, so far as the public know them, are encouraging. The starting of this mill has been awaited with eager expectation and hopefulness, for it was felt that if it proved a success the erection of other mills and the development of our numer- ous quartz ledges would follow as a matter of course. Our hopes seem, therefore, on the point of realization. The mill is a ten stamp one, and has four of the best modern concentrators.

West Kootenai Minerals at Toronto.

West Kootenai sent an excellent display of mineral specimens to the Toronto Exhibition. The utility and value of this exhibit was, however, sadly diminished by the wretched accommodation provided for it by the Exhibition people, the whole being crowded into a dirty little shanty in which British Columbia potatoes, fruits,

mountain goats and other products were piled in a most indiscriminate and unattractive manner. This is a matter which we commend to the attention of the authorities, who should be well able to provide first-class accommodation for exhibits of so much importance to the development of the country.

The following is a detailed description of the 43 samples of ore on exhibition :—

TOAD MOUNTAIN.

1. Grizzly, R. & A. C. Fry, 75 oz. silver, vein 6 feet, Toad Mountain, 60 feet of shaft sunk, 8 miles from Nelson.

2. Cariboo, A. C. Fry, 175 oz. silver, vein 4 feet Toad Mountain, 2 shafts sunk, 10 and 15 feet, 8 miles from Nelson.

3. Dandy, Fox, Kelly & Cook, 50 oz. silver, vein 7⅛ feet, Toad Mountain, 65 feet of tunnel on ledge, 8 miles from Nelson.

4. Iroquois, C. M. Townson & Co., 40 oz. silver, vein 13 feet, Toad Mountain, 2 tunnels 70 and 50 feet on ledge, 8 miles from Nelson.

5. Tough Nut, Dr. Hendryx, 45 oz. silver, vein 4 feet, Toad Mountain, 37 feet of shaft, 102 feet tunnel, 8 miles from Nelson.

6. Silver King, Hall Bros., $300 silver, vein 15 feet, Toad Mountain, 160 feet of shaft, 200 feet of tunnel, 8 miles from Nelson.

HOT SPRINGS.

7. United, Revelstoke Mining Co , 24 oz. silver, 50 per cent lead, vein 5 feet, Hot Springs, ledge stripped 150 feet ; 2 miles from Ainsworth.

8. No. 1. Revelstoke Mining Co., 89 to 249 oz. silver, vein 8 feet, Hot Springs, 430 feet of tunnel, 3 incline shafts, ore honses, etc., 2 miles from Ainsworth.

9. Spokane, L. C. Dilman & Co., $35 silver, vein 4 feet, Hot Springs, 40 feet of incline shaft, ¾ mile from Ainsworth.

10. Sky Line, A. D. Wheeler, $400 to $16000 silver, vein 15 feet, Hot Springs, 130 feet of shaft on ledge, 3 miles from Ainsworth.

11. Pearl, B. B. Barker, 40 oz. silver, vein 1½ feet, Hot Springs, 14 feet of tunnel, 3 miles from Ainsworth.

12. Little Phil, Thos. McGovern, $10 to $200 silver, 4 ft. Hot Springs, several crossents on ledge, ½ mile from Ainsworth.

13. Tariff, George Francis, $27 to $34 silver, vein 6 feet, Hot Springs, several crosscuts on ledge, 1-2 mile from Ainsworth.

14. Kismet, H. Auderson, 25 to 40 oz. silver, vein 10 feet, Hot Springs, 30 feet of shafts, 3 miles from Ainsworth.

15. Let Her go Gallagher, A. D. Wheeler, $460 silver, vein 8 feet, Hot Springs, 90 feet of shaft, ore houses, etc, 3 miles from Ainsworth.

16. Sunlight, Geo Herb, $40 to $175 silver, vein 8 feet, Hot Springs, 30 feet of shaft, cross-cuts, etc., 2 miles from Ainsworth.

17. Norman. McLeod & van Hook 40 oz. silver, vein 6 feet, Hot Springs 8 feet of shaft, 2½ miles from Ainsworth.

18. Arkansaw, Roberts & Buckley, 75 oz. silver, vein 8 feet, Hot Springs, 12 feet of shaft showiug large body of ore, 2½ miles from Ainsworth.

19. Neosha, R. McLeod, $500 silver, vein 6 feet, Hot Springs, 10 feet of shaft, 2½ miles from Ainsworth.

20. Union, Chas. Roster, 60 oz. silver, vein 5 feet, Hot Springs, 75 feet of shaft, ore houses etc., 2½ miles from Ainsworth.

21. Little Donald, E. L. Davanport, 75 oz. silver, vein 7 feet, Hot Springs, 130 feet of shaft, several crosscuts, 1 1-2 miles from Ainsworth.

22. Krao, A. D. Wheeler $90 to $384 silver, vein 12 feet, Hot Springs, 130 feet shaft, several crosscuts, 1½ miles from Ainsworth.

SUNDRY LOCATIONS.

23. Centre Star, Joseph Bourgeois, $8 silver, $48 gold, vein 20 feet, Trail Creek, 12 feet of shaft showing 20 feet of ore, 6 miles from Columbia river.

24. Josie, H. Sharon, $8 silver, $48 gold, vein 30, Trail Creek, ledge stripped showing large body of ore, 6 miles from Columbia river.

25. Queen Victoria, James Burr, 13 oz. silver, large deposit, Kootenay river, small test holes on hill, 6 miles from Nelson.

26. Royal Canadian, Simon Ray, $76 to $704 gold, vein 2 feet, Eagle creek, 2 tunnels 40 feet and 60 feet, 7 miles from Nelson.

27. Umatilla, F. C. Collins, 40 oz. silver, vein 5 feet, Nelson, shaft showing large body of ore, 7 miles from Nelson.

28. Poorman, E. L. Davenport, $100 to $200 gold, vein 2 1-2 feet, Egale Creek, 80 feet of shaft, 400 feet of crosscut, 6 miles from Nelson.

ILLECILLEWAET.

29. Maple, Cariboo C'k Mining Co., 45 oz. silver, 72 per cent. lead, vein 8 feet, Illecillewaet, 120 feet of tunnel 89 feet of shaft, 3 miles from C.P.R.

30. Maple Leaf, A. F. McKinnon, 80 to 90 oz. silver, 72 per cent. lead, vein 29 feet, Illecillewaet. Improvements $3,000, 3 miles from the C.P.R.

31. Blue Bell, Green & Gallop, 65 oz. silver, 60 per cent. lead, vein 2½ feet. Illecillewaet, 45 feet of shaft, etc., 2 miles from the C.P.R.

32. North Star, Green & Gallop, 62 to 125 oz. silver, 70 per cent. lead, vein 6 feet, Illecillewaet, 20 feet of shaft, etc., 6 miles from C.P.R.

33. Jumbo, Corbin and Kennedy, $100 to $800 silver, vein 6 feet, Illecillewaet, considerable improvements done, 4 miles from C.P.R.

34. Goat Cave, A. Chisholm, 30 oz. silver, vein 2½ feet, improvements done to the value of $400, 2 miles from C.P.R.

35. Dunvegan, Boyd, Bain & Co., 80 to 130 oz. silver, 78 per cent. lead, veins 8 feet, Illecillewaet, 500 feet of tunnel, etc., 11 miles from C.P.R.

36. Sultan, Boyd, Bain & Co., 200 oz. silver, 60 per cent. lead, vein 4 feet, Illecillewaet, improvements done to the value of $500, 4 miles from C.P.R.

37. Gold Queen, Stark & Taylor, 18 to 200 oz. silver, 45 per cent. lead, $9 gold, vein 4 feet, Illecillewaet, improvements to value of $250, 5 miles from C.P.R.

38. Sanquhar, Walter Scott, 110 oz. silver, 22 per cent. lead, vein 24 feet, Illecillewaet, improvements to value of $200, 14 miles from C.P.R.

39. Round Hill, Capt. McCallum, 18 to 42 oz. silver, 70 per cent. lead, vein 5 feet, Illecillewaet, improvemens to value of $500.

40. Gladstone, Kennedy and McCarthy, 70 to 1,100 oz. silver, 70 per cent. lead, vein 10 feet, Illecillewaet, improvements to value of $5,000, 3 miles from C.P.R.

41. Crystal, Corbin & Kennedy, 100 oz. silver, 70 per cent. lead, vein 6 feet, Illecillewaet, 20 feet of tunnel has been driven, 3 miles from C.P.R.

42. Bobbie, A. Chisholm, 110 oz. silver, 70 per cent. lead, vein 14 feet, Illecillewaet, improvements done to the value of $100, 3 miles from C.P.R.

43. Snow Flake, Jowett & Haigh, $300 to $1,500 silver, vein 2 feet, Illecillnwaet. Improvements done to the value of $1,000, 3 miles from C.P.R.

Portland Cement for Machinery Bolts.—The Troy, N.Y., *Polytechim* gives the following results of an experiment with English Portland cement for testing its adhesive strength in pounds per square inch, compared with sulphur and lead, for machinery bolts in rock. In a solid limestone ledge 7 holes were drilled 1⅝ inches in diameter, and 7 of 1⅛ inches in diameter, 3½ feet deep. Seven ¾ inch and 7 1-inch bolts were prepared with thread and nut on one end, plain at the other, but ragged 3½ feet from the blank end. The following are the results of the tests : In sulphur, 3 out of 4 bolts developed full strength, 16,000 and 31,000 pounds ; 1 1-inch bolt drew out under 12,000 pounds ; in lead, 3 out of 4 developed full strength as above ; 1 1-inch bolt drew out under 13,000 pounds ; in cement, 5 out of 6 broke without pulling out ; 1 1-inch bolt began to yield at 26,000 pounds, but sustained the load some second before it broke. Further tests showed the strength of the cement to be equal to 400 to 500 pounds per square inch of exposed surface. It seems to be ascertained that cement preserves iron from corrosion.

Profit Sharing by a Coal Company.—Three years ago the Campbell's Creek Coal Company, in the Kanawha Valley, commenced the sharing of profits with its men, and on the first occasion divided something over $6,000. Last year the amount was much less, because the profits were smaller. The result this year is shown in the announcement that on September 20th the company will divide $4,500 among the men. The money is given out in proportion to the amount of wages the men earn, and the next distribution will give each man an average of about $60. Besides sharing the profits the company does a sort of insurance business among the miners in a novel and commendable manner. In that district the miner is "docked," or forfeits a certain amount of his wages when the coal he turns out has over a fixed percentage of slate. The company mentioned takes the dockage according to the general custom, but that amount, instead of going to the company, is put into a fund for the benefit of the men. From this fund the men are entitled to draw $4 per week when sick. On several occasions, when through numerous demands this fund has become exhausted, the firm replenished it temporarily. In another way this company and its employés have moved together for the common good. In that locality the public schools are open only about four months in the year. To continue the schools for nine months each year the miners pay each twenty cents per month into a private school fund. The effect of this plan of sharing profits, and the mutual good feeling between the men and their employers, is plainly apparent. The men are contented and steady; they have improved morally and physically.—*American Manufacture.*

Phosphate Shipments.

