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18th YEAR OF PUBLICATION.

The CANADIAN MINING REVIEW

Established 1882

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

B. T. A. BELL, Editor and Proprietor. Secretary, Canadian Mining Institute, etc. | Published Monthly. | OFFICES { Slater Building, Ottawa; Windsor Hotel, Montreal.

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Notice.

During Mr. Bell's absence in England, contributors and correspondents are requested to direct communications for publication to the Ottawa Office of the Review.

No Nickel Monopoly.

It is a common opinion among the uninformed that Ontario has a natural monopoly of nickel, that the Sudbury ores are inexhaustible, and that no matter what restriction be placed upon this industry, the world must come to Canada for its supply of nickel. As a matter of fact, says the *Iron and Coal Trades' Review*, during the five years 1893 to 1897 inclusive, out of the world's total of 23,652 tons, Ontario produced only 9,151 tons of nickel. At no time has Canada produced even one-half the world's supply. Large quantities exist in New Caledonia, not to mention deposits known to exist in similar quantities in Norway, Austria, Germany, Spain, etc. The Société le Nickel, which is controlled by the powerful house of Rothschild in Paris, has by itself produced up to the present time more nickel than has ever been extracted from the Sudbury ores, and this company is at the present time manufacturing quite half of the nickel that is produced. Besides this powerful corporation there are other nickel-mine owners supplying other European refiners who contribute at least 1,000 tons of nickel a year to the European market, and there appears no difficulty for any European refiner to obtain almost unlimited quantities of New Caledonia ores.

Costs of Mining.

Data concerning costs of mining are fragmentary and unsatisfactory. Many mining companies, especially those controlled by British corporations, withhold all information as to costs and tonnage output, limiting themselves to a bare announcement to the public of the financial results of the year's operations. There are no good reasons for secrecy in this matter. It is one in which the public has a very justifiable interest, and if the management is not afraid of criticism it should be willing to gratify such curiosity. If it is afraid to reveal these details, this in itself legitimately lays it open to suspicion. Most mining companies occupy a position before the world which is altogether different from that of a private manufacturing concern. Its stocks are offered in the open market, and the public is therefore deeply concerned in knowing not only how well the enterprise is prospering, but whether it is doing the best possible under the conditions it confronts.

Many American companies issue quite exhaustive analyses of costs, from which a great deal can be learned, but even here there is usually lacking much which an enquiring mind would like to have explained. The usual items include costs of mining, hauling, treatment and general expenses. Some include dead work also, but this is indefinite. No mine can be long operated without doing considerable dead work, but it is manifestly misleading to charge work performed for the development of new ore reserves under this head, as is often done. There are better reasons for charging it to capital account, for it properly represents part of the cost of the mine. Other items which should be separated and reported are costs of pumping and timbering. No less important is it to know the proportions of ore and waste rock. Such discriminations reveal the conditions under which mining is being carried on, and serve to explain what might otherwise seem like extravagant outlay in mining operations. It will give greater confidence in the management when it is contending against difficulties, for the truth as to costs will show itself in the financial results in any case.

Whatever the cause may be, the costs of mining in Canada are high, and of these the costs of drifting and shaft sinking are perhaps the greatest. In the United States the expense of shaft sinking ranges from about $15 to $25 per foot, according to location and to size of shaft, and an average cost of drifting in ordinary hard rock is about $5 per foot. At the Atlantic mine in Michigan last year 352 feet of shaft were sunk at the rate of $22.91 per foot, and 5,732 feet of levels were driven at a cost of $5.03 per foot. A comparison of costs in some other prominent mines will be of interest. At the Mercur mine in Utah the total expenses of mining and milling were $2.27 per ton. The ore treated amounted to 128,804 tons. The distribution of these costs was as follows:—Mining $1.05, hauling 45c., milling 68c., general 49c. At the Horn silver mines in Utah the distribution of expenses was:—Mining $1.87 per ton, hauling and surface work 70c., milling $1.27, general 47c.; making a total of $4.31, the tonnage extracted being 32,649. There was in addition a charge against the ore taken out of 50c. per ton on account of dead work. The mines of the De Lamar Mining Company in Utah furnish an instance of high costs, where a tonnage of 53,233 shows an outlay of $6.647 per ton. The mining here represented $3.578, and the milling $2.251 per ton. The Homestake properties, in the Black Hills of Dakota, which enjoy a high reputation for excellent management, are nevertheless not remarkable for extremely low costs. Here the mining and transportation expenses were $2.05 per ton, milling 80 cents, and general expenses 53c., aggregating $3.38. As examples of low costs we may cite the following:—The Atlantic Copper Mine of Michigan, where the mining expenses were $1.03, hauling 6½c., and milling a fraction over 23c. per ton, the total charge against the ore milled being $1.71 per ton; the Alaska-Mexican Gold Mining Co., whose total cost per ton of ore mined and milled was $1.726; and the Alaska United Gold Mining Co., operating the Ready Bullion and the 700 ft. mines, in which the costs were respectively $1.97 and $1.68. In the latter mine the costs of mining approached very close to those in the Atlantic, being only $1.097 per ton. This remarkable result is due of course very largely to the practical absence of dead work, but when the remoteness of its situation is considered, together with the high costs of labor and provisions, it stands as a unique achievement, reflecting the greatest credit upon the intelligent management of the mine. It is indicative not only of successful dealing with the larger engineering problems presented, but also of careful attention to the minutest details of operation. There is no item too small to merit consideration in mining practice if the best economic results are to be obtained. It is by scrupulous watchfulness over the little things as well as the great that expenses can be brought down, and in this way only. A mine manager who cannot tell how much dynamite and steel is being used per ton of ore and of rock extracted, who does not keep his accounts so as to be able to analyze his costs to the last detail, is in no position to achieve reforms and reduce the charges against his marketable output, and we believe that many Canadian mining companies have much to accomplish in this direction.

Ontario Bureau of Mines Appointment.

As was anticipated, the promotion of Mr. Thomas W. Gibson, former secretary of the Bureau of Mines of Ontario, to succeed to the position of Director left vacant by the resignation of Mr. Archibald Blue, has taken place. The appointment should bring general satisfaction to those interested in the mining development of that Province. Mr. Gibson is personally a gentleman of high attainments, courteous and tactful. His long connection with the Bureau has given him an intimate acquaintance with the resources of Ontario, such as few persons have had an opportunity of acquiring. He is not, as we said in a previous issue, a mining man, and we are aware that the opinion has been expressed in many quarters that a technical training should be an essential qualification for the incumbent of this office. In this we are not disposed to concur. A technical man is more apt to prove arbitrary in his dealing with the questions which have to be determined by the Bureau, and to be out of touch with the great body of non-technical men who are chiefly interested from a financial standpoint in the development of the mineral industry. In the long run we believe that the Bureau will be likely to be administered more satisfactorily by such a person as Mr. Gibson than by a professional man. On the other hand, we do think that it would be to the interest of the Province and of the Bureau if there were a professional mining engineer regularly appointed as an advisor who should guide the Bureau in matters where technical knowledge is required.

Typhoid Fever in Mining Camps.

Some time since the War Department of the United States secured a special report on the subject of typhoid fever in mining camps, with especial reference to the disastrous ravages of the disease at Cape Nome. The authority of the Department in such matters is limited to territories, the separate states having supervision over sanitation within their own confines. The inquiry, however, should set other countries to thinking, for the prevalence of typhoid in mining camps is a conspicuous phenomenon all the world over. The outbreak at Cape Nome was of course due to the exceedingly congested population of the place, and to the entire absence of sanitary precautions. The pollution of drinking water under such conditions was inevitable. Although typhoid germs may be carried in the dust, the chief cause of infection is the contamination of the sources of water supply. In camps where much underground mining is carried on, the installation of modern water supply and sewerage systems has not always removed the difficulty. It is furthermore conspicuous that, in such cases, the victims are almost invariably the miners working underground. Under these circumstances it is natural to suppose that the infection occurs in the mines. The miners are accustomed, where the waters are free from acids, to use the streams which issue from the walls for drinking purposes. As provision for proper sanitation is usually not made, portions of the mine very commonly become dangerous centres for the propagation of disease germs. In factories and other industrial works the law prescribes rules touching such questions, which are rigidly enforced, and it is surprising that so little attention has been paid to the same matter in mines. The Province of Ontario has taken the initiative in protecting its miners against imperfect sanitary conditions below ground, prescribing rules similar to those imposed upon factories. It is a good move, and should set an example to others of a much needed reform.

Technical Schools.

Canada has now three technical schools of the first rank, which are turning out mining engineers. The technical departments of McGill University may be considered fully developed, and on a par with the best in America; the School of Practical Science in Toronto is mainly devoting its efforts to mechanical and electrical instruction; while the School of Mining at Kingston is particularly strong on the side of mining, having this year added greatly to its equipment, placing it on a high level in the point of ability to give thorough practical training. All this is highly encouraging, indicating a demand for special instruction to which Canada is promptly responding. It is a measure, in a certain sense, of the growth of the mineral industry in the Dominion, for young men are impelled to enter upon such courses from seeing around them opportunities to make successful careers in these special lines. But this does not imply that these Canadian institutions are destined to supply the home demand. Of engineers, perhaps more than of any other class, it may be said that they are citizens of the world. They go everywhere, regardless of nationality and of national boundaries. We cannot keep our own at home, nor can we keep others out. The only protection of the engineer is ability. It is not only the man who knows, but the man who can *do*, that is wanted. It is the broad man, who can take a full view of the world's work, who knows men, and can look deeply and understandingly into economic conditions, who is able to use his special training to the best advantage, and rise to positions of high responsibility. Such men are few, but it is just such men that it is the proper function of the University to turn out.

Now it is a significant fact that the positions of highest responsibility in great mining companies of this and other countries are not held as a rule by technical men. There are brilliant exceptions, but we anticipate that no one will deny that the rule works as we have said. We state what we see, while believing that it should be otherwise. There is no reason why technical men should not generally be promoted to the control of our great industrial undertakings, except that other men are found more capable of performing the peculiar duties required. One of our American contemporaries, commenting upon this recently, took the ground that it was generally best to confer the management of such enterprises upon men of business training, with technical advisors at hand to solve the scientific problems presented, but held in check and prevented from making economic mistakes by the business head of the concern. But it is perfectly clear that it would be more advantageous if the ability to manage great works were combined with technical knowledge and skill. That such is not the case more often, argues some defect in the college training of young engineers. It is due to narrowness somewhere; probably to an over-specialization before a suitable groundwork has been laid. Our schools, (and this applies to those of the United States and Europe as well) are graduating more and more a class of men who stand intermediate between the true engineer and the master mechanic. Their talents are in demand, and they step readily from college into lucrative positions. Meantime the young man in the office goes forward from post to post until at last he stands above and directs them.