The following have been the shipments of phosphate from the Port of Montreal, as per Custom House manifests, to date :—

Date.	Name of Ship.	Destination.	Shippers.	Quantity.
Aug. 25	SS Lake Winnipeg.	Liverpool	Millar & Co.....	250
" 28	Michigan	Hull.....	do ..	200
" 30	City of Lincoln..	London .	Lomer, Rohr & Co.	90
" 30	do	do	Millar & Co.....	300
" 30	do	do	Wilson & Green...	160
" 30	Barque Bianca.....	Newcstle	Millar & Co.....	200
" 30	SS Oxenholme.....	Liverpool	Wilson & Green...	415
Sept. 2	Lake Superior...	do	Millar & Co.....	150
" 3	Dominion.....	do	Lomer, Rohr & Co.	160
" 6	Cassius.....	H'mburg	Millar & Co.....	240
" 6	do	do	Lomer, Rohr & Co.	120
" 9	Strs. Magln.....	Liverpool	do ..	185
" 11	Amarynthia	Glasgow.	do ..	185
" 11	do	do	do (bags)	20
" 11	do	Liverpool	do ..	185
" 18	Barque Medor.....	U K. Port	do ..	75
" 20	SS Gleniffer.....	Liverpool	Wilson & Green,..	150
" 20	do	do	Lomer, Rohr & Co	150
				3215 tons
				20 bags.

SHIPPER'S RECAPITULATION.

	Tons.	Bags.	Tons.	Bags
Lomer, Rohr & Co., (to 19th June) ..	2,715	100		
do (to 23rd July)...	1,830	100		
do (to 23rd Aug.)...	1,845	..		
do (to 20th Sept.)...	1,350	20		
			7,740	220
Millar & Co. (to 18th June).....	1,475			
do (to 15th July).....	1,540			
do (to 23rd Aug.).....	300			
do (to 6th Sept.).....	1,140			
			4,455	
Wilson & Green, (to 16th June).....	823			
do (to 22nd July).....	2,132			
do (to 23rd Aug.)	559			
do (to 20th Sept.).....	725			
			4,239	
			16,434	220

RECAPITULATION OF EXPORTS.

	Tons.	Bags.	Tons.	Bags
Liverpool—Previously reported.....	7,075	100		
do Reported to 25th Sept....	1.645			
Reported to date.....			8,720	100
London--Previously reported.....	2,990			
do Reported to 20th Sept.....	550			
Reported to date.....			3,540	
Hamburg—Previously reported.....	1,554			
do Reported to 20th Sept. ..	360			
Reported to date.....			1,914	
Glasgow—Previously reported.....	1,170	100		
do Reported to 20th Sept....	185	20		
Reported to date.....			1,355	120
Swansea—Reported to date.....			130	
Hull—Previously reported.....	300			
do Reported to 20th Sept.....	200			
Reported to date.....			500	
Newcastle—Reported to date.....			200	
U. K. Ports—Reported to date.....			75	
Total exports to Europe since opening of navigation.....			16,434	220

Colliery Winding Ropes.—In the mining district of Dortmund, in 1887, at 91 collieries there were 201 winding ropes, namely, 32 flat steel ropes, 4 flat aloe ropes, 156 round steel ropes, 9 round iron ropes. Of the 3,005 winding ropes discarded during the sixteen years from 1872 to 1887, the following broke suddenly during working:—Of 809 flat steel ropes, 21, or 6·80 per cent. ; of 147 flat iron ropes, 19, or 12·93 per cent. ; of 86 flat aloe ropes, 6, or 6.89 per cent. ; of 8 flat hemp ropes, none ; of 1,598 round steel ropes, 51, or 3·19 per.cent. ; of 857 round iron ropes, 104, or 12·14 per cent. ; altogether of 3,005 winding-ropes 201, or 6·69 per cent. ; in 1872 out of 114 winding ropes, 22, or 19·30 per cent. broke suddenly. This proportion gradually decreased, until in 1887, out of 201 winding ropes, 3, or 1·49 per cent. broke suddenly.

Silver Milling in Montana.

In an excellent paper "Concentration before Amalgamation," etc., read before the American Institute of Mining Engineers, the operations of the Combination Mining and Milling Company, of Black Pine, near Lodge County, Montana, are described as follows :—

"The mill, as originally constructed by Messrs. Fraser and Chalmers for the Black Pine Mining Company, was an ordinary 10-stamp, wet-crushing mill, with room left between the battery and settling-tanks for concentrating machinery should it be found necessary to add it. As illustrating the impractibility of working these ores by raw-amalgamation alone a short summary of the operations of the Black Pine Mining Company may be given.

The mill was started on the 16th of July, 1887, and the run lasted until the 14th of September of the same year. During this period there were treated 1,178 dry tons of ore, assaying 17.5 ounces, and containing 20,615 fine ounces silver. Of this amount there was recovered in the form of bullion 9482.90 fine ounces, or 46 per cent. of the battery assay.

We need only note the points of difference between the Combination Company's plant and the form of mill ordinarily employed for treating silver-ores of the class usually termed "free-milling." These, as is well known, are so-called more because their low grade precludes their profitable treatment by the various other more efficient but vastly more expensive methods, than because they are better adapted to that process.

The ore is stamped, passed over four Frue vanners, the light pulp that goes over their "tails" being settled in tanks, shovelled into pans, and there amalgamated, discharged into settlers, and the resultant amalgam strained, retorted and melted in the usual manner. An analysis of these concentrates for the month of October, 20 tons into 1, gave the following result :

	Per cent.
Silica	32.50
Lead	9.10
Copper	8.22
Sulphur	1.19
Zinc	0.81
Silver	0.54

Samples of the pulp going to the pans for the same month show that it contained :

	Per cent.
Copper	1.05
Lead	0.48
Zinc	0.25
Sulphur	0.09
Silver	0.05

For the year ending May 31, 1889, the details of milling were as follows :

Dry tons crushed	9,061.965
Average assay, ounces of silver per ton	22.67
Gross contents of ore, ounces of silver	205,434.75
Estimated per cent. of reduction	80.70
Estimated product	165.785.84
Dry tons concentrates produced	541.805
Average assay of concentrates, ounces of silver per ton	136.17
Silver in concentrates	73,777.55
Silver in bullion	97,660.60
Total fine ounces	171,438.15
Actual per cent. saved	83.45
Total cost of milling	$ 39,537.61
Average cost per ton	4.36

Batteries in service, 347 days, 5¾ hours.

Average ore crushed per stamp in 24 hours, 2,612 tons.

An analysis of the cost of treating one ton for the year gives the following figures :

Labor and superintendence	$ 25,821
Salt and other chemicals	2,965
Fuel, at $1 per cord	1,944
Castings and iron	3,846
Oils and illumination	1,066
Quicksilver	4,915
Miscellaneous supplies and team in yard	3,084
Total	$ 43,641

When the mill was started by the present management, an assay of the escaping slime-water was made, showing the value of the slimes carried by it to be 52 ounces in silver to the ton, or more than double the silver contents of the original ore. A series of carefully conducted experiments were at once inaugurated, and from them it was learned that three tons of these slimes, dry, containing 156 ounces of silver were passing through the waste-gate from the settling-tanks every 24 hours. These slimes were too light to permit of their being thoroughly settled by even the most extensive system of tanks, and to check this heavy loss, a China pump was placed in the last of the series of slime-tanks. This pump discharges into a small tank placed above and immediately in front of the mortars. It is only 1 foot deep, being made shallow in order to prevent the gradual settling of slimes in it, and the consequent necessity of cleaning it out from time to time. From the side of this tank, and near its bottom, is the 2-inch pipe for supplying the water to the stamps. The only purpose of this tank is to furnish water to the stamps at uniform pressure. By prohibiting the use of any clear water in the battery, the escape of these slimes was very materially reduced, but this of itself was not enough to stop all overflow, as it would be in an ordinary wet-crushing mill, for reasons which will be explained later on.

The immediate effect of turning back into the battery, say two tons, every 24 hours, of slimes carrying twice as much silver as did the original ore (and this proportion of values has always existed), was to heavily "salt" our battery sample, and as the most rigid economy was essential to the commercial success of the property, the question of securing any accurate check on the mill became momentous. After careful consideration, it was decided to adopt the following system: Night and day samples are taken from the battery-launders in the usual manner, and are assayed daily with the other mill samples, but the results are corrected by the salting for the previous month. To determine this percentage, it is simply necessary to obtain the actual battery assay, and this is secured from the data furnished by the balance of the mill work, after the monthly averages are made up, in the following manner: The number of tons crushed, minus the number of tons of concentrates produced, must equal the number of tons amalgamated. The number of tons amalgamated, multiplied by the average assay pan-sample, must be equal to total silver contents of the pulp amalgamated. This, added to the total silver contents of the concentrates produced, secured in the same manner, gives the grand total of five ounces of silver in the ore. This divided by the number of tons crushed gives the actual battery-assay. In this computation all tons are dry tons. The percentage of salting thus determined varies slightly, but the fluctuation is due more to errors in sampling than to any change in the actual amount of the salting. Usually, this is about 5 per cent.

But there was still a heavy loss in the escape from the settling-tanks of water carrying rich slimes, owing to the introduction of water at the heads of the vanners. To stop this, a small jet pump, using steam from the boilers and supplied with 50 feet of steam-hose for a discharge, was placed at the tanks, and slime water used in lieu of clear water for thinning down the pulp in the pans. While this corrected the evil, it also had the effect of increasing the difficulties in the way of concentration, as, in order to stop all overflow from the tanks, only as much water could be used on the heads of the vanners as was pumped into the pans, plus the evaporation.

After much experimenting it has been found, that with the limited quantity of water that can be used on the vanners, a speed of 180 revolutions of the crank-shaft per minute, with a belt travel of 3½ feet per minute, and an inclination of 3½ inches in the length of the machine, gives the most satisfactory results on these ores, although intelligent and constant adjustment is rendered necessary by reason of the changes occurring from time to time in the character of the pulp treated.

By reference to the details of milling for the year ending May 31, 1889, it will be noticed that the mill overran its assays 2.49 per cent., or 5144.63 ounces. As the actual battery-assay is determined by the assays of average pan and concentrate samples, and as the pan-sample is of necessity taken before the rich slime-water is pumped into the pans for the purpose of thinning down the pulp, the mill is bound to overrun, presuming perfect accuracy of sampling and assaying, exactly the amount of that part of the silver contained in the slime-water used in the pans which is amalgamated. As the greatest care is exercised to secure the most accurate sampling possible, and as in the assaying no deduction is made for silver in litherage, except in the tailings sample, the amount that the mill overran may safely be credited to the use of slime-water in the pans.

The pan charges have been changed constantly, according to the character of the pulp treated, and the amalgamation tests have been many and varied. The charge now being used, which seems to be the best tested, is 50 pounds of salt, 2 pounds of sulphuric acid, and ½ pound of cyanide, with 100 pounds of quicksilver strained in after the pan has been running 4 hours. The temperature of the pulp is raised by steam to 180° Fahrenheit, and the charge is run at 65 revolutions per minute for 8 hours. Settlers are run 14 revolutions per minute,, and give good agitation with 3-inch shoes.

In the battery, 40-mesh brass-wire screen-cloth has been used during the past year, with the exception of about two weeks, when 30-mesh was tried by way of an experiment. After a thorough test it was found that the loss occasioned by higher tailings exceeded the profit accruing from increased crushing capacity, and the 40-mesh screens were replaced. The falling off in the savings during the time the 30-mesh screens were in use was largely owing to the fact, that the difference between the very finest of the slimes and the coarse particles that would pass through a 30-mesh screen was so great, that with the increased quantity of pulp to be treated by the vanners, they could not be made to do close and clean work.

The concentrates produced, which thus far have been the final product, have been shipped to a smelter for treatment ; but experiments are now in progress looking to their treatment at home, and it is highly probable that the necessary machinery will be added to the plant in the near future.

The Treatment of Fine Gold in the Sands of Snake River, Idaho.*

By T. Egleston, Ph.D., New York City.

The sands of Snake River, Idaho, have long been known to contain gold. They were worked by some of the first prospectors who came to Idaho, and on the banks still stand the ruins of camps abandoned for years. There are almost always prospectors searching for gold during the season of low water, and it is not an infrequent thing to find a miner of the old type actually panning the sand, or the prospect-hole which he has just left. There is more or less mystery about these miners and their methods of finding the spots where they work. They are always subjects of much speculation to the ordinary traveller. The rich discoveries are, for the best of reasons, concealed until the claims can be taken up. It is difficult to find a place where there are no prospects, but the "colors" are so very fine that they do not offer much inducement to enterprise. The California miner usually values a color at from 5 to 10 cents, often the latter ; while on Snake River it would take 100 colors, or even more, to make that amount.

There is not much difficulty in panning out the heavier pieces of this gravel, so that those which remain have not over half the diameter of a pin's head. Below this size the separation is extremely difficult, as the flakes are very thin. The heavier pieces of the basalt, the black sand and fine gold remain persistently together ; and, after the iron has been separated by a magnet, there still remains a material which appears grayish to the eye, has about the same gravity as the light particles of gold, and cannot be removed with an electro-magnet run by a very strong battery. After the heavy black sand has been separated by the magnet, the fine particles of gold float, while the gray sand sinks ; so that I had the greatest difficulty in concentrating half a liter of material, taken up from under the head of the burlap sluice, into a bulk of 15 by 14 millimeters. A large part of the concentrated gold floats ; and when, after much trouble, the surfaces are wetted and the gold is got under the water on to the top of the sand, the first wave from the other side of the pan over the sand floats the gold again.

The minerals contained in the fine sand are quartz, chalcedony, semi-opal, zircon, topaz and magnetite. I have not been able to distinguish any trace of pyrite, and have only occasionally seen small grains of periodote. These minerals are sometimes ground and broken, and sometimes are small detached crystals, which can, however, be seen only with high powers. The gold itself is in flattened forms. Almost every piece is convex and shows surfaces which are bright and more or less mammilated, having the appearance of having been acted upon by some reagent. They are quite similar to the artificial nuggets which I described some years since.†

It is a question of interest how this gold got into the sands. The most probable answer seems, at first sight, to be that it came from the abrasion of the rocks. This leads to the further question, Why is it, then, so very much finer than gold-sands ordinarily are ? I do not pretend to be able to answer these questions decisively now, but hope to do so at some future time. The object of this paper is rather to describe the method in use for catching a part of the gold.

Snake river, during the course of nearly 100 miles, which I have studied, runs through a columar basalt. The rock covers the plains, where the surface of the flow is covered with great nodules from 15 to 40 feet in diameter, and from 10 to 12 feet high, which have a radiated and at the same time a columar structure. The erosion and destruction of this rock has formed the sands of the great Idaho desert. The rock is much fissured and is covered only to a slight depth with sand. It is generally compact, but the surface of the ground is covered in some places with small pieces so full of bubble holes that they appear like scoria. All such pieces have a more or less large coating of silica on them. It is in this rock that the Lost river disappears, to come out again, as is generally believed, in one of the numerous large springs which flow from the north side of the bluff below Shoshone Falls.

The Oregon Short Line railroad crosses Snake river at American Falls station, where the river is 1,500 feet wide and descends 50 feet in several falls 10 or 15 feet high between bluffs 30 to 60 feet high. It runs west in this way a little over 100 miles, the bluffs on both sides of the river gradually growing deeper, until at what is known as Twin Falls the river suddenly falls 175 feet, leaving the bluffs 500 feet high. In the course of the next 3 miles it forms

Shoshone Falls, where the river first narrows to 750 feet in width and then takes a jump, first of 75 feet and then, within a few yards, of 210 feet, leaving the bluffs at the foot of the falls 1,200 feet high on both sides of the canon and the river 1,000 feet wide. The top of the bluffs is a very hard compact basalt, with occasional small modules of chalcedony, but only in a single place, just above the Twin Lakes, below Shoshone Falls, did I see in this top rock any large holes, and nowhere any appearance of weathering or decomposition in the rock itself in place. The rock is in many places coated with a white covering of silica, formed by the evaporation of the water percolating through or collected on the surface. These coatings sometimes take fantastic shapes, as in the case of the Devil's Spade, about a mile above Shoshone Falls, where what appears to be a painting in white of a gardner's spade can be seen in a niche just below the top of the bluff. Notwithstanding this deposition of silicia, the rock shows to the eye no trace of decomposition. I was told that the iron pyrites is found in modules in the upper part of the bluffs ; but I did not see, in the course of more than a week that I spent on the river, a single piece of iron pyrites, however small, though I looked carefully for it. Below the great Shoshone Falls, on the level of the river, the rock is porphyritic, light gray in color, and much more felspathic and friable than the basalt above, and thoroughly rotten from decomposition. About 100 feet from the foot of the falls it is so worn away that I crawled through apertures in the decomposed rock for 25 or 300 feet, at a distance of about 10 feet above the water, the outside of the rock still being intact. This decomposition is much like that which occurs in the sand-rock of the Kentucky River, near Jackson, Ky. It is not an uncommon thing in the various side-canons which lean into the main canon of the river to find that the bottom rock has been so much decomposed, by the absorption of its alkalies, or so much washed out, that pieces of the overhanging hard rock, 50 to 75ft in length and 8 to 10 feet in width, have dropped down, retaining their vertical position, leaving a chasm 2 or 3 feet wide between them and the main rock. Striking examples of this occur in the side canon near the Twin Falls and below the Great Falls.

This decomposition of the underlying rock has taken place on a very large scale, and is particularly visible just above and for a considerable distance below the main falls, so that the surface for 500 feet from the main cliff is broken up into what appears at first sight to be small terraces, which are difficult of access. From the top of the cliffs this sinking of the rocks gives an appearance, on a very small scale, quite similar to the grand canon of the Colorado river, as seen about 75 miles from Flagstaff, Arizona, when the same phenomena takes place on a different rock, on a scale probably larger than anywhere else in the world. The water of the river is cool, and slightly alkaline to the taste. The soil is full of alkali, which is undoubtedly one of the results of the decomposition of the rock. It is also probably one of the sources of the solution of the gold, and its subsequent deposition in the sands of the high banks as well as the deposition of the silica minerals formed by evaporation.

It is a fact well known to those who chlorinate pyrites concentrates, that the gold they contain is in all degrees of fineness ; that, in some cases, it is extremely difficult to attack the gold ; and that, in other cases, the loss in roasting is enormous, on account of the very large surface, as compared to the weight, of the gold particles. It is known that the gold is much finer in some pyrites than in others, and I supposed at first that this might account perfectly for the condition of the gold in these sands. The microsopic examination, however, does not justify the conclusion that the gold has come exclusively from the decomposition of pyrites ; since in no case have I been able to find any gold that was coated, or the surface of which was not just as bright as if it had been for a long time exposed to chemicals. That small quantities of gold are contained in solution in the waters flowing through these rocks seems to be probable. The experiments that I have been able to make in the laboratory tend to confirm this opinion.

Snake river, below Shoshone Falls, runs for 18 miles through basalt, the height of the bluff varying from 1,200 feet at the falls to about 500 feet at the end of that distance. It then commences to widen out gradually, the talus of sand increasing little by little in height until at last the outlines of the rock only, come up at the top of the bluff. These finally disappear ; and what was a talus becomes sand-hills on the south side, and, on the north, more or less irregular sand-bottoms, with cliffs of basalt varying in height, but generally not more than 30 to 40 feet high, so that in several places roads have been constructed in the side canons from both sides down on to the bottoms. On the top of the bluff there is no water. The rock is columnar and very much fissured. It dips south, so that there are no springs on the south side of the river, but all along the north side at intervals of three or four miles great springs gush out, which form at once considerable streams, issuing directly from the rock.

The river bottom-lands widen from nothing to about half a mile. They rise above low-water mark as much as 30 to 40 feet. Where it is possible to get water to them, either from the springs on the north side or by flumes taking water high up the river on either side, the sands, after the alkali is washed out of them, make excellent soil, and in both ways some beautiful ranches have been made.

The sand in the river contains some gold, not in large quantity anywhere. It is so very fine that it is difficult to collect it without special apparatus. The gold value of these sands is estimated at about five cents to the cubic yard, which includes top soil and bottom gravel as well. The pay-streak is richer than this, but in the working it is impossible to make any separation.

The pay-streaks, after prospecting, are worked on both sides of the river. There are a number of these placer-workings about 50 miles below Shoshone Falls, which have been operated for a number of years by a method but little known. One of these, known as Hunt's placer-claim, at Salmon Falls, which is 17 miles across the desert from Bliss Station on the Oregon Short Line Railroad, I had occasion to visit in the summer of 1889.

The method of excavating the sands is simple. It consists in bringing a ditch into the pay-dirt, and making the ditch itself do almost all the work of excavation. The fall of the water breaks the ground down, and sufficient grade is given to carry it to the machines. The best grade for the water-ditch has been found to be 4 inches in 12 feet. Ditches with earthen banks, and flumes, sometimes partly in earth, and at others wholly on tresses, are used. When the ground-sluice is not over 36 inches wide, gravel runs easily on a 4-inch grade. The long flumes have a grade of 3½ inches to 12 feet. The ground-sluice is made so as to gradually work back, cutting itself out by the fall of the water. The top soil is broken back by the pit-man with a steel bar, and the lumps are broken up with a light pick. The pay-gravel varies from 10 to 25 feet in thickness, and has to be washed in benches, taking from 5 to 8 feet for a bench. No ditch is required in the gravelly places. The stream is directed around the bank by the pit-man, who uses "shear boards," 14 inches wide and 2 inches thick, with round sticks 1 foot long and 2 inches in diameter, run through them as handles' These are so placed as to direct the water against the bank, to undermine it slowly, so that the sands cave, but not so rapidly as to impede the course of the water. These planks require the constant attention, in the day time, of one man in the pit, who in ten hours will bar down ground enough to keep the machine working for twenty-four hours. The skill of the pit-man consists in so barring his gravel and arranging his shear-boards that the pit will take care of itself at night. The current must be strong enough to carry all that falls into the sluice leading to the machine. Occasionally, the ground-sluice is dammed by the gravel in the night, and cuts a channel in such a way as to make it impossible to reach certain blocks of ground. This is not, however, a serious inconvenience, since the ground has to be broken in benches, and the spot so left is taken in, in working the bench below.