The complaints in the commercial world against the technical graduate are generally that he lacks ability to manage men, and that he is deplorably ignorant of accounts and business methods. A man deficient in these important qualifications cannot, of course, control a great industrial establishment. The school cannot train students in the art of managing men. This comes only through contact with workmen, through working with them until their limitations, their needs, and their capabilities are understood. No one can acquire this by merely looking on. The young engineer who is willing to accept positions as a workman among workmen, rising thus to places of gradually increasing responsibility, can remove this deficiency at least. It is a common fault with young graduates to aspire too soon to positions where technical training is required. The other lack is one which to a considerable extent the college can make good. If the aim of the technical school is to fit men for the industrial application of science, it should then make practical men of them as well as practical scientists. If a knowledge of book-keeping and business forms is necessary for the success of the practical man, then the least that the college can do is to give its students a course in these subjects. It certainly should not leave them at a disadvantage with the graduates of the so-called business college. Where is the technical school that gives such a course?

This is not all. The technical course may cultivate brain power, but it does not give breadth. The business man is acquiring knowledge of men, of the great movements of the world, of economic conditions. The circumstances that make for success or against it in the great concerns of the world's industrial life, he learns by rude experience. His knowledge may be partial and narrow, but so far as it goes it is usually sound, and eminently practical. It is real knowledge, and it gives power. This is a sort of knowledge which in a different, and doubtless a better way, a broad college training can afford. It is an argument for the broadly educated, cultured engineer, who knows something more than his technology. We believe that one so equipped has a better chance in the world than he who specializes before receiving such an education. The subject is one which deserves the serious thought of our University authorities. If the chances for technical graduates, as a result of their training, to become something more than superior skilled artisans (save in exceptional cases), do not improve, it will become a reproach to the schools that send them out.

EN PASSANT.

The output of pig-iron from Canadian furnaces during the first half of 1900 was 45,234 gross tons. This indicates no increase in the rate of production over 1899, the total output for that year being 94,077 tons. Of the pig-iron turned out in the current year about one-sixth was with charcoal as fuel. One-third of the product was Bessemer pig.

The Canada Iron Furnace Co. will soon have its new works at Midland in operation, smelting ore from the Helen mine at Michipicoten, with small quantities of Calabogie magnetite. This will be the first instance of an Ontario furnace running entirely on Canadian ores. The Helen ores contain about 58.7 per cent. of iron, with 0.114 per cent. of phosphorus, and 0.046 per cent. of sulphur. The new furnace is 64 feet high, 13 feet in diameter at the boshes, and 8 feet in diameter at the crucible. The regenerative plant consists of three Gordon stoves, 60 ft. by 16 ft. The blast will be supplied by two blowing engines of 400 h.p. each. It was originally intended to use charcoal as fuel, and plans had been drawn for a large by-product plant. But it has been decided, for the present at least, to employ Cornellsville coke, which can be cheaply laid down at Midland from Lake Erie ports.

Considerable difficulty having been experienced by millmen using built-up mortar blocks in stamp-mills from the loosening of the anchor bolts which hold the mortar upon the blocks, it will be of interest to note how this tendency has been overcome by Mr. D. G. Kerr, of the Belmont mine, near Marmora, Ont. The bolt holes are bored to a distance of 5 feet, inclining from the top toward the bottom, the distance from the edge of the block to the centre of the bore-hole at the top being 3 inches, and at the bottom only 1 inch. At this point the sides of the block are recessed to receive horizontal blocks 6 inches high and 4 inches wide, one on each side, inset 1½ to 2 inches. These small blocks are bolted on by bolts passing through the mortar block. The anchor bolts pass down through these small blocks, the nuts being tightened against washers below them. By this arrangement the bore-holes are prevented from being worn larger through the jarring of the bolts.

There has lately arisen a discussion over the efficiency of the Bryan mill as an amalgamator and crusher, compared with the stamp-mill, which brings up the old question of high crushing capacity in gold milling operations. The desire to secure at once a high crushing capacity with good extractive work, perennially leads to a crop of errors. The desire is natural, but not easy to satisfy. The Bryan mill is undoubtedly a good crusher, admirably adapted to ores containing much argillaceous material. The Huntington mill is adapted to similar ores, though perhaps the Bryan will render better service on somewhat harder material. But neither of them can really be compared as amalgamators with the stamp mill, and for the same reason, viz., the high centrifugal velocity imparted to the pulp causes too rapid a discharge. Moreover, the rollers ploughing through the material on the dies, keep it too thoroughly stirred up. The ideal condition for amalgamation, so easily obtained in the stamp mill, is that of a suspended pulp, never too violently disturbed, and yet never fully at rest. That this condition is not always maintained in stamp milling is the fault of the millman, who does not attend to the economical adjustment of his mill as carefully as he should. Furthermore, the importance of the time factor in amalgamation cannot be too strenuously insisted upon. This, again, is under complete control in the stamp mill, but is not capable of regulation in any mills of the rotary type now on the market.

Ontario promises soon to show a large increase in its copper production. In addition to the old works at Copper Cliff, the Victoria mine, owned by Dr. Ludwig Mond, will soon be producing ore which will be smelted and blown in converters to high grade copper-nickel matte for exportation to England. Large mining operations are also projected at Massey, where a promising deposit of ore carrying over 4 per cent. of copper is now being developed. The future of the Parry Sound mines is still uncertain, though development is being actively prosecuted. The copper district at Bruce mines, however, is soon to be energetically exploited. A concentrator of 400 tons daily capacity, with a smelting and converting plant, is being erected at Bruce Mines, where the old workings are being equipped with a modern plant, contemplating deep mining. The Rock Lake copper mines have also been extensively developed, showing a large vein of good ore, and a 200 ton concentrator is nearly finished, which will produce high-grade concentrates for shipment.

COAL MINING AND TRADE.

The labor question is at the moment the most important factor in connection with the coal trade of the Dominion and one which is likely to loom up with still greater significance in the near future. In every coal field in Canada there is a scarcity not only of skilled miners but of ordinary laborers. In Cape Breton this is accounted for by the enormous amount of development in the mines themselves, and also by the demand for men in connection with the operations of the Dominion Iron and Steel Co. This is accentuated by the development of work in the iron ore mines of Newfoundland. Hitherto there has been an annual exodus of the able-bodied men of the Ancient Colony to the coal mines of Cape Breton to the extent of 300 to 500. This year they are nearly all staying at home and receiving higher wages as a result of the recent strike. The first natural consequence has been an increase of 10 to 15 per cent. in the wages of Cape Breton and Nova Scotia miners. In spite of this, however, there is a great scarcity of men, and although every effort has been put forth to increase the number the response has been very meagre. One of the consequences is to be found in the diminished shipments of the Dominion Coal Co. last month, which fell 20,000 tons below the total of August, 1899. In addition most, if not all the collieries in the Maritime Provinces have been obliged to refuse tempting offers for cargoes because they had not sufficient labor to cope with the demand. The manager of the Dominion Coal Co. is reported as anticipating an output of at least 3,000,000 tons next year, and no doubt the capacity of the mines will warrant such an estimate, but it is more than doubtful whether the necessary labor will be forthcoming even with the assistance expected from the hundreds of raw laborers who by that time will be discharged from the constructive operations of the Steel Co. In view of the abnormal activity of the coal trade in Great Britain and the United States it is not likely that any considerable immigration will take place, and, at any rate, until there is a subsidence in the present universal boom—which is likely to last until 1902—it is evident that Cape Breton mines will have to rely chiefly on local labor. When things settle down, as they undoubtedly will, into a normal groove, and wages abroad fall again and work becomes short, it may be possible—if a judicious policy has been pursued meanwhile—to attract foreign workmen of a desirable character, as Cape Breton will be a much more desirable *habitat* in the future than in the past; and many conditions will conspire to make it a place in which good wages can be earned, and living should be cheap, whilst the climate is unsurpassed. It is not likely, for many reasons, that British miners will be attracted in any considerable numbers. They are not migratory, and for many years to come will do better at home; but good machine runners can be got from the United States and raw labor will flock from the land. In spite, however, of the most promising possibilities, the colliery proprietors of Cape Breton have more reason than ever to congratulate themselves on their coal cutting machinery, for it is abundantly evident that it is on the "iron man" they will have to rely for any large increase in tonnage. Those whose prescience and dogged perseverance won the battle and in face of opposition from almost every quarter succeeded in establishing coal cutting machinery in this coal field now have their justification, for without the "machine" even such increase as the present years' output shows would have been impossible and 3,000,000 tons next year entirely out of the question.

On the Pacific coast, whilst the general conditions of the labor market are entirely different, the same scarcity is apparent and wages are advancing. The want of miners has been emphasized by the exclusion of Chinese and Japanese workmen. The mines at the coast are not so favorably circumstanced as those in the east for the extensive use of coal-cutting machinery owing to the irregularity of the pavement and the "faulty" character of the seams, and the tonnage produced in this manner is not large. Skilled miners are hard to get and most of them are trained on the spot. The British Columbia people seem to have very decided views as to the wisdom of excluding Mongolian labor, and as far as the fisheries are concerned there may be something in their contention, but to exclude them from the mines in a country where miners cannot be procured, where every miner who presents himself can have work, and where the output is curtailed and the prosperity of the country limited, has always seemed to us a doubtful policy. The truth is that Canada has no unemployed native labor willing to work in the mines. The metalliferous mines are recruited from the United States, and the only effect of preventing coal mines from employing such labor as is available will be to draw men from the land, where wages are lower, and where they are more urgently required than at the mines. This has already begun to take place in British Columbia and Ontario, it has obtained, in part, in Cape Breton for many years, and manifests a growing tendency throughout the Dominion.

It is not unlikely that the great strike in the anthracite coal region of the United States may have some important bearing on the future of the labor market in Canada. It is hard to find fault with any of the demands of the men except that for an increase in wages on which no outsider is competent to pronounce an opinion; but the abolition of company stores, payment in cash, freedom to select their own doctor, and recognition of the Union, are all sound planks and cannot be successfully contested. The last item is the rock on which most large corporations which have undertaken to fight labor have split, the latest victim being the Taff Vale Ry. Co. It is too late in the day, and the wise man conciliates and not antagonizes the Union.

The Dominion Coal Co. are building pockets at Portland, Maine, to enable them to handle 200,000 tons of coal this winter, sold recently to the G.T. R.

There are numerous enquiries for coal areas in Cape Breton just now, and if reasonable terms are asked holders may be able to dispose of them and contribute to the prosperity of the country. The areas between Bridgeport and Lingan have been bonded to Mr. Ira Taylor, of New York, for $150,000, and Boston men are negotiating for 13 sq. miles east of Reserve. The South Shore Railway will open up promising areas near the Mira, and it will be surprising if next season does not witness such a boom in coal as Canada has never known. If a trade is to be done with Europe the United States cannot for a moment compete with Eastern Canada.

Operations in the coal areas at Broad Cove are progressing rapidly under the supervision of Mr. Fergie. Two slopes are being driven in the 7 ft. 6 in. seam which dips at an angle of 16 deg., and steps have already been taken to equip with the most modern plant and machinery. There is no reason why the Mackenzie-Mann Co. should not be shipping a large output next season, as they have good seams, easily accessible, of excellent quality and cheap to mine.