The stream carrying the broken-up gravel runs through sluices, in general not more than 24 inches wide. But, from about 8 feet before it reaches the first iron plate of the machine, the sluice is enlarged, so that where it meets the plate it is 4 feet wide. The machine consists of a board-sluice, lined with perforated sheet-iron plates, 3 by 4 feet in size, which are called "grizzlies." Below them, on both sides, is an inclined sluice, leading to an undercurrent, which discharges into sluices covered with burlap, called "sack-boxes." The width of the machine is constant, but the length varies with the fineness of the gold to be caught. At Hunt's claim there are three—one 24, one 30, and one 36 feet long. The flume that carries the gravel is 1 foot lower than the top of the "grizzly." The sand accumulates here and makes a pavement, and prevents the wearing of the bottom. In some of the small machines this sluice is paved for some distance with wooden blocks placed on end ; but all of them have blank plates for the length of one plate, at least, set almost without grade; and these have been found to wear best, as the water builds its own grade from the sluice to the machine. The blank plate is 4 feet long. It is made, like the other plates, of steel or coke iron, 5-32 of an inch thick. The grizzly-plates are perforated with conical holes, ½ an inch between centres, which are 5-32 on the top and ⅜ on the bottom, to prevent the holes from clogging. These plates are 3 feet long and 4 feet wide. The sides of the sluice are made of boards, 1 inch thick and 12 inches wide, except just over the undercurrent, where they are 2 feet wide. The grade of the "grizzlies" varies from a ¼ to ¾ of an inch, according to the size of the gravel. The coarser it is the more grade is required. In setting up the machine a frame is first built, and on this the grizzly is placed loose, so that the grade can be changed if necessary by wedges placed underneath it. Ordinarily, ½ an inch to the foot is found to be the best grade. When the grade is determined, the grizzly is wedged firmly to its place. At the end the grizzly discharges the material too large to go through the holes into the tail sluice, which must have sufficient grade to carry off all the tails. Below the grizzly the sides incline both ways towards the center at the rate of 2 to 3 inches, or more, to the foot, and end in an undercurrent called a "sand-tank," which is 4 feet wide. This has a grade of 1½ inches to the foot, towards each side. It is generally placed immediately under the center line in the middle of the machine, but its exact position depends on the lay of the ground. In its center is a sump, 4 inches lower than the lead-boxes, so as to distribute the water equally to the burlap-sluices on each side of the machine. These are 4 feet wide, incline ½ to to ⅜ of an inch to the foot, and are arranged according to the length of the grizzly. For the 36-foot grizzly there are twelve of them, six on a side ; for the 30-foot, there are ten, five on a side ; for the 24-foot, there usually are only six, three on a side. Four would work better. The grade of the lead-boxes is ½ to 1 inch to the foot. The lead-sluices are arranged so that the back one carries the gravel to the sluice furthest away from the machine. They are 10 inches wide. In order to distribute the sand evenly in the width of the sluice, there are four divisions at their head, which vary in length so as to distribute the current equally. At their upper end there is a movable grating made of strips of wood, set inclined, to keep out any floating matter which may accidentally get in, and to further distribute the stream. The sluice-boxes are 3 feet wide, and 24, 30 and 36 feet long ; made of thin boards placed end to end. The sides are 6 inches high and are nailed to the sides of the bottom boards. They have a grade of ¼ to ¾ of an inch to the foot. If the material treated is all sand, which is the usual case, the grade is ¼ ; if gravel and sand together, ¾. These burlap-sluices connect with the tail-sluice by a sluice at their end, at right angles to the main sluice, which is 3 feet wide and has a grade of ½ an inch to the foot, over which the burlap-sluices project 6 inches, and which projects 2 feet beyond them. These sluices, like the grizzly, are set on a frame, so that the grade can be changed by wedging, and when once determined on, can be set firmly in place. As the tail-sluices are on both sides of the machine, they discharge in front of the grizzly with sufficient force to move all the tails down the main tail-sluice.

At the head of the burlap-sluice, just beyond the wooden gratings, which regulate the flow of the gravel, is a cross-cleat, under which an iron plate, 1 foot wide and as long as the width of the sluice is fitted. This is made of old grizzly iron. It is held down at the side by a cleat, under which it slips.

The sluice is covered with burlap 40 inches wide. It has been found by experience that 7 ounces to the yard is the best burlap to use. Heavier and lighter have been used, but are not found to answer so well. The lead-sluices have a grade of 1 inch to the foot ; when the plate is put on them, there is a slight drop ; and here there is always gold to be seen at the clean-up. Each of the lead-sluices is so arranged that it can be cut off separately. This is done by a gate of wood wrapped with burlap to make it quite tight and, in order to further keep out the water, the burlap, which is to go on to the sluice after the clean-up, is thrust into the lead behind the gate, which prevents the passage of water and at the same time wets the burlaps, so as to fit it to be spread out on the sluice. These gate-wrappings, as soon as the clean-up is finished, are hung up on the east side of the grizzly, so as to be ready for use at the next clean-up. The burlaps on the sluices are held down by cleats of wood, kept in place by wooden eccentrics, screwed to the side, so that when they are turned down, they hold the cleat in place. These cleats are 1½ by 1 inch and are cut from a 1-inch board. After six years' use some of them are so worn that they have to be turned up on their angles to meet the eccentrics. In the 24-inch sluice there are six of these on each side.

To make a clean-up, the man in the pit comes down to the machine with the superintendent, and the water is turned off from each of the sluices, one at a time, commencing always with the outside sluice. The assistant has a piece of flat rubber set in a handle. He knocks down the eccentrics on both sides of the sluice to be claned, with the handle, so as to loosen the cleats. These are then taken out, washed in the next sluice and placed crosswise over it, to be at hand when wanted. The superintendent takes out the iron plate at the top and carefully scrapes off the sands and gold, washing the plate in the next sluice. The assistant takes the burlap from the bottom, brings it up to the center of the sluice, and commences to push with his rubber the material collected underneath the burlap on the bottom from the lower end to the middle of the sluice. The superintendent carries the top of the burlap to the middle, folds it to 18 inches and the width of the sluice, then doubles it over towards the side of the sluice, presses it flat with his feet, and places it in one of the boxes. There are two of these boxes for each sluice. They are 18 inches long, 13 inches wide, and 7½ inches deep, and are lined with tin. The woodwork of the boxes is only knocked together, but with constant use they last four years. When the tin commences to rust through, so that they leak, the boxes are used exclusively for the burlaps. The tight boxes are always used for the sand. While the superintendent is

arranging the blankets, the assistant goes to the top and pushes the sand down to the middle, to be put into the other box. When the sluice is clean, the fresh-wetted burlap is taken out of the lead-sluice, the upper end being held by the superintendent and the lower end by the assistant, and stretched with both hands over the sluice, leaving the upper end of the burlap to project over the upper end of the sluice. The burlap is shoved under the cross-cleat by the iron plate, which is cut off at the corners to prevent cutting the bnrlap; this goes under the cleat and is held fast, leaving about 2 inches of the burlap projecting over the top of the plate. The side-cleats are now taken from adjoining sluice and put in, commencing at the top. On their hands and knees the two men go from the top to the bottom, pressing the cloth in place, spreading the burlap so that it comes up to the sides of the cleats and sometimes over the top, according as it stretches. They then turn down the eccentrics, put in the grating, and turn on the water. This work, in a single sluice, takes five minutes. The next sluice is treated in the same way, and so on until the clean-up is completed. They are careful to spread the burlap tight and smooth; for, if it is wrinkled or bulges, sand collects under it and less gold is caught. If they are properly put down, only two or three pans of sand will be thus collected which, at the head of the sluice, contains considerable visible gold. Most of the gold, however, is caught in the burlaps.

The burlaps are cut so as to cover the whole length of the sluice and lap over the lower end; but they wear, and after some use grow short, so that they are generally 18 inches to 2 feet shorter than the sluice. The lead-sluices at the head of the burlap-sluice, which distributes the stream, are keyed in and are kept together by diagonal strips. The grating is put in loose, 6 or 8 inches from the slats.

Nothing but burlap has been found to answer for this work. Ducking was used at one time, but it did not catch the gold so well and rotted too fast. The burlaps are used until they go to pieces from rotting. They usually last two months. When worn out, they are used around the gate. When they can no longer be used, they are dried and burned, and the ashes are panned. In order to prevent the closing of the pores by vegetable matter, the burlaps must be spread out in the sun to dry thoroughly after each clean-up, to destroy the plant-life before they can be used again. They last longest in summer. In the winter they are apt to tear from freezing at the sides. The whole work of the three machines is done by five men,—one man in each pit; the helper, who does other work; and the superintendent who, with the pitmen, makes the clean-up and "rocks" the dirt.

Over the 24-foot machine, 200 to 250 inches of water are constantly run in 24 hours: on the 30-foot, 350; and on the 36-foot, 400 inches. The work done on each machine averages about a cubic yard of gravel for each miner's inch of water used. The essential requisite is to secure a good dump; unless this is done, the tail-sluices will soon be filled up. Usually, on Snake river the spring freshets wash the tail-sluices out; but for two or three years, on account of the low water in the river, this has not been the case. It is also necessary to set the bed-rock sluice in such a way that there will be plenty of water the year round. In some places it has been set too high, so that when the river is low there is no water to wash with, while there is plenty of water in the river. Not only plenty of water, but free water is essential to the economical success of this process.

The boxes from two of the machines which are at a distance, are cleaned at a shed near the house, half a mile from the sluices. In one which is difficult of access the rocking is done on the spot. The clean-up house is 14 by 12 feet. On the long side against a window is the washing-tank. An ordinary gold-sand rocker is placed at the end next a window, and the retort-furnace opposite to it. The boxes containing the burlaps are piled next the washing-tank. The sand in the boxes is piled next to the rocker. The washing-tank is 10 feet long, 3 feet wide and 3 feet deep. It has a shelf 6 inches wide behind, and one 4 inches wide at an angle of forty-five degrees in front. The burlap taken from the box is washed several times up and down in the tank, where water is constantly running in and out. It is then allowed to fall into the tank; the end being held by the hand, is washed by shaking it on to the front ledge, and is then folded backward and forward so as to make the folds 1 foot wide. It is then thrown on to the ledge behind. The gold sand from the burlap which remains on the front ledge is then washed into the tank, the end of the burlap is brought over on to the front ledge, while the rest remains on the opposite ledge, and the space between the two parts of the burlap washed up and down and again folded on the front ledge. This is repeated twice; so that each burlap is washed three times. The ledge is washed every time to throw the gold into the water. The washing is done at some distance from the discharge-pipe, to avoid the danger of the fine gold floating off. The sand collected at the bottom of the vat is allowed to settle until the water is almost clear. The water is drawn off from above at three plug-holes, at different levels, and the sand collected is rocked. The rocker has a plate 60 inches long by 24 inches wide. The end and sides are turned up 1 inch, so that the inside space on the plate is 22 by 59. The hopper, into which the sand is put, is 13 by 15 inches, and 5 inches deep. The bottom of the hopper is made of a grizzly plate and the constant washing has worn grooves laterally towards the holes. The inclination of the plate is 2¾ inches in 2 feet, which experience has shown to be the best. The plate is copper and not silvered, silver-plated plates not having been found to answer. The plate is first washed with a swab soaked in potassium cyanide. Then mercury, sprinkled half way down through a fine cloth placed over the end of a bottle, is wiped over the surface with the cyanide swab. The sand is put in at the hopper and the rocker is rocked seventy-eight times a minute. What comes off the plate runs into a tail-sluice, and carries almost no gold, not more than two dollars to the ton. About seven small coal-shovels full are worked in a minute, care being taken never to clog the holes. This is all that is done with the sand from the boxes. The sand from the tank is mixed with cyanide, the proportion being determined by trial, and allowed to stand two hours before rocking. The moment the rocker is stopped, the end of the amalgamated plate is turned up so as to drain to the back, to prevent the loss of mercury and amalgam. Each machine is cleaned twice a week. The 24-foot treats from 78 to 80 tons per day, and the others correspondingly more. The gold collected by this method is very fine,—much finer than any that I have seen, except from some of the Arizona placers.

The machine runs itself, with only one man in the pit. It pays to run sand which has from 50 to 85 colors. These machines collect from thirty-five to forty dollars a day each. The work of the clean-up varies with the size of the machine. With the 30-foot machine, all the work of cleaning up the sluices, washing the burlaps, spreading them out to dry, and rocking, is done in six hours. The 36-foot machine takes an hour longer, and the 24-foot an hour less.