The following are the shipments of the companies montioned for August:—

Dominion Coal Co.	197,000
Acadia Coal Co.	21,900
Intercolonial Coal Co.	16,600

For the first eight months of 1900 the former shows the substantial increase of 277,000 tons.

An enthusiastic contemporary thinks that the Dominion Coal Co. is or shortly will be the largest coal producer "in the world." Without referring to returns we mention Joicey Bros. & Co., Durham, Eng., whose output last year was nearly 10,000,000 tons, an ideal standard for Cape Breton.

It is said that the roads in Cape Breton are proverbially bad, especially in the spring and fall. We are not in a position to deny the soft impeachment. Perhaps somebody will be able to divert a portion of the enormous increase in Provincial revenue from coal royalties to this laudable object. It is said that the income next year from this source will be $400,000; three years ago it was less than half this amount.

Since the recent re-adjustment of wages in Nov. Stotia, the following are the standard rates per ton:—

	Machine.	Hand.
Dominion Coal Co......	26c.	48c.
Newcastle Coal Co......	26c.	48c.
Acadia Coal Co......	....	41½c.
Intercolonial Coal Co.	....	46½c.

Loaders, $1.25 to $1.50 a day.

There is likely to be a coal famine in Newfoundland owing to the closing of Mr. Reid's mine at Grand Lake and the inability of the United States collieries to spare tonnage. The former is much to be regretted as it would have been a great advantage to the island to have a local supply and we hope the enterprising owner will be more successful in some other part of his extensive region. Some 20,000 tons have been mined at Grand Lake but the quality was not good and the seam was too thin to admit of profitable working.

As an evidence of the growing importance of Canadian mining matters in the old country we observe that our esteemed contemporary the *Colliery Guardian* is now running a special column of Canadian notes.

The French Fire-damp Commissioners who are probably the greatest experts on the subject have just reported on the special merits of the Marsaut safety lamp with special reference to the advantage of the "bonnet." They say that the interior may be full of blue flame for a period of one to three hours without any appreciable effect on the gauze if kept perfectly still but if moved quickly in a current of air an explosion would undoubtedly take place but for the bonnet. For some yeras the best judges have stood by the Marsaut and this report will confirm their opinion.

The advantage of coal-cutting machinery in a country where skilled labour is scarce is well illustrated by the experience of a mining engineer in Cape Colony who installed a disc wheel long-wall machine driven by electricity. After overcoming more than the usual initiatory difficulties he has finally triumphed and says each machine yields at the rate of 45,000 tons of coal a year at a saving of 25 cts. a ton.

The coal trade on the Pacific coast and especially the supplies of the San Francisco market are being affected by the rapid development of the New Mexico Coalfields. For the year ending June 30th, 1900, the output was 1,187,334 tons and the value at the mines $1,837,165, an increase of 138,300 tons over last year. The total number of workmen employed is 2015, so that the production per head is 589, a very high figure. The cost of production is under $1 and if the quality were not inferior our British Columbia mines at the coast would feel the competion keenly.

In consequence of the presence of large bodies of gas in their seams the Crow's Nest Pass Coal Co. have determined to apply compressed air as a motive power and have placed an order for a large plant with The James Cooper Manufacturing Co. of Montreal.

We exceedingly regret to have to chronicle the death of Mr. Robert Fisher who was killed in a railway collision near the Ladysmith mine of Messrs. Dunsmuir on the 17th September. Mr. Fisher was a young Scotchman who, until recently, acted as certificated manager to the Crow's Nest Pass Coal Co. and had enjoyed a wide experience in his profession. He was a man of much force of character and executive ability, and was deservedly respected by all who knew him.

CORRESPONDENCE.

The Mikado Gold Mining Co.--The Late Manager Replies to the Chairman.

To the Editor Review:

SIR,—In discussing problems relating to public affairs as well as questions of individual struggle of life, it is remarkable how ready some are to form a conclusion, without even giving the subject matter practical or thoughtful consideration. The majority of people do not seem to appreciate the fact that it is very essential to completely summarize and analyze the matter at issue, and to thorougly understand it in all of its ramifications, and to study it in all the various phases, that is, to go beneath the surface.

In the Rat Portage *Miner*, issued on May 18th, is an address reproduced from the London *Financial Times*, given by Mr. Jas. Reid in a general meeting of the Mikado Gold Mining Co., the said gentleman being the chairman.

The speaker, endeavoring to make plausible to his audience how it happened that in the spring of 1899 a period of retrograde production set in, chooses the poor way of laying it on the shoulders of the late manager, and talks about deplorable conditions and evidences of neglect and extravagance he has met with when visiting the mine two months after the former manager had left.

I, being the late manager, readily admit that there was need of finding an answer to the question as to how it is that a mine, in the great value of which "believed nearly every man about the place," should fall off, and at the best should only be thought of as being a spasmodically producing concern. The admittance of the possible occurrence of such gaps in the scheme for the future propounded by Mr. Jas. Reid in the course of his speech would have proved disastrous.

It is said that men entrenched behind a pile of pounds and shillings, and who know how to speak with a dignified countenance, are always right *per se*, and that a poor man, struggling with daily life's perversities, is always in the wrong as a matter of course. But this shall not keep me from trying to reduce these accusatory remarks of Mr. Jas. Reid's to their real value, and in doing this I shall be led by straight technical facts.

There has been given to the public repeatedly a piece of history of the Mikado mine, setting forth that an Indian detected the vein, how the financial transaction took place, how a manager was sent out to develop the mine, how in a comparatively short time things were shaped so that several hundred tons of ore broken at the surface were milled in the Rat Portage Reduction Works, and how the results of these millings were exceedingly satisfactory. How the company then built a mill on the location, and how the product from their own milling had covered all expenses incurred up till then, development, running cost, buildings, machinery, etc. The public is further acquainted with the fact that then followed a period of retrogression, that the manager resigned in February, and that since September under the new management an improvement in production was achieved.

This is, in fact, all that the public is familiar with. There has never been published a description of the ore body, nothing is known about its shape and size, nobody knows about the difficulties I was laboring under, owing exclusively to the peculiarity of the ore lodgings and the greedy push of the company.

In order to enable the public, especially the mining men, to understand fully my way of defence against the unqualified utterances of Mr. Jas. Reid, it is necessary to describe the Mikado ore body, and let mining men judge for themselves whether a fluctuation in the production was avoidable in the past and whether it will be so in the future.

Horizontal sections of the ore body of the Mikado exhibit the form of flat ellipses with irregular curvatures. A section near the surface shows the major axes to be 200 ft., the minor axis 12 ft. long, the area amounts to 1,920 square ft.

A horizontal section at a depth of 60 ft. shows the ellipse of some different measures. The major axis is 250 ft., the minor axis but 8 ft. long. The area gives 1,625 ft.

Sixty feet deeper, that is 120 ft. from surface, the major axis of the horizontal section is contracted to a length of 230 ft., the minor axis measures 7 ft. The area covers say 1,250 square ft.

This ore body consists of quartz and slate. The quartz is a solid mass. Between it and the slate no distinct contact line is discernible, they gradually merge into each other.

If you draw another ellipse *within* the first one (surface), making major axis to be 140 ft. long and both minor axes equal, you have encircled all quartz existent. The area of quartz within the first horizontal section amounts to say 1,300 square ft.

A second ellipse drawn within the horizontal section of the body at 60 ft. depth encloses all quartz at that point if its major axis measures 133 ft. and its minor axis 6½ ft. Consequently the area of quartz is about 700 square ft.

The area of quartz at a depth of 120 ft. is again different. The ellipse enclosing said mineral possesses a major axis of 120 ft., and a minor axis of 5 ft. long. Accordingly the area amounts to 470 sq. ft.

As to gold values the quartz varies very much. There are portions running but $5.00 to $6.00, others assaying $30.00 to $40.00 per ton.

The slate, here and there streaked and patched with quartz, gives but poor assay results throughout; $6.00 is the highest figure ever obtained.

Figuring out the contents and reckoning 12 cubic ft. to the ton, there existed between the surface and 60 ft. depth a body of:

8,860 tons, consisting of 56 per cent. rich quartz, and
44 " poor slate.

Between 60 ft. and 120 ft. depth a body of:

7,185 tons, consisting of 41 per cent. rich quartz, and
59 " poor slate.

Or, the whole body between surface and 120 ft. depth contained:

49 per cent. rich quartz, and
51 " poor slate.

Of course, these figures were obtained step by step as work progressed, the shape and size of the ore body being completely unknown when work was started.

The ore body, as you will have observed, being a lense, trends Northwest. Near its southern extremity, shaft sinking was commenced by hand-drilling, and sunk down vertically to 60 ft. Here a short cross-cut struck the body at its richest point. From the cross-cut drifting was begun and carried on north and south simultaneously.

Drifting north for about 50 ft., the quartz became mixed with slate and assay values went down suddenly. The drift was continued to about 40 ft. further in slate, when assays gave only traces of gold from that end.

Drift south cut for about 80 ft. through solid quartz when it turned into slate, the latter assaying poor. On driving 80 ft. further, assays did not indicate any more payable ore. The drifts were continued for the sake of examination, but nothing of encouraging character was encountered. Shaft sinking was resumed.

Whilst sinking shaft, the company informed me of their having ordered a twenty-stamp mill, giving instructions to speedily erect it.

On reaching a depth of 120 ft., a short cross-cut led to a vein matter, carrying less than $3.00 per ton. Drifts were started simultaneously north and south.

Driving north for a considerable distance, no improvement was perceptible as to gold values.

Driving south, say 35 ft, within which distance no value was encountered either, the end of the drift stood in slate, assays of which indicated approach of better material. Driving continued for say 40 ft. through $4.00 to $5.00 rock, the slate yielding gradually to quartz. This quartz, giving excellent assays, continued for say 120 ft., when the end stood again in $4.00 slate. The slate gave but traces of gold after about 70 ft. further driving.

Meanwhile the mill was swallowing the quartz from above 60 ft. level at the rate of about 1,000 tons a month.

Owing to the scanty financial equipment of the company, it became imperative to pay my own way, and in order to be able to do so, only rich quartz was fed. A thousand tons is not much, but you can keep up feeding at said rate for but a short while if you have a vein of less than 200 ft. long to break from and a mill is, so to speak, from the very start at your heels.

The block of stoping ground between 60 ft. and 120 ft. level was meanwhile prepared and the mill was kept running on quartz assaying $.1.00 to $12.00.

Plotting on paper measures of the ore body obtained at the surface a.. underground, a straight line runs exactly through the centre of every ellipse above described, and declines towards south at an angle of 30° from the horizon.

The extension of this chute towards depth is of course not known. As there exists no payable ore of consideration beyond it in the horizontal line either south or north, you can easily figure out from the above that 1 ft. of shaft sinking corresponds to only 68 tons of ore. But the more shaft sinking you do, the more you move away from the chute, so that at a depth of 240 ft. you would have to drive say 300 ft. in order to reach it.

Although seeing this poor chance, I resolved to continue shaft sinking down to 240 ft., hoping that in that mentioned distance of 300 ft., vein matter might be met with that would be acceptable for the mill. In order to accelerate sinking, only two-thirds of the size of the shaft was continued.

By the time the shaft reached 240 ft. depth, the mill had consumed all rich quartz between 60 ft. and 120 ft. level, but was kept running on ore from underhand stoping in the bottom of 120 ft. level, on stray patches of quartz in all stopes not having been worth considering before, on slate in all stopes assaying $4.00 to $5.00, and on ore obtained from shaft No. II. and its drifts. The mixture gave about $7.00 ore.

Here the period of "famine" set in. Standing in the bottom of the shaft, nothing above me but slate that hardly would pay expenses, behind me nothing but barren ground, and in front a chute of rich quartz, however small, but 300 ft. distant, and only to be reached by six months' driving.

Whilst drifting was carried on and the mill being run on poor ore that consisted of say 70 per cent. slate, a cyanide plant was installed to work the tailings.

The slatey character of the ore caused a sliming under the stamps up to 42 per cent. of the tailings. The plant (not designed by me) did not provide for working the slimes. The gold in these slimes, not amalgamable, had no chance to be extracted by cyaniding (as the slimes were rejected), and therefore was lost. The tailings leaving amalgamation in December, 1898, and January, 1899, carried gold up to $8,755.00, from which amount were extracted by cyaniding but $2,373 00. Whether, since, an improvement in cyaniding has been accomplished, I do not know.

Facing such poor results, combined with an unfortunate mining prospect, and having a chance to change position for one of better pay, I resigned management of the Mikado. Before leaving I pointed out to Mr. Jas. Reid that it would take about two months yet before the rich chute would be reached, and that from the moment of cutting into it, for a good period a considerable production would take place. Requests by cablegrams (received from Mr. Jas. Reid as well as from the company) to cancel resignation I could not comply with.

Mr. Jas. Reid states in his speech that the returns from the stamp mill began to fall off,—"so much so that the board concluded that the management was faulty, or else the mine was decreasing in value." Neither the one nor the other was the truth. It was and will be always *a question of getting in time at the value*, if a 20-stamp mill is constantly to be fed. The small size and singular position of the chute make it impossible to keep development ahead of the mill.

As to the neglect Mr. Jas. Reid accuses me of,—there has not been a decrease in tonnage milled during that poor period, though I was forced to break this tonnage from a poor portion in that same chute. This accounts for the fall off in mill returns,—or can you make this out to have been a fault of the management?

As to the accusation of extravagance, does this vouch anything towards proving the value of the mine, which is what Mr. Jas. Reid is desirous of doing in his speech? What can this have to do with the falling off of mill returns? Extravagance means "not called for and needless expenses." Why did not Mr. Jas. Reid condescend to name an instance of this?

When I left the Mikado mine, the drift at 240 ft. level had advanced about 200 ft. My prediction that the chute would be cut within two months was frustrated by my successor. He, supposing me to have driven the wrong way, stopped work in said drift, and started search by means of diamond drilling, cross-cutting and winze sinking at "impossible" places. This took several months, after which time driving of 240 ft. level was resumed.

The chute was cut some time in August, and since then lively stoping of ore has been going on between 240 ft. and 120 ft. level. I do not know how much ore is left in that block; at any rate it cannot be much, according to the tonnage taken out.

The drift at 240 ft. level has been continued beyond the top line of the chute, and was then stopped. As on that (southern) side of the chute no ore was met with in upper levels, it is evident that the 240 ft. level was discontinued for the same reason.

There has been sunk from the 240 ft. level down, a winze in the underlay line of the chute which measures 110 ft. (slanting 30°), so that a vertical depth of 60 ft. has been reached. Liberally estimated, this block, below the level, contains 3,500 tons, and is partly taken out already.

Mr. Jas. Reid mentions a 4th and 5th level,—I assert that they do not exist.

The Rat Portage *Miner* mentions in the issue of May 4th, "The Great Mikado Mine—1,230,000 tons of $10.00 ore in sight."

What means "Ore in sight"? Qualitative, it means that there exists a mineral containing a metal, extractable at a profit; quantitative, it means that a bulk of such mineral has been blocked out in every way and is known all round so far that from measurements in three lines its cubic contents can be figured.

I think the manager of the Mikado far too wise to have referred in his report to 1,230,000 tons of ore *in sight*,—it will be rather the product of an estimate on the top line of one chute to be the bottom line of a following one, and so on through the whole length of the property. But then, even this estimate which is based, according to authentic reports, on a vein matter of 2 ft. in width, seems to be the playful bubble of some evil spirit. Consider only this formula, taking one ton of ore to be 12 cubic ft.:

$$\sqrt{\frac{1,230,000 \times 12}{2}} = \text{round } 2,720 \text{ ft.}$$

which says, that the estimate covers an ore body of 2 ft. in width, 2,720 ft. long (that is, to the end of the property), and *2,720 feet deep.*

This ore is said to exist all on the south side of the shaft. How do they know? At the surface on that side you meet occasionally a stringer or patch of quartz, so you will in any location; but four years' prospecting around Bag Bay has proven them to be incoherent and of no account. In the trend of the Mikado chute a vein is not discernible at the surface. Underground the levels south as well as north were discontinued for lack of ore as soon as they reached (the southern drifts) beyond the chute. If there exists ore in the end of 240 ft. level south, why is it not driven ahead? Is there no need of development? The chute described is taken out so far as development goes.

The existing machinery is not adequate to the problem of following the small chute towards depth, if it should be worth while to do so at all. If I were the manager, I would quit the job, in order to escape the coming calamity which I predict.

No. 2 vein has produced say 1,500 tons of low-grade ore, and work was discontinued there in my time, on account of its ceasing to yield even that any longer. The big find made in that vein which at one time caused a sensation throughout the mining world amounted to $490. The vein will prove a surprise to the separate company to be made of this portion of the property.

In demonstrating the real cause of the less productive period that set in at the Mikado under my management, I repel those accusations made by Mr. Jas. Reid that this period was brought about in consequence of negligence and extravagance. I understand very well why the existence of a gap in the profitable production had to be explained by Mr. Jas. Reid, and so will the public when buying shares to be dropped in the market next.

No Englishman will deny me the right to put in practice the motto he himself writes on his standard—"Fair play for everyone."

RAT PORTAGE, 21st September, 1900.

Canada's Mineral Display at Paris.—List of Awards.

The mineral exhibit of Canada occupies the greater part of the ground floor of one wing of the Canadian Pavilion in the Trocadero Gardens, and although it was impossible to obtain sufficient space to enable many large specimens to be shown, or local suites of specimens, the exhibit as a whole is a very complete representation of the economic minerals of Canada so far as these are at present worked or known.

The collection is much larger than any previously shown by Canada at International Exhibitions, embracing nearly twice as many localities as were represented in the Colonial and Indian Exhibition. There are in fact about 1,200 separate entries in this collection, many of them including large numbers of specimens representing associated minerals or various products.

In addition to the general catalogue of Canadian exhibits at Paris, there has been prepared by the Geological Survey a special descriptive catalogue of the economic minerals of Canada, making a thick pamphlet of 217 pages. This is published in English and in French separately. Also accompanying the mineral exhibit is a small general pamphlet by the Director of the Geological Survey entitled "The Economic Minerals of Canada," likewise separately published in French. Several of the provinces have supplied reports and other special publications for distribution in connection with their minerals at Paris, and altogether the mineral display should serve as a useful advertisement for Canada.

The exhibit has attracted very favorable comment and notice from many professional and other visitors whose opinion is of value, and the large proportion of awards granted in connection with this exhibit—a total of 52—is additional evidence of its importance. The list of awards, lately published, is as follows:—

6 GRANDS PRIX—

Geological Survey Department — Minerals, publications, maps, models, photographs, &c.
Canadian Commission at the Exhibition—
Ontario Bureau of Mines, Toronto—Minerals and publications.
Department of Mines of British Columbia—Minerals and publications.
Department of Mines of Nova Scotia—Minerals and publications.
Department of Mines of Quebec—Minerals and publications.

10 GOLD MEDALS—

Canadian Copper Co., Sudbury, Ont. (Two gold medals)--Nickel ores and products.
Orford Copper Co., New York—Nickel ores and products.
Canada Iron Furnace Co., Montreal—Iron ores and iron.
General Mining Association, Sydney Mines, Cape Breton, N.S.—Coal.
Dominion Coal Co., Glace Bay, Cape Breton, N.S.—Coal.
Le Roi Mining Co., Rossland, B.C.—Gold ores and products.
Montreal-London Gold and Silver Development Co., Montreal—Gold ores.
Nova Scotia Steel Co., New Glasgow, N.S.—Iron ores and iron.
New Vancouver Coal Mining and Land Co., Vancouver, B.C.—Coal.

18 SILVER MEDALS—

Albert Manufacturing Co , Hillsborough, N.B.—Gypsum and plaster of Paris.
Asbestos and Asbestic Co., Danville, Que.—Asbestus, etc.
Bell's Asbestus Co., Limited, Thetford Mines, Que.—Asbestus and products.
Crow's Nest Pass Coal Co., Fernie, B.C. · Coal and coke.
Jack & Bell Gold Exhibit, Halifax—Gold quartz from Nova Scotia.
Milne, Coutts & Co., St. George, N.B.—Granite monument.
Union Colliery Co. of B.C., Ltd., Comox, B.C.—Coal and coke.
Union Industrielle et Metallurgique du Labrador, Quebec—Ores, etc.
Wallingford Bros. & Co., Ottawa—Mica.
Windsor Salt Co., Limited, Windsor, Ont.—Salt.
Walker Mining Co., Buckingham, Que. (Two silver medals)—Graphite crude and manufactured.
Hall Mines Smelter, Nelson, B.C.—Silver and copper ores and products.
Canadian Smelting Works, Trail, B.C.—Gold and copper ores and products.
Owen Sound Cement Works, Ont.—Cement.
Queenstown Cement Works, Ont.—Cement.
Battle Bros., Thorold, Ont.—Cement.
Toronto Lime Co., Limehouse, Ont.—Lime.

9 BRONZE MEDALS—

Blackburn Bros., Ottawa, Ont.—Mica.
Coleraine Chrome Mfg. Co., Black Lake, Que.—Chromic iron and concentrates.
MacMachine Co., Belleville, Ont.—Rock drill.
Milton Pressed Brick Co., Milton, Ont.—Bricks.
Nichols Chemical Co., Capelton, Que.—Pyrites.
Samuel Winter & Co., Moncton, N.B —Yellow Head Pass mica.
Canada Paint Co., Montreal—Mineral pigments.
C. E. Fish, Newcastle, N.B.—Pulp-stone.
Keystone Graphite Co., Grenville, Que.—Graphite.

4 HONORABLE MENTIONS—

Laurentides Granite Co., Cote des Neiges, Que.—Worked granite.
Eustis Mining Co., Eustis, Que.—Copper and iron pyrites.
Fossil Flour Co., Bass River, N.S.—Tripolite, etc.
Canadian Peat Fuel Co., Toronto, Ont.—Peat.

AWARDS TO COLLABORATEURS.