This method is one of the least expensive of all the devices for the treatment of fine gold. It requires but little capital and labor, and the returns well repay the men. It requires, however, free water. By changing the grade of the machine and sluices. and multiplying the number of burlaps, very close work can be done.

* Paper read at the Ottawa Meeting of the American Institute of Mining Engineers.

† *Trans.*, ix, p. 633.

Coal-Mining and the Duties of Colliery Managers.

The following address was given by Mr. William Rogers, J.P., F.G.S., at the annual meeting of the National Association of Colliery managers, held at Wigan in the North of England.

Every intelligent workman, before commencing operations in his particular trade, necessarily considers well the material he has to work upon, the object he desires to obtain, and the tools he has to work with; and before he is an efficient manager he must further know what is the necessary knowledge he must acquire in order to place him in this position. Our first point of enquiry, therefore, must be this, viz.:—What is this coal, the material upon which we have to work? Time does not permit me to enter into a scientific description of the origin or formation of coal; we all know that it is supposed to be a vegetable formation, in some cases of large forest trees, and in others of more humble origin in the shape of lower growth, such as ferns, moss, &c., which by peculiar coverings of water and soil has escaped the ordinary and natural decay so general in all vegetable matter; but there are coals and coals, and it is of the greatest importance, before you can arrive at the best mode of working any particular stratum of coal, to see that you clearly understand its special nature. For instance, some seams of coal may be hard, others soft, some seams thick, others thin, some seams are intervened with bands of foreign matter of varying qualities; the strata also above and below the seams to be operated upon want due consideration, such as the nature of the roof and floor, and if the field is disturbed or dislocated by faults they also form an important element in arriving at a right conclusion as to the best mode of opening it out. All these indicate to you not only the vast importance, but the absolute necessity of a certain amount of geological knowledge, which will make your work not only more interesting, but far more efficient and valuable. Formerly the study of geology was confined to, comparatively speaking, a few scientific men who had both leisure and special training to pursue it, but now, happily, we are living in an age when there exists a desire and a real endeavour to combine theory with practice in all branches of industry, and the facilities for your acquriement of the amount of geological knowledge necessary for any of yourselves are greatly multiplied; these are advantages possessed by colliery managers of the present day which were utterly unknown by your predecessors. If it had been a compulsory study for all workmen seeking advancement as a colliery manager, numbers of areas of acres of coal now unworked would have been opened out, and work found for thousands of our artisan classes, and on the other hand thousands of pounds would have been spared the country in foolish attempts to find coal where none could possible exist. To some geologists the idea years ago prevailed that coal did exist where it has lately been discovered through the borings for the Channel Tunnel, and I think I can safely predict that there are yet existing vast fields of coal which at the present time are not even thought of. It may, however, be said, and with some truth, that the prospecting for coal is more the province of a mining engineer than a colliery manager, but surely an intimate knowledge of the strata, through which a sinker has to pass before reaching the coal, is of the utmost benefit to the colliery manager.

The history of mining is lost in the traditions of the past. Early Scripture history shows us that the Egyptians and other nations were intimately acquainted with metalliferous mining, and before then mining was extensively practised by Asiatic races. When the use of coal came first into existence history is altogether silent or very vague. In this country, I believe, tin and copper mining were first known in Cornwall, but the early stage of coal-getting can hardly be dignified by the name of mining. There is scarcely a mining district where the coal crops out to the surface that has not extensive remains of day-eyes or tunnels driven from the surface. The extent of such tunnels was of necessity limited by measure of the animal power that could bring the coal from the face to the entrance of the eyelet or tunnel, or where water existed, to the limit of drainage power. Of course, in those days the use of coal as a general article of consumption was comparatively very limited. In many places (and I believe this state of things can be remembered by some now living) the coal had to be conveyed on the backs of pack horses to the nearest points of distribution. This limited demand naturally prevented any systematic mode of getting it, although in a few more populated districts shallow shafts were sunk, and windlasses or whimseys were utilised for the purpose of raising it. It is amusing and interesting to anyone, but especially to colliery managers, to contrast the very clumsy and yet simple methods of getting and dealing with coal in the past with the wonderful advantages we now enjoy. Really and truly, mining in the strict sence of the word did not become a practical science until the successful application of steam power to colliery operations, completely revolutionising the whole trade. Rapid indeed was the progress of coal-mining when the steam engine as an effective machine came into popular use, creating at one and the same time the demand for coal as the feeding power of the mechanical steam horse, and the means of winning the same, by bringing it from the face of the mine to the bottom of the shaft, and again from the bottom to the surface, by clearing the mine, by steam pumps, of its old enemy, water, and by ventilating it either by furnace or fan of the deadly foul air and gases so fatal to the thousands dependent upon it for their livelihood, and last, and by no means the least, by distributing it at a cheap cost over the United Kingdom, and even over the mighty seas which lap our shores. The power of steam was known thousands of years ago; its useful application scarcely goes back beyond the last century. From that useful application has sprung up untold wealth to the world. We have it upon indisputable authority that at the commencement of last century the pit shafts in the north of England—afterwards to become the greatest coal district in the world—were only a few yards in depth, none exceeding 50 yards; there was no mechanical haulage underground, the coal was actually carried from the working-places to the pit bottom on the heads of women and children; a slowly-revolving whimsey, propelled by some animal, performed the operation of winding and pumping; and upon reaching the surface, horses and mules conveyed loads not exceeding 3 cwt, of coal over very bad roads, across hill and dale, for shipment. At that not very remote period there was no other mode of conveyance. Ventilation needed no appliances because the workings were so limited in extent, and the persons employed so limited in number, that natural ventilation fulfilled all requirements. Somewhat later, roads for the better transit of coal were made, and consignments of something approaching 17 cwt. were made possible in carts. Then wooden rails were laid as a help to the carts, and afterwards wagons were used, provided with sails.

The rapid development of coal mining causing extensive workings at nearly every pit presented a new and serious risk to the workman in the form of explosive gas—hitherto the chief danger being firedamp and (what is still too much the case) falls of roof. This explosive gas was the cause of many and appalling losses of human life, hundreds of poor follows at one instant of time being killed and mutilated, and thousands of pounds lost in damage to the workings where they occurred. It is also true that even now the world is not exempt from the recurrence of these explosions, but what would have been the extent of them had not Sir Humphrey Davy

invented the safety lamp, it is appalling to think. The greatly-extended workings of the present day necessitate increased ventilation, and this is a subject that every colliery manager should never lose sight of. The more rapid velocity of air through the workings has to some extent lessened the safety of the lamp, as there can be no doubt that explosions have taken place through the current of air being driven through the wire gauze hitherto so impervious; there again the existence of a new danger leads to the effort to discover a suitably remedy. New lamps to meet this difficulty have been introduced in a great many instances, but, in my opinion, the safest lamp, without at all depreciating the excellence of the electric lamps, is yet to be found in some modified form of the old and tried friend that has served the collier for so many years. I would, however, impress upon all colliery managers the old proverb, "Prevention is better than cure," and he is the best manager who, by carefully distributing a sufficient quantity of air (not only in the working-places, but also through the goaf) prevents the possibility of the formation of huge gasometers.

This slight sketch of the progress of coalmining brings us to our present favoured position. As compared with the old days of manual labour, ill-directed and badly applied (being merely a labourer's calling), we have a trade requiring all the assistance that science (in the form of geology and chemistry), skill and appliances in the forms of engineering, both mechanical aud mining, can give us. We require stores and implements unknown and unthought of in its early history, and many trades have sprung up in connection with mining, finding employment for thousands of our labouring classes, wire and steel ropes, steel rails and wheels, iron castings, timber and other utensils too numerous to specify in detail requiring a training for the position you gentlemen now hold, second to none in the industries of this country. We now have pit shafts sunk to a depth of near upon half-a-mile; poverful winding engines hundreds of horse-power, worked by steam, and raising tons of coal at each journey at speeds equal to that of an express train; workings extending for miles from the pit bottom, and mechanical power conveying expeditiously large trains of coal from the working places to the cage; magnificent pumping appliances placed above ground or below, and capable of raising any quantity of water from any depth; enormous ventilating machines passing through the workings of a colliery not merely tons, or even hundreds of tons, but thousands of tons of air per day, and capable of running night and day for years. And much as has been done during our own century, the next will, in the opinion of many who are competent to judge, be equally fruitful of improvements. Shall I, at this point, without trenching on a later portion of my remarks, suggest that the wonderful invention of electricity, still in a state of infancy, will probably advance to giant's growth? Shall we have it applied not merely to signalling, but to pumping and winding and hauling? and in the actuel getting of coal? Greatest perhaps of all, will the dim light with which we now grope our way amidst the darkness underground, contending with dangers more difficult because unseen, pass away? and by an effeetive and safe and comprehensive application of electric light, provide us with an illuminant in every part of our mines, equal to the light of day?

To a certain extent the mining schools of this country have rendered most efficient service in providing for the requisite knowledge in chemistry, mechanical engineering, &c., but I should like to see the day when these schools are not only used by aspirants for certificates, but those who, having acquired them, still desire to extend their knowledge, and apply it to the special works under their control. I am convinced that the better chemical acquaintance with the seam of coal a manager has to win, and an extended acquaintance with the science of mechanical engineering would frequently assist the firm he is connected with in various ways, such as finding the most suitable or particular coal markets, and he would save them hundreds of pounds in more ready mechanical contrivances for drawing and raising it to the surface. I believe that great benefit would arise to the trade generally if the managers would seek out and encourage miners of thought and experience, so that by their aid a more easy and effective method of winning coal would be soon discovered at a cheaper cost, resulting in increased wages to the collier with less trouble to himself, a less percentage of small with a greater percentage of round, and a greater employment for labour.

A colliery manager's first duty is to provide for the safety of the men under his employment. This is a short sentence, but what does it not embrace? No mine can be safe unless all the details essential to mining are carefully thought over and carried out. Parliament has wisely set out certain rules to guide a colliery manager, but these regulations only touch the fringe of what ought and must be done before the maximum amount of safety can be secured. He is, indeed, a poor manager who thinks he has done all that is required of him when he has committed to memory these rules and reduced the same to practice. In order to prevent accidents from gas, too much attention cannot be given to proper and sufficient ventilation both in the goaf and working places; also, to prevent accidents from falls of roof, a regular and systematic inspection of the main roads and working places must be made; and, further, to prevent the numerous miscellaneous accidents, uniform attention must be given to propping, inspection of the main roads, machinery, and all working places.

The next duty of a colliery manager is to see that he gets his coal at the cheapest possible cost, consistent with the safety of the men under his supervision and the efficient opening-out of the mine. It will be seen that very much depends upon considering in the first instance a well matured plan. This is of the utmost importance, and I would urge upon managers, after having carefully considered their plan, not to deviate from it unless some glaring error is manifest. Many good collieries have been rendered too expensive to work by ill-advised and badly-matured plans, and even in some cases through having been worked haphazard without plans at all. One great point is not to open out the mine too extensively at one time, thus incurring large dead expense in keeping open the requisite roads and airways; another is to have as short drawing roads as possible, for the great aim of every manager should be to keep the collier and his drawer as much occupied at the face of his place as possible, The various systems of mechanical haulage, whether tail-rope or endless rope, and whether driven by steam or compressed air, enable us to overcome all difficulties under this head. Again, too little attention is, I fear, in many cases paid to the saving of timber, pit rails, coal tubs, &c. There are few concerns that at one time or another have not to lament the loss of rails, and more old timber is lost annually than can be imagined, from neglect to draw it when opportunity arises. Another great point is to see that the proportion of small to round is kept at the very lowest point. The annual loss under this head is something enormous, and I should say that a manager who can decrease this percentage is almost as great a benefactor as the celebrated agriculturist who could grow two blades of grass where one grew before. A great deal depends, of course, upon the nature of the strata lying above or below the seam to be worked, but where holing is possible in the warrant it should always be strictly followed out.