The Exhibition Regulations provide that Assistants, Engineers, etc., who have co-operated in the production of the Exhibits, are qualified to receive awards Gold medals have been awarded to the following collaborateurs:—

5 GOLD MEDALS—

E. R. Faribault, Geological Survey Department, Ottawa, Ont.
A. P. Low, Geological Survey Department, Ottawa, Ont.
Edwin Gilpin, Inspector of Mines, Halifax, Nova Scotia.
W. F. Robertson, Provincial Mineralogist, Victoria, B.C.
Aubrey White, Deputy Minister, Crown Lands, Toronto, Ont.

One of the views reproduced herewith shows, in the foreground, four specially protected steel and plate-glass cases, in which a large series of valuable gold specimens chiefly from the Klondike, British Columbia and Nova Scotia is exhibited. Behind these is a section showing the whole depth (about 16 feet) of the gravels and other deposits from a part of Bonanza Creek in the Klondike, illustrating the actual conditions under which the gold is found there.

The second view has in the foreground table cases containing polished stones and gems, and a large case holding a detailed model, made from plans and sections prepared by Mr. Faribault, of one of the Nova Scotia gold fields. Behind and to the left are a number of building stones and in the centre several handsome displays of mica.

Colliery Surface Arrangements.

By MR. S. A. EVERETT.

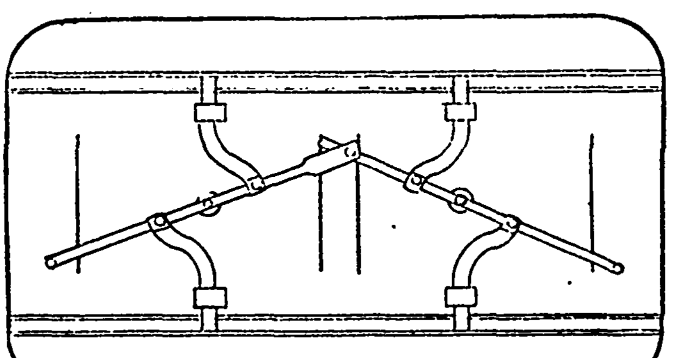
(Continued from August Number.)

(1) BANKING.

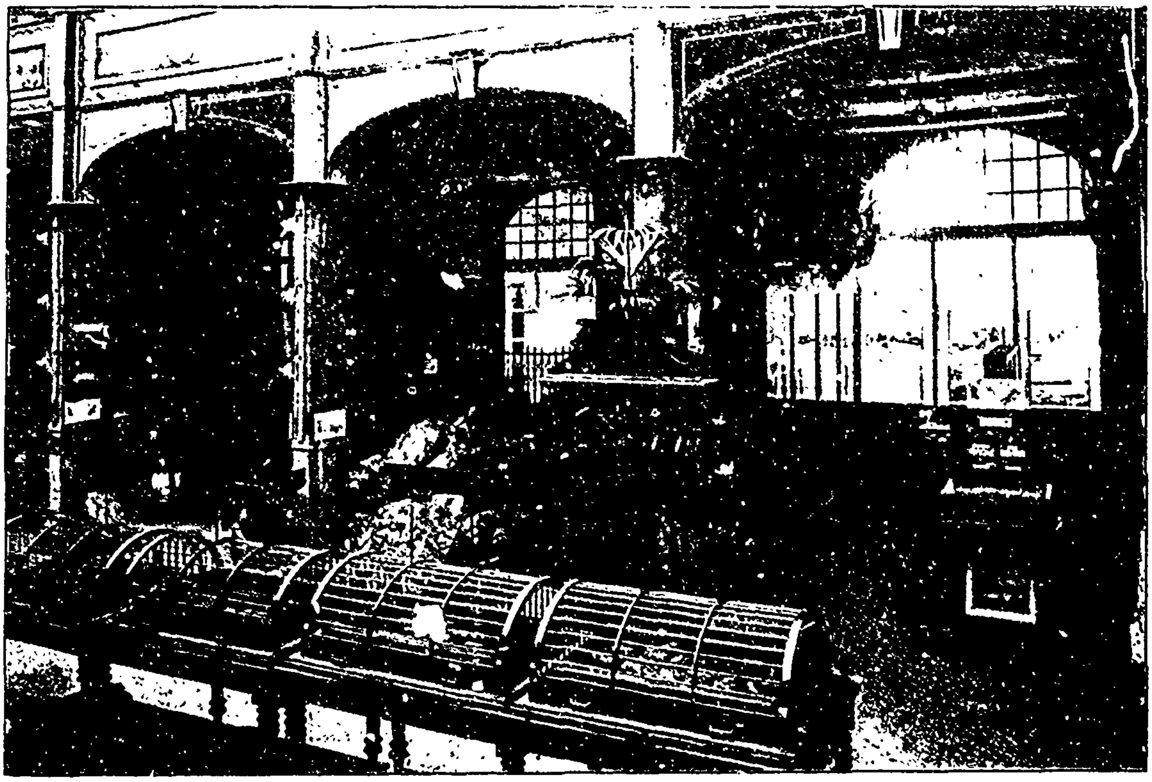
The operation of banking consists in exchanging empty trams for full trams on the arrival of the cage at the surface. Formerly, when quantities were smaller, banking was almost universally accomplished by manual labour. When the cage landed at the surface, attendants opened the catches on the cage, pulled out the full tram, pushed in the empty, and closed the catches, then pushed the full tram to the weigh-machine and tippler, and after tipping, returned it to the empty side of the pit. This method, on account of the tram returning over a portion of the same road, necessitated considerable power if the trams were large, as the road had to be kept fairly dead, and favourable gradients were not possible.

The introduction of the throughway tippler has enabled considerable improvements to become possible, and at all large collieries to-day *the banking arrangements are more or less of an automatic nature.*

FIG. 1.



The cage on landing at the surface falls back on stops or keps; the catches are then opened automatically by the cage, the full trams run out of themselves, and are followed by the empties, the catch being closed at the proper moment by the full tram in passing out. Then it



Klondike Gold Specimens.

Stones and Gems.

VIEW OF SECTIONS OF CANADA'S MINERAL DISPLAY AT PARIS.

runs under gravity to the weighing machine and from there to the tippler, and after being tipped, passes through under gravity to a chain bank on steam hoist, where it is elevated sufficiently high to admit of the empty tram returning of itself to the back side of pit The road on the full side should be graded through tippler to the chain bank.

The trams are held in position and prevented from moving in the cage by catches usually placed on the bottom; there are different arrangements in use. Fig. 1 illustrates a form which was almost exclusively used in this coalfield before the introduction of automatic appliances, and is largely used to-day.

It consists of two flat levers connected by a pin and slot at one end, the other ends being turned up at right angles to facilitate its movement from side to side; each lever is pivoted at its centre, and has small bent side levers placed at equal distances above and below; these side levers are the catches, and when the large levers are on one side they extend across the rails and prevent the tram moving; when moved across to the opposite side the catches are drawn in, and allow a free way for the trams to pass out.

FIG. 2.

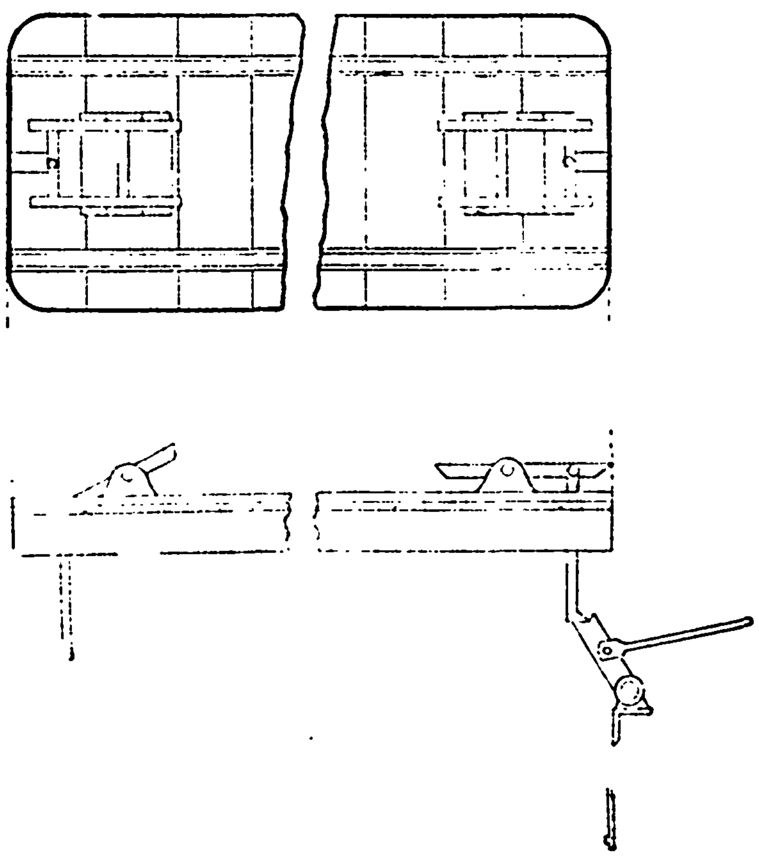
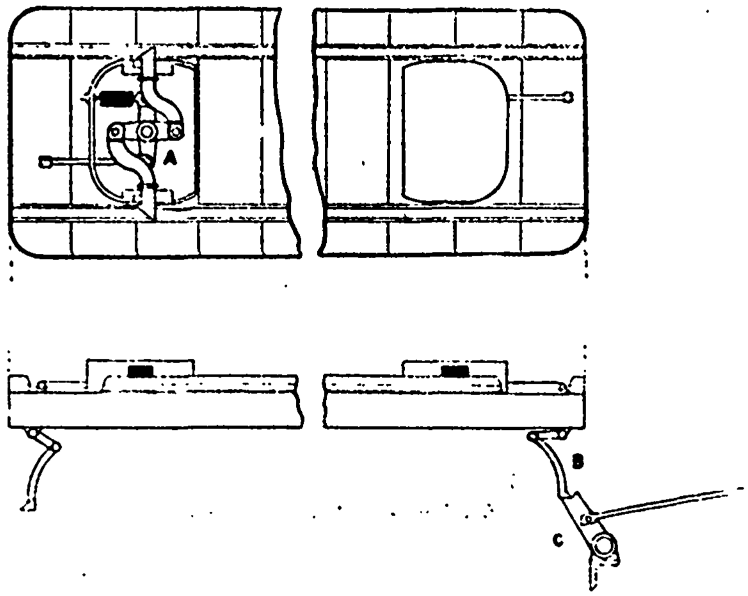


Fig. 2 shows an arrangement of drop catches which are opened by the cage in landing on the keps, and consist of two short levers connected together and suspended out of centre, so that when released they fall and catch the axle of the tram. From the centre of the connecting bar on the longer side a lever is fixed which passes through a slot in the bottom of the cage; when the cage lands, this lever comes in contact with a small kep, which is fixed between the large keps on which the cage rests. This small kep is weighted to always fall toward the shaft, and has the effect of bringing the catch levers to a horizontal position and allowing the full tram to pass out. At the proper point a vertical lever, which is connected by a rod to the small kep, is placed between the rails of the full road, which is pulled over by the axle of the full tram. This withdraws the small kep and releases the catch in time to arrest the empty trams in the proper position in the cage. The catch on the empty end of the cage comes into operation at the bottom of the pit.

The catches shown in Fig. 5 are a modification of those shown in Fig. 1, and are worked automatically by the cage. The catches are placed in a cast-iron gear case placed between the rails, and consist of a centre piece A, with arms at right angles. This centre piece turns on a spindle The catches are fixed to one pair of arms, and a tension spring and lever rod to the other pair. When the cage is running in the pit, the spring keeps the catches in position over the rails, and prevents any movement of the trams. Upon landing at the surface, a lever, B, comes in contact with the small kep C, and by moving it upwards, withdraws the catches from over the rails. The full trams then

FIG. 3.



pass out, and are followed by the empty; at the proper distance the axle of the full tram comes in contact with a vertical lever, which withdraws the small kep C, and the catches are immediately closed by the spring The trams on the empty side pass in by the wheels pressing against the catches and forcing them in.

In deep shafts, when any additional load is a consideration, the cages are generally constructed of steel to ensure the maximum strength with the minimum weight. In South Wales, where large trams are almost universally in use, the shafts are now generally sunk large enough in diameter to admit of two trams being wound in one cage placed tandem, or end to end. Where the shafts are not large enough to do this, the cages are decked, generally two, more rarely three or four decks, being employed. In large and deep shafts, where the engines are very powerful, four trams may be raised on two decks. At some places on the Continent, notably Belgium, where shafts of small diameter are in use, decking is carried to an extreme, as many as twelve decks being known with cages over fifty feet high, four platforms are erected at the top and bottom of shaft, the operation of decking being effected in three stages. Where possible, decking should be avoided on account of the increased labour cost, or the time expended in decking, and the cages arranged to carry two trams end to end.

Where decking is employed, the trams may be changed in various ways:—

(1) Decking with the winding engine. If the winding drum is a cylindrical one, each deck is brought opposite the pit bank at top, and the onsetting place at bottom, by means of the winding engine, or, as it is termed, "decking" This arrangement is objectionable on account of the time taken, and the wear and tear to the rope by constantly stopping and starting at the same point.

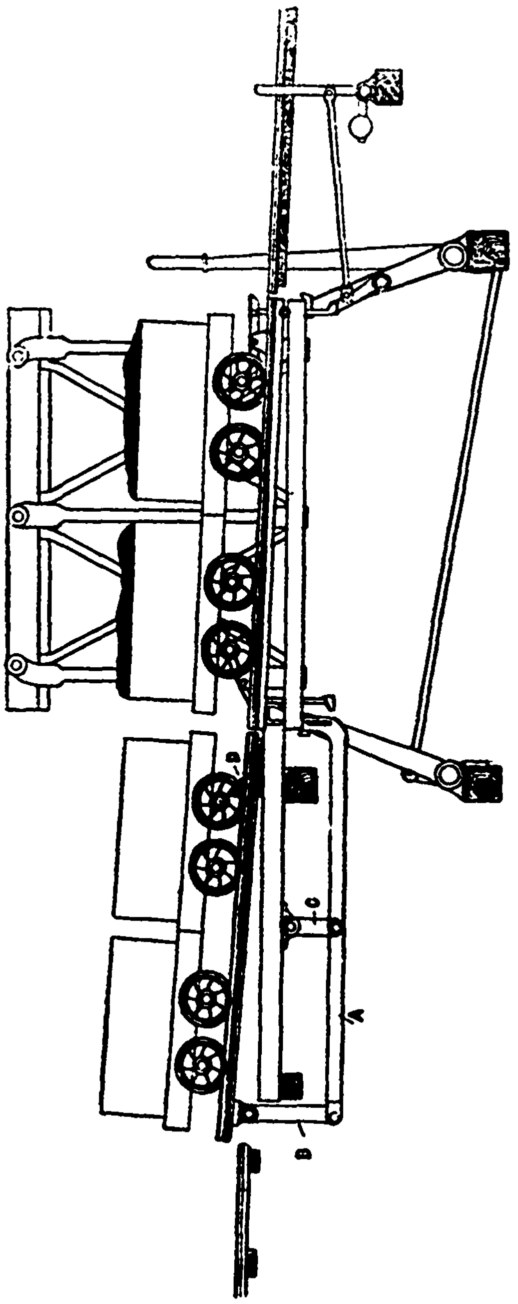
(2) Platforms or stages are erected at the top and bottom of the shaft at the proper height for each deck, and all the trams are changed simultaneously. This method requires additional labour, as attendants have to be kept on each deck, and the full coal has to be lowered and

the empties raised from the platform by some means during the winding. This arrangement for two decks is illustrated in Figs. 5, 6 and 7. Both decks have the same automatic appliances for facilitating the operation of banking.

(3) Another arrangement for simultaneously changing the trams on all the decks consists in providing supplementary cages on both sides of the top and bottom of the shaft. These cages have the same number of decks as the cages employed for winding, and are lowered and raised by hydraulic power. The empty trams are placed on the cage on the empty side, the other cage being ready to receive the full tram: upon the arrival of the cage at bank, the empty trams are pushed against the full ones by hydraulic rams fixed on the empty side of shaft, then during winding the full trams are lowered to the pit bank, and the empty trams raised into position for the next cage.

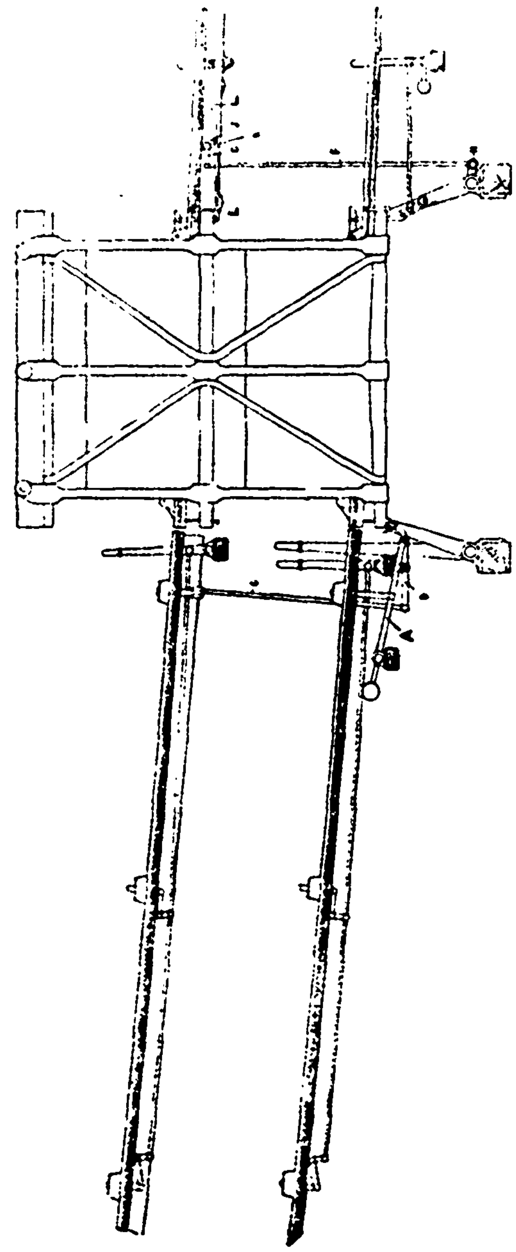
The stops or keps generally in use are shown in the illustration in Fig. 4, and consist of four rigid arms or levers for each cage, placed

FIG. 4.



two each side of shaft upon which the cage rests when at bank. They are weighted to fall in towards the shaft, and are connected together by a lever arranged to give them an articulated motion in opposite directions, and by means of a conveniently placed lever are under the control of the banksman, who withdraws them to allow the cage to pass down. Falling stops, to obviate the lifting of the cage in starting, have been invented, and are largely in use on the Continent, but have not yet had any general application in this country. They require the rope to be nearly the exact length, and for this purpose an adjusting

FIG. 5.



screw-link arrangement is fixed between the rope cap and bridle chains of cage.

The changing of the trams at the surface may be accomplished in three ways:—

(1) Hand labour.

(2) Hydraulic, steam, or some other power.

(3(Automatic arrangements worked by the cage.

(1) Hand labour was in past years the only method used, and is employed to a large extent at the present time. The cage when resting on the keps is usually level, the catches often, as shown in Fig. 1, are worked by hand, the trams are changed entirely by attendants, the roads being graded as far as possible to facilitate working.

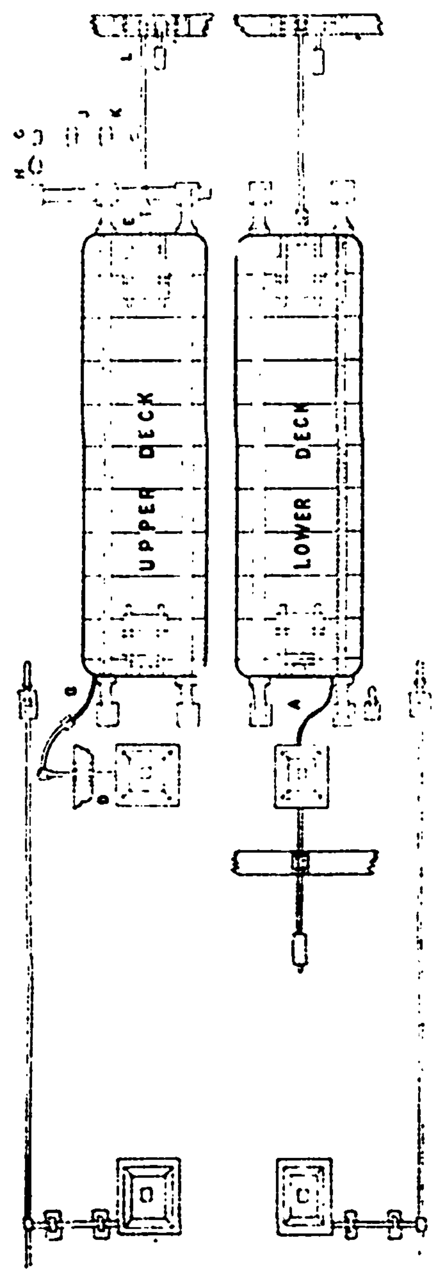
(2) In the second arrangement, the empty trams are placed upon a stage or platform at the back of the pit, similar to the stage shown in Fig. 4. The end next the shaft is hinged, and the opposite end is attached to a cylinder operated by steam, or some other power which is worked by the cage landing on the keps by an arrangement of rods and levers. The platform is raised sufficiently high to allow the empty trams to run in and replace the full ones; the cage has a fixed gradient

or a tilting bottom, the empty end being raised when the cage rests on keps.

(3) In the third arrangement all the work is done by the cage in landing on the keps. The cage has either a tilting bottom, or a fixed gradient in favour of the full load, which greatly facilitates the operation of banking, and the catches are opened and closed automatically. The empty trams rest against stops which are removed mechanically at the proper moment.