Again, in these heavy days of competition, the condition of the coal as far as cleanliness is concerned is a great and important subject for attention. I have seen positively unmerchantable coal take a fair position in the market where this point has been carefully watched and attended to. This opens out the wide subject of coal picking, coal sorting, and coal washing, on which we have not time to dwell.

Lastly, there is the great and important question of output, and here I would point out the necessity of a manager studying the interests of the miner under his charge. The get of any one collier is of as much importance to the concern he serves as it is to the collier himself—what is a loss to the one is also a loss to the other. Short drawings, plenty of empty tubs, good roads, sufficient props, quick despatch of full boxes means filling the pit with good workmen, while others are shorthanded. Above all, I would impress upon you the fact that colliery managers are men of position who should respect their office and themselves if they desire to have it respected by others; they should be courteous in manner to those under them while firm in their determination to see that all do their duty—violence, hasty temper, and bad language only degrade, and do not assist the manager in controlling those under him; a kindly word and an interest so far as is practicable in each collier's work under him is a surer method of having his wishes obeyed.

I have purposely avoided dealing with any special subject of a controversial character, pointing out the goal all should strive to reach rather than the means by which it should be arrived at. Time would not permit me going into the numerous questions of detail. Let safety and cheapness of output be your watchwords so far as the management of the mines under your control are concerned, and courtesy, firmness and fairness be your watch words so far as the men are concerned. The human machine, remember, is far more intricate to manage than the natural laws that govern mining. First learn how to govern yourselves, and then the watchwords I have given you will assist you in managing others. I am by no means an enthusiast, and do not expect the day will ever arrive when men, having separate interests, will arrange them without some friction, but of this I am convinced, that where courtesy and firmness are displayed on the one side it will be more or less reciprocated by the other, and that where interests are mutual there will be a mutual desire to make them so.

Messrs. Doblie & Stewart, Thorold, Ont., have issued a handsomely illustrated catalogue of their specialties in machinery for contractors, miners and quarrymen.

The new works of the Canadian Rand Drill are now in full swing under the management of Mr. F. A. Halsey, formerly of the New York establishment.

The General Phosphate Corporation.

The statutory general meeting of the General Phosphate Corporation, at Cannon-street Hotel on Tuesday, 16th Sept. was a lively affair.

The Right Hon. Lord Stalbridge was in the chair, and in the course of his address he said:—

Ladies and Gentlemen, as you are all aware, this is the first ordinary or statutory meeting of the company, and it has been called perhaps rather earlier than the extreme limit which is allowed by law, in order to make you fully aware of the present arrangements of the company. Of course it is not possible to go into great detail, but still we thought it was only right that you should know exactly what has been done. In Canada, as you have seen, there appears to have been a general scream of delight at the operations of your corporation, and every owner of either what was real good phosphate property, or what was thought was good phosphate property, furbished up his lands, such as they were, and hoped, by some means or other, to foist them at once on this corporation; but I can assure you that your directors intend to be in no hurry in purchasing properties without making themselves thoroughly acquainted with the value of those properties. We are now at this moment entering into provisional contracts for the purchase of two what I trust will prove valuable properties to the company; but before doing so we intend to make ourselves thoroughly acquainted with the value of those properties. With that object one of the ditectors, Sir George S. Baden Powell, M.P., who is thoroughly acquainted with Canada, and with all the leading gentlemen in that Dominion, has gone off to Canada, and is there now. Our able solicitor (Mr. Davidson) hopes to leave also shortly for Canada in order to perform the legal part of the business, and examine the titles and so on. We hope by means of these two gentlemen, aided by experts, in accordance with the aims laid down in our prospectus, to be, before the end of our first year, the possessors of valuable and good properties. Of course, the difficulty with such a property as ours is to obtain a thoroughly valuable output, and we do not intend to purchase any properties without obtaining guarantees from the vendors that the output will come up to what they assert it is to be, both in quantity and quality. In that way we hope to pecuniarily benefit the corporation, and to become the owners of valuable properties. More than that, we do not intend to run before we can walk. We do not propose to proceed too fast, and we certainly shall not take every property that is offered to us. I can assure you that the list of properties that have been offered to us would reach nearly from here to Charing-cross; but we do not intend to proceed without the utmost caution. I regret to say that two of our directors have resigned, from causes over which they had no control. Mr. Sampson Lloyd finds that the times at which the board meet are not those which enable him to give that attention to the company which he would like to give, and he has therefore resigned, and Sir James Whitehead, I am sorry o say, since he joined the board, has been ordered by his medical adviser to go abroad for some time. Sir James worked very hard on the board while he was in London, but owing to the advice of his medical adviser, and knowing that at this period of the existence of the company it is absolutely necessary for the directors to give their attention to it, he has sent in his resignation, which, I need hardly say, has been accepted with very great regret by the board. We, of course, shall not be in a hurry to elect fresh directors, but we shall take our time to select gentlemen who will be able to give time to the board, and will also be able to give it the benefit of their experience. I do not know that there is anything more that it is in my power to say at the present time, except to assure you that the prospects of the corporation are very good indeed, and I hope and trust that in a year's time we shall be able to appear before you with a satisfactory account of the proceedings of the company.

The shareholders listened with commendable patience to the noble chairman, but immediately he sat down there was a hurried movement amongst certain turbulen spirits present to commence "heckling" him.

A Mr. Grantham had the first innings. He wanted to know the number of shares actually allotted.

"Twenty thousand shares," replied his lordship, "equal to a capital of £200,000."

"Absurdly insufficient," said Mr. Grantham, amid a chorus of "Hear, hears."

Then several indignant folk wanted to know why Sir James Whitehead and Mr. Sampson Lloyd had resigned, and if up to the time of their resignation they had been in accord with the rest of the board.

Lord Stalbridge said they had, but some incredulous shareholders appeared to doubt it.

Then followed a rough-and-tumble conversation, during which Messrs. Grantham, Foreman, Snare, and Unwin kept bobbing up and down like so many jacks-in-a-box. Lord Stalbridge kept his temper admirably; not to some of his tormentors, who indignantly asserted that had they known that the company would have gone to

allotment on so small a subscription they would unhesitatingly have withdrawn their applications for shares.

Some, in fact, went so far as to request the chairman to call a general meeting, in order to see whether, under the circumstances, it was desirable to go on with the company; others stated they would be content with getting back a portion of the money they had paid, for they were convinced that if the company went on not only would they lose all they had put into the concern, but that they would, in all probability, be liable to a further call.

The chairman asserted that, in the opinion of the board, there was no necessity for making a further call; but several shareholders impolitely asserted that this was all fudge.

Pressed to call the meeting asked for, the chairman firmly declined to do anything of the kind. He said there was no necessity for calling such a meeting, as he and those associated with him had every confidence in the future of the undertaking.

Frankly, I think "it goes without saying" writes the editor of the *Mirror* "that many people put their money into the General Phosphate Corporation on the strength of the magnificent list of founders, whose names are paraded big in the papers and in the prospectus. The list of founders is, we are assured, the same as when the company was floated; if they, then, have confidence in the concern, there should be no difficulty whatever in filling the places of the directors who have resigned from out of their number. Until this is done, and men as good as Mr. Simpson Lloyd and Sir James Whitehead have been elected on the board, the shareholders have every right to feel uneasy. It would be interesting to know whether the high opinions formed of the prospects of this company are shared by the founders; in any case, it will be equally interesting to know what induced them to become founders. If things do not turn out as Lord Stalbridge fondly anticipates, a very serious responsibility will rest upon these gentlemen. I shall be glad to insert any communication they may have to make upon the subject."

Asbestos Rivals.

(Trade, Finance and Recreation.)

Those companies which own asbestos mines in Canada swear that Canadian asbestos is the best that can be got, while those having mines in Italy say that all other is rubbish, but we may take it as a fact that Canadian is quite good enough for ordinary purposes. At all events, this is the conclusion we arrive at when we see, of the two companies which we are quite prepared to admit, in the absence of evidence to the contrary, do the greater part of the English business, that one which openly professes to use nothing but Canadian can give its shareholders dividends at the rate of 22½ per cent., while the other has so far been unable to pay interest owing on that half of its capital appropriated to preference shares.

The United Asbestos Company has a capital of £50,000 in ordinary shares, and £9,970 10 per cent. preference shares, yet after providing for the interest on the debentures, the trade profits do not yield enough to be worth dividing even amongst the preference shareholders, while the Bell's Asbestos has £100,000 in ordinary shares, which for last year received 22½ per cent., after interest on £68,400 debentures had been provided for. If these figures mean anything at all, they would prove that Canadian asbestos is not only good enough for ordinary purposes, but is infinitely the more profitable of the two kinds to manufacture. We have seen the different kinds, and would, if we were in the habit of wearing asbestos garments, prefer to have them made of the Italian material; but so far as we can gather, this kind of the stuff is an *article de luxe*, and too expensive for ordinary use. The accounts rendered by the two companies are too meagre to enable us to form any idea of what one or the other is doing, as we have no trading accounts, therefore we cannot get at what the turnover actually is, and this, after all, is what we desire to know. There is, besides, another item to take into consideration, especially as regards the Bell Company, and that is how much of the profit is derived from the sales of asbestos, raw and manufactured, and how much from lubricating oil, engineers' stores, etc., etc., in which this company does a large business. We understand that the United Company has recently given a good deal of its attention to this branch of business, yet we cannot but fancy that there is something wanting, some life and go which is absent in the one case and is conspicuous in the other—for with a very long start in business, and one half of the capital to provide for, the United would seem to have fallen hopeless by the roadside.

We noticed but a short time ago a letter from the general manager and secretary of the last named company, which apart from a certain amount of historical information, stated that the company's business had increased more than 20 per cent. over that of the previous year, that the increase in the first six months of this year was nearly 25 per cent., and in the months of July and August the increase was over 35 per cent. This, we hope, is not altogether an imaginary or delusive increase, that is to say, an increase in the quantity of goods sold, without any corresponding increase in the profits; because we cannot get rid of the idea that we have heard somewhat similar words before. Still, as regards the benefit of this increased work to the shareholder, the result was practically *nil*. In fact, we turn back to the company s report for the year 1888, issued on February 20th, 1889, and find the following words:—"An encouraging feature of the business is, that while the sales of the first nine months of the year showed an increase of over 20 per cent. compared with those of the previous year, the sales of the last three months showed an increase of 35 per cent." Here we have almost word for word and figure for figure what is again repeated 18 months afterwards, the shareholders, preference and ordinary alike, still being innocent of dividends.

Turning now to Bell's report for 1888, we find the following paragraph:—"The large growth of the business during the past year has been continuous, the trade in each month showing an increase on that of the corresponding month of the preceding year"; and again, the report for 1889 says, "during the past year the home trade has grown in bulk, but the margin of profit has been less than was obtained in thepreceding year"; and, in fact, the same dividend of 22½ per cent. was maintained.

Of the relative merits of Canadian or Italian asbestos, we confess that we know little; in our narrow-minded way we are compelled to judge by results, and we see that Canadian gives its shareholders 22½ per cent., and Italian nothing. There are probably other things to take into consideration, for even the United, which boasts so much of its superior Italian article, owns Canadian mines, so that it ought to be able to meet Bell's on its own merits in this quarter; therefore we are compelled to come to the conclusion that it is not to Canada or to Italy that the palm is to be given, but rather that results largely depend upon the way each company is managed.