In the arrangement shown in Fig. 4, the empties are placed on a platform or stage, hinged at the end nearest to shaft; the other end is

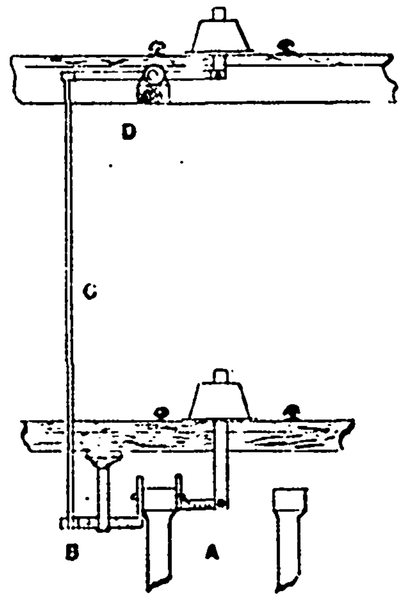
Fig. 6.



connected to a lever. A, by lifting links, B. This lever is connected at the centre to suspension links, C, fixed to a beam placed above, which acts as its fulcrum. The other end of the lever is turned upwards and connected to the side of one of the keps by a slot and pin, which enables it to move a limited distance in a vertical direction. On the upper side of the beam, and between the rails, a triangular stop, D, is placed, which catches the axle of the first tram when the stage is down, and holds it in position for the cage; when the cage arrives on the surface and falls back on the kep, it presses down the end of the lever, A, as far as the slot will permit, by this means raising the stage sufficiently high to allow the trams to pass over the stop and into the cage. When the cage is raised, the stage falls back into position to receive the next empty trams. The trams are kept against the stop by giving the stage a slight gradient towards the shaft. In Fig. 4 the cage has a swing floor, and the catches, which are of the drop lever kind, are opened and closed automatically.

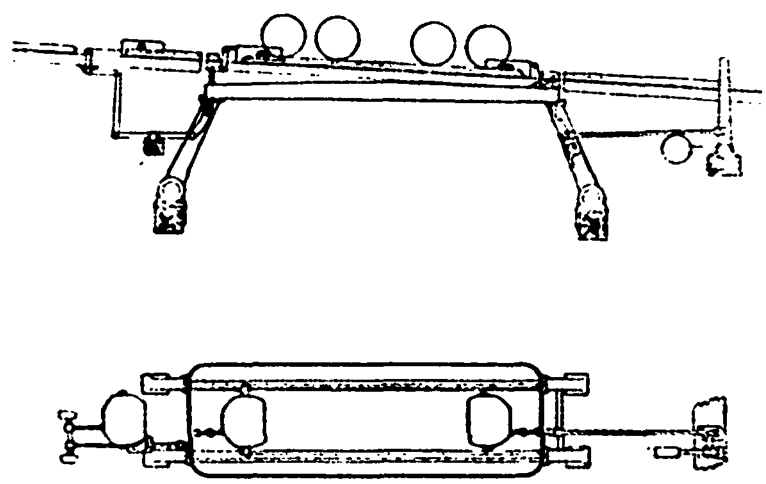
In the arrangement shown in Figs. 5, 6 and 7, the same operation

Fig. 7.



is effected in a slightly different way. The empty trams are here placed on a fixed gradient of about 1 in [illegible], and a stop is placed near the shaft. The stop is worked by the cage, and is weighted to remain up and prevent any tram passing, except when the cage is resting on the keps. In the arrangement shown, four trams are raised on two decks, and by means of platforms at the top and bottom of the shaft two decks are changed at the same time. Both decks are fitted with swing floors, and are coupled together by side rods, which enable the upper deck to be tilted with the lower. The stops on both decks are operated simultaneously, the lower deck through the lever A, the upper deck through the bent lever B, which is suspended at the centre by a link—one end is turned upwards and has a slot and pin fixed to kep, and the other is connected to a vertical rod C, which is connected to the stop by a horizontal lever D. Fig. 7 shows an end view of the platform on the empty side of shaft. The cage catches shown here are the drop kind illustrated in Fig. 2, and are operated automatically when the cage falls back on the stops. In the upper deck the small kep for

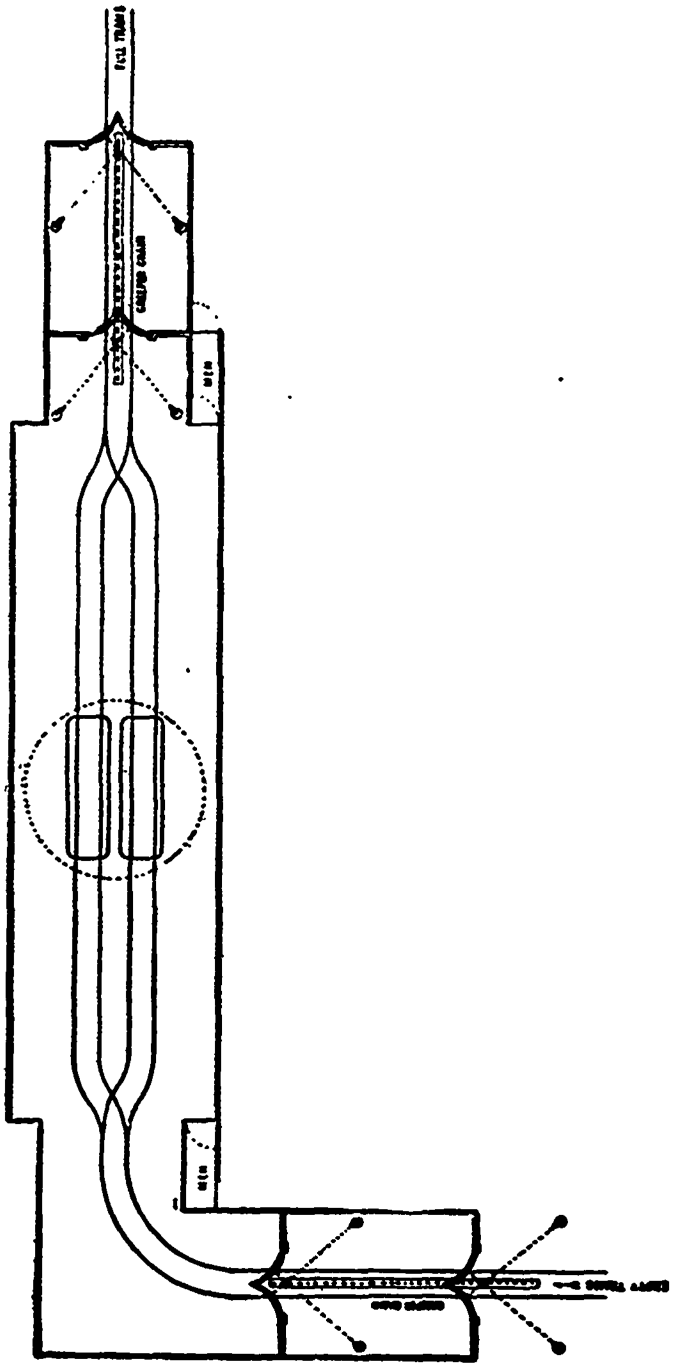
Fig. 8.



opening the catch on full side is replaced by a flat plate E, which does not come below the platform. The plate is hinged so as to allow the cage to pass up. To ensure this plate being withdrawn to allow the cage to pass down a special arrangement is necessary A crank lever, H, is fitted on the same shaft as the keps and connected by a rod, F, to a lever, G, fixed on one end of a shaft, J, on the upper deck, and a vertical lever, K, at the other end, which comes in contact with a stop on the weighted lever, L. By this arrangement the plate, E, and lever, L, are withdrawn by the opening of the keps. The stops placed at the back of the pit are for regulating the supply of empties, and by the arrangement of the levers are moved in opposite directions, so that when one is in operation, the other is withdrawn. These stops are worked by a lever conveniently placed, and are under the control of the banksman, who lets the empty trams down as required.

Fig. 8 shows a cage fitted with the catches illustrated in Fig. 3. This makes a very compact arrangement, and the floor of the cage has

FIG. 9.



not the obstruction caused by the drop catches. A similar stop is placed at the back of pit to hold the empty trams in position.

Where high water gauges are in use, unless precautions are taken, great leakages take place when winding coal from the upcast shaft. To obviate this, it is now becoming the practice to entirely enclose the upcast shaft by a wooden or iron casing, the banking operations being carried on inside. Fig. 9 illustrates an arrangement of this kind. Air doors are placed on each side of the shaft for the passage of full and empty trams. The doors are in duplicate, so as to ensure one being always closed to the shaft; the arrangement is entirely automatic. The doors are in the form of arcs of circles, with the convex side towards the direction in which the tram is moving. The doors have rubbing pieces fixed where they come in contact with the trams; each door is fitted with a chain and balance weight, so as to self-close immediately the tram has passed through. The distance between the doors is sufficient to allow two trams to pass through at the same time. The gradient through the doors in this case is laid nearly level, and the trams are conveyed through by means of a creeper chain placed between the rails which engages the axles of the trams. The chain passes through the first door, but stops short of the second; from this point the gradient is arranged to fall sufficiently to allow the tram to move away under gravity. The object of employing the chain is to pass the trams through without any undue shock or vibration and consequent wear and tear and leakage to the doors. Doors are also arranged for the passage of men.

(2) THE TIPPLER.

The tram of coal having been weighed, is next passed on to the tippler, which discharges it into the screen for the purpose of sizing and cleaning, as far as possible, before finally delivering it into the wagon. The tram should pass from the weighing machine to the tippler under gravity. There are a large number of different contrivances in use for this purpose, but few of them fulfil all the conditions of what may be defined as an ideal tippler.

A good tippler should fulfil, among others, the following conditions:—

(1) It should be constructed to pass the tram through to economise time and labour.

(2) It should be discharged slowly, and after delivering the empty tram should return quickly.

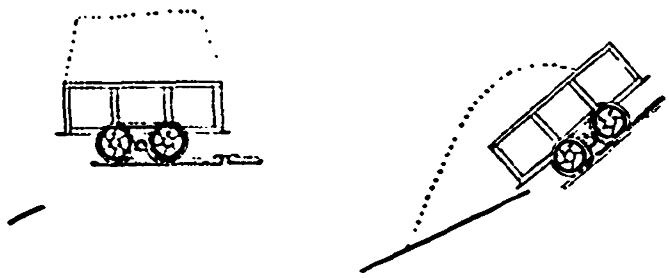
(3) It should stop itself automatically.

(4) It should place the coal gently on the screen.

(5) It should distribute the coal before arriving on the screen.