The Ventilation of the Saarbrucken Collieries.

R. Nasse states that, of the twenty-four collieries in the Saarbrücken mining district, bituminous coal is mined at eight, the remainder working gas and non-coking coals. The total quantity of coal raised in 1884, to which year this report refers, amounted to 6,087,126 tons. The number of men working in the collieries with forced ventilation was 13,168. One-fourth of these worked with open lights, the remainder using safety-lamps. In all the larger collieries there are several independent ventilation sections, each of which has a special ventilating shaft, besides which they have usually several openings at the surface for the intake of fresh air. The mean greatest length of the air-ways is 3.26 miles, the minimum being 1.2, and the maximum 6.1 miles. Guibal's *temperament* (the ratio of the volume of the air-current, in cubic metres per second, to the square-root of the depression in millimetres of water) was determined in 24 cases; 14 times it was between 2 and 4, 7 times greater than 4, and thrice below 2; the minimum 0.9 occurring with an underground engine and boilers. The relative degree of moisture of the air-current reaches nearly everywhere, and usually at a very short distance from the intake shafts, 95 to 100 per cent. The latest analysis of the return air, made on behalf of the Russian Commission on Fire-Damp, showed it to contain from 0.203 to 0.652 per cent. of carbonic anhydride, as compared with 0.04 per cent. in fresh air; the percentage of hydrocarbons was from 0.473 to 1.463. At the time at which the samples were taken the air-current was at the rate of 69.22 cubic feet for every miner underground, one horse counting as four men. The temperature of the return-air in the main air-way proved in the Gerhard Colliery to be 25° C., a temperature exceeding by 6.5° C. the highest normal rock temperature of the strata occurring in the colliery. At the Camphausen Colliery, which is the most difficult one to ventilate, the return-air proved to be of a temperature varying from 27.5° to 29° C., the ventilation having lowered the temperature by 4° C.

At the end of 1884 only two of the collieries had natural draught; in one of these the air in the return-shaft was heated by a steam-pipe. In the collieries with forced draught there were 17 ventilating furnaces and 29 centrifugal ventilators. The furnaces produced air-currents with a mean volume of 352,212 cubic feet per minute, and the centrifugal ventilators a current with a volume of 979,082 cubic feet per minute.

Of the 29 ventilators, 26 are of the Guibal type, 2 of the Pelzer type, and 1 of the Zimmermann type Up to the year 1877 the Guibal fans were all built from the same model, having a diameter of 23 feet, by a breadth of 6½ feet. At the present time the Guibal fans are constructed with a diameter of from 26 to 33 feet, the breadth varying up to 10 feet.

The volume of air allowed in the different collieries per man per shift is, in the mean, 85.8 cubic feet, the minimum quantity being 25.42 cubic feet, and the maximum 298.7 cubic feet; this is at the mean rate of 71.69 cubic feet per ton of coal raised during the shift, the minimum rate for this quantity being 15.18 cubic feet, the maximum 265.5 cubic feet. The rate at which the return-air passes up the up-cast shaft reaches 16 to 23 feet per second. The ventilating furnaces are of small size, and burn in the mean 45.5 tons in the twenty-four hours. For 1,000 cubic metres of draught there are burnt by the furnaces 456 tons of coal, and for an equal rate there are used in working the fans 2.12 tons of coal. The annual cost of ventilation, at the rate of 1,000 cubic metres of air per minute, was :—

Furnaces	£401
Fans	432

The coal in the case of the furnaces being calculated at cost price, and with the fans at selling price. For the year 1883 the average cost of production of an air-current per ton of coal was a little more than one-half penny. Zinc pipes are used almost without exception for transmitting the air; they have usually a diameter of 10.23 inches. If the diameter is not sufficient two lines of piping are employed. The cost of such piping, together with the wages for placing in position, is, in the mean, four shillings per yard.

For dividing the air-currents sliding doors are employed. Brattices of indiarubber or of sailcloth are temporarily used; the indiarubber wearing best. For permanent use, masonry is employed. Wooden brattices are less frequently in use, as they are difficult to keep air-tight. The cost of the brattice, including the wages expended while placing it in position is, per square metre :—

Sailcloth	from 1s. 10d.	to 2s. 0d.
Indiarubber	" 2s. 0d.	to 2s. 6d.
Wood	" 2s. 0d.	to 2s. 6d.
Brickwork	" 3s. 6d.	to 4s. 0d.

The German Government and the Miners.—It is officially announced that all, or nearly all, the demands which were recently submitted to the German Government by the miners' delegates have been conceded. The principal points are that shifts last eight hours only, that all the miners who were dismissed after the recent strikes shall be reinstated, and that provision shall be made in the Labour Amendment Bill, now before the Reichstag, for the creation of arbitration courts. The mining officials also are to come under the jurisdiction of the court of discipline, and they are to be punished for ill-treating miners. "Farming" certain jobs is also to be abolished.

Comparison of Electricity and Compressed Air.—Mr. H. W. Hughes (South Staffordshire Institute of Mining, Eng., vol. xv., pp. 69-82,) has collected details of cost and efficiency of electric transmission of power, and compares them with the cost of pneumatic transmission. At the Chapin Mine in Michigan, air is compressed to 60 lbs. pressure at 60° F. by four turbines, and is conveyed through a 24 inch pipe for three miles. The pipe cost £12,000, and the total cost of the plant is estimated at £100,000. A test showed 1430 indicated horse-power at the compressors, and the sum of the indicated horse-power at the mines was only 390; the loss is therefore nearly 73 per cent., and this amount does not include friction of the compressors. The author gives a second case, in which a 500 horse-power turbine compressed air and delivered it three miles distant. The efficiency was 32 per cent. and the cost of the plant £84,000. An electrical company has agreed to give an efficiency of 60 per cent. from a similar turbine for a cost of £17,520, inclusive of the entire electrical equipment.

Arbitration in Labor Disputes in the United States.—Referring to the decrease in labour disturbances in the United States during the past year, the British Consul-General in New York in his last report says that this favourable change is attributable largely to causes—first, to the general acceptance of arbitration in one form or another, as enforcing the true principle of settlement of disputes, especially in productive industries, where the interests of capital and labour are mutual; and, secondly, to the power of investigation vested in the Board of Mediation, which has had the effect of deterring parties from making undue exactions and imposing unjust conditions. The Board in its report to the Legislature, states that its constant effort has been, through a wide distribution of its reports among those whom they may concern and by other available means, to impress the lesson of arbitration and infuse a spirit of compromise, and to induce settlements by local boards, or by direct negotiations between the parties, free from outside intervention. The tendency and growth in this direction have been encouraging. The destructive policy of a "a word and a blow, but the blow first," is gradually being reversed, and the blow of a strike or lock-out is coming to be regarded in order only as a last resort after the word of reason has prowed a failure.

Coal Production in Japan.—Trade returns recently issued indicate that the export of coal from Nagasaki in 1889 show a decrease compared with that of the previous year. The figures for the last three years are—1889, 641,150 tons, valued at £403,543; 1888, 770,710 tons, valued at £353,994; 1887, 586,567 tons, valued at £228,140. The decreased output of the Takashima mine during 1889 is accounted for by an epidemic which broke out among the miners, lasting from July to November, during which time the output of the mine was reduced to half the usual quantity, and even less during August and September, when the epidemic was most severe. The produce of the numerous mines in Chikuzen is estimated to have fully come up to, if not exceeded, a total 720,000 tons. The prices averaged during the year $3.20 (9s. 11d.) per ton for common, and $5.50 (17s.) for best. The owners of the Takashima mine have endeavoured to exploit other seams of coal, which are known to exist in the neighbourhood of that mine. Their chief undertaking in this direction was the opening of a mine at Matsushima, a small island about 20 miles from Nagasaki. A shaft was sunk, but serious difficulties were encountered, owing to the ingress of large quantities of sea-water through flaws in the seam. Work was, however, steadily progressed with till the latter end of April of last year, when a more than usually large flaw caused such an enormous inflow of water as to stop all further operations.

Improved Steam Dredger for Minerals.—An improved steam dredger has just been constructed for the Rio Tinto Copper Company by Messrs. Priestman Bros. of Hull, England, which possesses some novel features. It is built after the manner of this firm's B size dredger, usually placed upon steam hopper barges. The barge upon which this dredge is fixed is 65 feet long by 19 feet beam, and 6 feet 3 inches deep, holding in the hopper about 50 tons of material. It was constructed in sections, each being properly fitted ready for fixing when sent out to its destination at the company's property. The boiler is of vertical form, and both supplies steam to the engines of the barge and those of the dredger. The boomer motors are of the vertical inverted type, and are capable of propelling the barge at a speed of from 5 to 6 miles an hour; these, of course, are placed aft in the barge, while the dredger is fixed forward. There is also fixed in the engine room of this barge a Merryweather fixed steam fire engine, with a working capacity of 300 gallons per minute, delivered to a height of 150 feet. Over 500 of these patent dredgers have been made recently by this firm, which should speak well for this class of apparatus

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(*t.*) Chemical Contributions to the Geology of Canada from the Laboratory of the Survey, by G. C. Hoffman, F. Inst. Chem., F.R.S.C.

Note.—These and all other Publications of the Survey may be purchased from or ordered through

W. FOSTER BROWN & Co., Montreal,
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F. A. BROCKHAUS, Leipzic,
B. WESTERMANN & Co., 838 Broadway, N.Y.,

or by application to

DR. JOHN THORBURN,
Librarian,
Geological and Nat. Hist. Survey, Ottawa.

ST. LAWRENCE CANALS.

RAPIDE PLAT DIVISION.

NOTICE TO CONTRACTORS.

SEALED TENDERS addressed to the undersigned and endorsed, "Tender for the St. Lawrence Canals," will be received at this office, until the arrival of the eastern and western mails on Wednesday, the 23rd day of July next, for the construction of a lift lock, weirs, etc., at Morrisburg, and the deepening and enlargement of the Rapide Plat Canal. The work will be divided into three sections, each about a mile in length.

A map of the locality, together with plans and specifications of the respective works, can be seen on and after Wednesday, the 9th day of July next, at this office, and at the Resident Engineer's office, Morrisburg, where printed forms of tender can be obtained.

In the case of firms there must be attached to the tender, the actual signatures of the full name, the nature of the occupation and residence of each member of the same, and, further, an accepted ceeque on a chartered back in Canada for the sum of $6,000, must accompany the tender for Section No. 1, and an accepted cheque on a chartered bank in Canada, for the sum of $2,000 for each of the other secttons.

The respective accepted cheques must be endorsed over to the Minister of Railways and Canals, and will be forfeited if the party tendering declines entering into contract for the works at the rates and on the terms stated in the offer submitted. The cheques thus sent in will be returned to the respective parties whose tenders are not accepted.

By order,
A. P. BRADLEY,
Secretary.

Department of Railways and Canals,
Ottawa, 13th June, 1890.

Money Orders.

MONEY ORDERS may be obtained at any Money Order Office in Canada, payable in the Dominion and Newfoundland; also in the United States, the United Kingdom, France, Germany, Austria, Hungary, Italy, Belgium Switzerland, Portugal, Sweden, Norway, Denmark, the Netherlands, India, Japan, the Australian Colonies, and other countries and British Colonies generally.

On Money Orders payable within Canada the commission is as follows:

If not exceeding $4			2c.
Over $4, not exceeding		$10	5c.
" 10,	"	" 20	0c.
" 20,	"	" 40	20c.
" 40,	"	" 60	30c.
" 60,	"	" 80	40c.
" 80,	"	" 100	50c.

On Money Orders payable abroad the commission is:

If not exceeding $10			10c
Over $10, not exceeding		$20	20c
" 20,	"	" 30	30c
" 30,	"	" 40	40c
" 40	"	" 50	50c.

For further information see OFFICIAL POSTAL GUIDE.

Post Office Department, Ottawa,
1st November 1889.

SEALED TENDERS, addressed to the undersigned, and endorsed "Tender for Caisson," will be received at this office until Friday, the 18th day of July next, inclusively, for supplying, erecting and completing in place, a Wrought Iron Caisson for the Dry Dock now in course of construction at Kingston, Ont., in accordance with the plans on exhibition at this office, and at the Engineer's office, 30 Union street, Kingston, and with the conditions and stipulations contained in a Form of Tender, copies of which can be obtained on application to the undersigned and W. O. Strong, Esq., Resident Engineer, 30 Union street, Kingston, Ont.

Tenders will not be considered unless made on the form supplied, and signed with the actual signatures of tenderers.

An accepted bank cheque, payable to the order of the Minister of Public Works, equal to five per cent. of amount of tender, must accompany each tender. This cheque will be forfeited if the party decline the contract, or fail to complete the work contracted for, and will be returned in case of non-acceptance of tender.

The Department does not bind itself to accept the lowest or any tender.

By order,
A. GOBEIL,
Secretary.

Department of Public Works,
Ottawa, 13th June, 1890.

North-West Mounted Police.

RECRUITS.

APPLICANTS must be between the ages of Twenty-two and Forty, active, able-bodied men of thoroughly sound constitution, and must produce certificates of exemplary character and sobriety.

They must understand the care and management of horses, and be able to ride well.

The minimum height is 5 feet 8 inches, the minimum chest measurement 35 inches, and the maximum weight 175 pounds.

The term of engagement is five years.

The rates of pay are as follows:—

Staff-Sergeants	$1.00	to $1.50 per day
Other Non-Com. Officers	85c. to 1.00	"

	Service pay.	Good conduct pay.	Total.	
1st year's service,	50c.	——	50c.	per day
2nd "	50	5c.	55	"
3rd "	50	10	60	"
4th "	50	15	65	"
5th "	50	20	70	"

Extra pay is allowed to a limited number of blacksmiths, carpenters and other artizans.

Members of the force are supplied with free rations, a free kit on joining and periodical issues during the term of servce.

Applicants may be engaged at the Immigration office, Winnipeg, Manitoba; or at the Headquarters of the Force, Regina, N.WT.

Mining Regulations

TO GOVERN THE DISPOSAL OF

Mineral Lands other than Coal Lands, 1886.

THESE REGULATIONS shall be applicable to all Dominion Lands containing gold, silver, cinnabar, lead, tin, copper, petroleum, iron or other mineral deposits of economic value, with the exception of coal.

Any person may explore vacant Dominion Lands not appropriated or reserved by Government for other purposes, and may search therein, either by surface or subterranean prospecting for mineral deposits, with a view to obtaining under the Regulations a mining location for the same but no mining location or mining claim shall be granted until the discovery of the vein, lode or deposit of mineral or metal within the limits of the location or claim.

QUARTZ MINING

A location for mining, except for iron on veins, lodes or ledges of quartz or other rock in place, shall not exceed forty acres in area. Its length shall not be more than three times its breadth and its surface boundary shall be four straight lines, the opposite sides of which shall be parallel, except where prior locations would prevent, in which case it may be of such a shape as may be approved of by the Superintendent of Mining.

Any person having discovered a mineral deposit may obtain a mining location therefor, in the manner set forth in the Regulations which provides for the character of the survey and the marks necessary to designate the location on the ground.

When the location has been marked conformably to the requirements of the Regulations, the claimant shall within sixty days thereafter, file with the local agent in the Dominion Land Office for the district in which the location is situated, a declaration or oath setting forth the circumstances of his discovery, and describing, as nearly as may be, the locality and dimensions of the claim marked out by him as aforesaid; and shall, along with such declaration, pay to the said agent an entry fee of FIVE DOLLARS. The agent's receipt for such fee will be the claimant's authority to enter into possession of the location applied for.

At any time before the expiration of FIVE years from the date of his obtaining the agent's receipt it shall be open to the claimant to purchase the location on filing with the local agent proof that he has expended not less than FIVE HUNDRED DOLLARS in actual mining operations on the same; but the claimant is required, before the expiration of each of the five years, to prove that he has performed not less than ONE HUNDRED DOLLARS' worth of labor during the year in the actual development of his claim, and at the same time obtain a renewal of his location receipt, for which he is required to pay a fee of FIVE DOLLARS.

The price to be paid for a mining location shall be at the rate of FIVE DOLLARS PER ACRE, cash, and the sum of FIFTY DOLLARS extra for the survey of the same.

No more than one mining location shall be granted to any individual claimant upon the same lode or vein.

IRON.

The Minister of the Interior may grant a location for the mining of iron, not exceeding 160 acres in area, which shall be bounded by north and south and east and west lines astronomically, and its breadth shall equal it length. Provided that should any person making an application purporting to be for the purpose o mining iron thus obtain, whether in good faith or fradulently, possession of a valuable mineral deposit other than iron, his right in such deposit shall be restricted to the area prescribed by the Regulations for other minerals, and the rest of the location shall revert to the Crown for such disposition as the Minister may direct.

The regulations also provide for the manner in which land may by acquired for milling purposes reduction works or other works incidental to mining operations.

Locations taken up prior to this date may, until the 1st of August, 1886, be re-marked and re-entered in conformity with the Regulations without payment of new fees in cases where no existing interests would thereby be prejudicially affected.

PLACER MINING.

The Regulations laid down in respect to quartz mining shall be applicable to placer mining as far as they relate to entries, entry fees, assignments, marking of localities, agents' receipts, and generally where they can be applied.

The nature and size of placer mining claims are provided for in the Regulations, including bar, dry, bench, creek or hill diggings, and the RIGHTS AND DUTIES OF MINERS are fully set forth.

The Regulations apply also to

BED-ROCK FLUMES, DRAINAGE OF MINES AND DITCHES.

The GENERAL PROVISIONS of the Regulations include the interpretation of expressions used therein; how disputes shall be heard and adjudicated upon; under what circumstances miners shall be entitled to absent themselves from their locations or diggings, etc., etc.

THE SCHEDULE OF MINING REGULATIONS

Contains the *forms* to be observed in the drawing up of all documents such as:—"Application and affidavit of discoverer of quarts mine." "Receipt for fee paid by applicant for mining location." "Receipt for fee on extension of time for purchase of a mining location." "Patent of a mining location." 'Certificate of the assignment of a mining location." 'Application for grant for placer mining and affidavit of applicant." 'Grant for placer mining." "Certificate of the assignment of a placer mining claim." "Grant to a bed rock flume company." "Grant for drainage." "Grant of right to divert water and construct ditches."

Since the publication, in 1884, of the Mining Regulations to govern the disposal of Dominian Mineral Lands the same have been carefully and thoroughly revised with a view to ensure ample protection to the public interests, and at the same time to encourage the prospector and miner in order that the mineral resources may be made valuable by development.

COPIES OF THE REGULATIONS MAY BE OBTAINED UPON APPLICATION TO THE DEPARTMENT OF THE INTERIOR.

A. M. BURGESS,

Deputy Minister of the Interior

PROVINCE OF NOVA SCOTIA.

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

— AND —

PRECIOUS STONES.

Titles given direct from the Crown, Royalties & Rentals moderate

GOLD AND SILVER.

Under the provisions of chap. 7, Revised Statutes, of Mines and Minerals Licenses are issued for prospecting Gold and Silver for a term of six months, which can be extended by renewal for another six months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. Up to ten areas the cost is 50 cents per area, for every area in addition in same application 25 cents. Cost of renewal one half the original fees. Leases of any number of areas are granted for a term of 21 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents annually for each area contained in the ease it becomes non-forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19.00 an ounce, and in smelted Gold valued at $18.00 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of th Province he may stake out the boundaries of the area he desires to obtain, and ths gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for twelve months are issued, at a cost of twenty dollars, for Minerals other than Gold and Silver, out of which one square mile can be selected or mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department free of charge, and provision is made for lessees and licensees whereby they can acquire promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists who have always stated that the Mining Laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are :—Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones, five per cent.; Coal, 7½ cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and inveators.

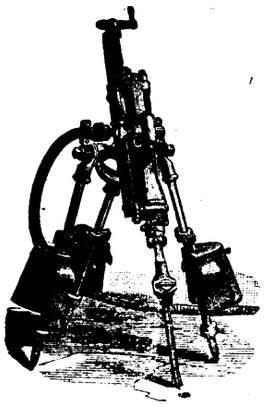
Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH,

Commissioner Public Works and Mines,

HALIFAX

NOVA SCOTIA.



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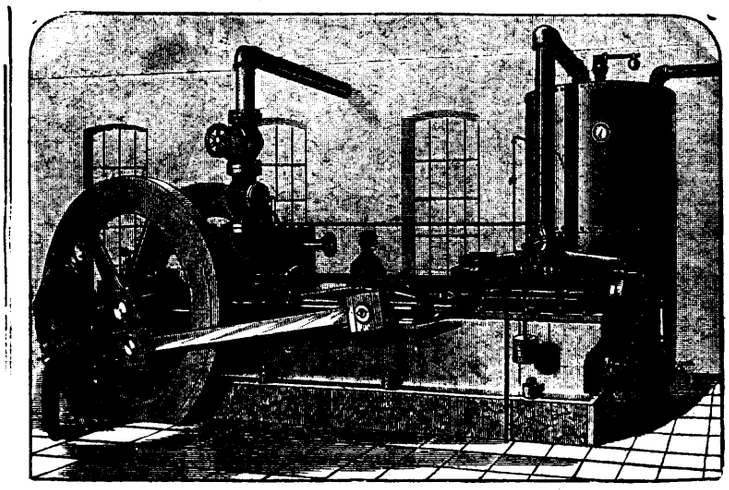

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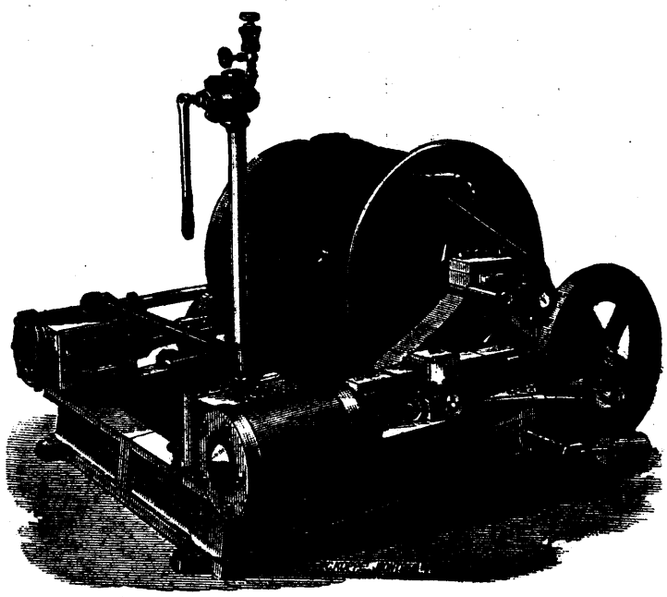

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