It is generally the practice in South Wales to rake the coal above the top of the tram, in some instances as high as 2 feet 6 inches. The tippler illustrated in Fig. 10 is one which has been, and is at the present

FIG. 10.



time, largely used in this coalfield, although in most of the modern collieries it is being superseded by the better and more modern appliances. It consists of a flat plate carried by two journals, and having rails fixed on it which are turned back to catch the wheels of the tram and prevent it going too far. The tram is run on until the centre of gravity of mass is in front of the point of support, so that when released it falls forward and discharges the coal; when empty the greater weight being behind assists in bringing back the tram. Considered from the point of view of the ideal tippler, it is at a great disadvantage. This tippler is not under control: it precipitates the coal violently into the screen in such a mass, and such a manner, that great breakage must ensue, and efficient screening is hardly possible; the large coal falling first often carries a large portion of the small over with it into the truck. The coal enters the screen with such momentum and velocity that a considerable portion of the length of the screen bars is traversed before screening can be effected. If we consider the height to which the coal is raked above the sides of the tram, and consequently the increased fall into the screen, and the simple screening and tipping appliances which have held their own for the past decade, it is a distinct emphasis of the excellent quality and hardness of the South Wales steam coals.

(To be continued.)

Centrifugal Sluicing.

By A. J. Bensusan, A.R.S.M., F.C.S.*

This process of winning gold from auriferous gravel is known also by the names, "Steam Hydraulic Sluicing," "Gravel Pumping," "Barge Sluicing," "Centrifugal and Hydraulic Dredging," and consists essentially of breaking down the gravel from a face by the force of a jet of water from a giant nozzle and causing same to flow towards a sump hole, from where it is lifted to gold saving sluice boxes, by powerful centrifugal pumps.

Last year saw the introduction into this Colony of centrifugal sluicing, or to be strictly correct, the system of centrifugal sluicing that has been developed in the Beechworth district of Victoria, and its advent may be said to have been caused by the attention that was directed to bucket dredging areas, when seeking for which auriferous deposits were found, which, being unsuited for exploitation by the bucket dredging process, would lend themselves to that of centrifugal sluicing; and also to the fact of the latter having been in operation with considerable success in Victoria. [Since writing this I learn that in this Colony at Brown's paddock, Uralla, there has been a pump sluicing plant in operation for some years.]

Information regarding the early introduction and use of centrifugal pumps for the working of gold-bearing gravel, other than that found in running streams, is not easily obtainable, but the system seems to have been introduced into Victoria about ten years ago.

The evolution of centrifugal pumping dredges for operations connected with the deepening of harbors and rivers can, however, be traced back to about 1855, when Libby in the United States of America, and Frederick Hoffman, collaborating with Schwartzkopff in Germany, were both independently at work upon it.†

Centrifugal suction dredges are constructed to-day of great capacity, and under favorable circumstances it can be shown that there is no type of dredge to come near the suction dredge for economical work. The New South Wales Government is in possession of several suction dredges, and in the Annual Report of the Engineer-in-Chief for Harbors and Rivers for 1895, attention is drawn to the fact that during five years 28,750,000 tons had been dredged by this process for forming river channels.

As a means of recovering gold, however, from river bottoms, suction dredges have been tried in New Zealand and elsewhere, but their work has been found to compare very unfavorably with the bucket dredges. This is a curious fact when considering the experiences of those engaged in the work of deepening harbors and rivers, for of the two systems it can be shown that the suction dredge under most circumstances is the more successful, at any rate from the point of view of economy. No doubt the difficulties connected with the actual recovery of the gold after the material has been raised, have left the field in favor of the bucket system.

Mr. Wheeler, in his work on Tidal Rivers, published in 1893, says that where a sufficiently large amount of material has to be removed to warrant the purchase of plant and the employment of a regular staff, dredging in sand can be done with suction dredges at one penny half-penny as against twopence half-penny per ton for an equally elaborately arranged plant on the bucket system. And returns of work performed by the huge sand pump "Brancker," on the Mersey bar, have been published, which show that the cost is only 0.89d. per ton. This system was not adopted in the United Kingdom till 1890, when it was so successful on the Mersey bar that the Liverpool Harbor Board built two pumping dredges each capable of lifting no less than 4,000 tons of sand per hour, but the first successful pump for reclaiming was used on the Amsterdam Canal in 1867.*

Of course the processes of pump sluicing for gold, and harbor and river dredging are widely different, but these figures and particulars are given to show that there exists a wide field for engineers to design machines with the centrifugal pump as the main principle, that will enable extremely poor auriferous ground to be worked at a profit.

At the present time the process of centrifugal sluicing as practised in Victoria, cannot be compared in any way with the bucket dredging of the rivers of New Zealand, for each has been evolved for the working of different kinds of deposits; bucket dredging for the bottoms of running streams, centrifugal sluicing for areas that would be suitably worked by ground sluicing, but where water pressure and other essential conditions, such as "get away" for headings are not available.

It is necessary here to state, that auriferous flats other than those adjacent to running streams are being worked in New Zealand by the Bucket Dredge, when a paddock is excavated, filled with water and the dredge launched, the ground has, however, to be comparatively flat to be able to work in this way. Comparing these two processes, that of centrifugal sluicing and of bucket dredging, for flats where it is necessary to excavate a paddock to float the dredge, each would have its advantages depending largely upon the contour and condition of the ground. If there were no slope on the bed-rock and the ground was fairly even in depth, doubtless the bucket dredge in the hands of a New Zealand dredging expert would be the better appliance to use, but if there were buried snags, boulders and rock projections and uneven depth of ground with a fairly regular slope of bottom, the centrifugal system should be applied. The wear and tear of a bucket dredge working on a river is heavy, but it is infinitely greater when there is not a running stream to keep the elevator chains free from grit.

One great consideration with the investment of capital in any kind of dredging scheme, is the examination of the ground to prove its value before building an expensive plant, and while there are considerable difficulties in testing the bottoms of rivers, it is a comparatively simple matter to thoroughly test a dry deposit suitable to treatment by the centrifugal process.

In the sister Colony the Hon. John A. Wallace has given much attention to the development of the system, and its importance can be judged from a description of some of his claims, and the plants at work on them.

The principal claims are at Yackandandah in the Beechworth district.

No. 1 Rowdy Flat claim: the oldest plant of the kind can be seen here, and it is here indeed where all the experiments were made.

The plant comprises a barge carrying the machinery, consisting of a horizontal engine, that indicates 100 horse power. This drives, by rope pulleys, a 12 inch centrifugal pump carrying a Hedley runner. Water for the nozzle to break the ground is brought on the claim by gravitation. The "wash" being very clayey it takes an enormous amount of water to break down and sluice it to the sump hole, from where it is lifted to the sluice boxes, or gold-saving tables above.

* From the Journal of the New South Wales Chamber of Mines.
† "Engineering," Dec. 12th, 1899.

* Centrifugal Pump Dredging in New South Wales, by A. B. Portus, Assoc. M. Inst., C.E., read before the Engineering Section of the Royal Society of New South Wales, Oct 21st, 1896, Vol. 30.

The plant and working face—and the same may be said of most of the others in this locality—are lighted by electricity, enabling work to be carried on continuously.

The plant at No. 2 Rowdy Flat claim is more interesting, as it is one of the latest constructed, and more particulars are available.

The depth of the wash being operated upon is 21 ft., 9 ft. of which is gravel, and 12 ft. sand and pebbles, and consists entirely of debris deposited from old hydraulic sluicing claims, which is indicative of the fact that it is not likely to be very rich, but it has the advantage of having had all the clayey material washed out of it, clay being so detrimental to efficient gold saving.

The barge is 34 ft. by 35 ft. by 4 ft. 6 in. deep, and carries a horizontal tubular boiler 18 ft 6 in. long, containing 54 return tubes and 3 Galloway tubes. The engine is a compound vertical tandem, with 10 in. and 16 in. cylinders, has a 12 in. stroke, and indicates 100 horse power. The pressure gauge on the boiler registers 125 pounds. The speed of crank shaft is 220 revolutions per minute, and the pump is driven by rope pulleys at 300 revolutions.

The pump is a 12 in., and lifts the material 57 ft. from the bottom of the sump hole to the discharge. The "spinner" or "runner" is of Hedley design.

All this machinery was manufactured in Melbourne, by the Austral Otis Co. The gold-saving box is made of three sixteenths of an inch black iron, is 4 ft. 6 in. wide, 12 in. deep and 100 ft. long, with a grade of about 7 in in 12 ft. Lying on the bottom there are perforated iron plates which permit of the sand getting down and the fine gold depositing in ripples in which mercury is occasionally used. The boxes are sometimes covered with cocoanut matting. The average capacity of the pump is 64 cubic yards per hour, and 5,000 gallons of water per minute are used, which is about 27 times the weight of material treated.

Water is brought to the claim by gravitation for the two giant nozzles, which are used for breaking down the gravel and sluicing it to the sump hole, which is made 20 ft. deep in the solid rock.

The total expenses are said to be covered by 80 ounces of gold per acre, which is equal to about 1.1 grains per cubic yard. Twenty-seven men are employed in three shifts of eight hours, wages being 6s. 8d. per day. Eighty cords of wood are used per month at 8s. 9d. per cord. These figures show that expenses are covered by about £10 10s. per day.

One week is lost in sixteen, for removing the barge to a fresh site, and it usually costs about £70 before a re-start can be made. Allowing for the one week's stoppage, and taking 59 cubic yards at 1.1 grain treated per hour, 3 ounces 5 pennyweights of gold would be recovered per day.

A bucket dredge was at work on this claim ten years ago, but was discarded in favor of the present system.

An important consideration in this and other similar claims is the means to be adopted for stacking the tailings and getting rid of the water in a comparatively clean state, as it would not do to permit of its carrying sand and sludge, and filling up the water courses and perhaps destroying good land for miles away from the site of operations. This is accomplished at the No. 2 Rowdy Flat claim by means of wooden pipes, 20 in. in diameter, which are laid on the ground over which it is intended to run tailings for deposition, after they have been passed over the gold-saving tables. These pipes are covered up temporarily with bushes and earth to prevent them floating. An opening is left to the pipe by means of a roughly constructed shaft of billets of wood, so that only the water can get away while the sand and shingle is prevented from getting over and into the pipe. As the heap of debris becomes higher, so the shaft is kept up, until finally the pipes are covered by, say, 60 to 70 ft. of tailings. These pipes are made of 1½ in. sawn timber, bevelled to measure 4½ in. outside, and 4 in. inside, the planks being held together by iron clamps. They are constructed at the claim, and cost 1s. 3d. per foot run.

The Staghorn Flat plant is a larger one. The barge was built in 1894 by Mr. James Cadzow and is 50 ft. by 40 ft The engines are a pair of marine, taken from the wreck of a small steamer, and are nominally 90 horse power; they are said to have indicated 545 horse power with 80 pounds steam. The gravel and water pump are both 15 in.; the former carries a Kershaw "runner." The suction pipe is 26 ft. long and the vertical lift above the pump is 60 ft.; total lift, 86 ft. About 15,000 gallons of water per minute are used, which is about all the boxes will carry.

The work done in thirty-eight weeks was 10 acres of ground of an average depth of 45 ft., which is equal to about 132 cubic yards per hour, including stoppages. A careful record was kept for five weeks when the ground was close to the sump hole, and the pump averaged 3 cubic yards per minute. The ground had been worked 10 chains away from the barge when it was decided to float the machinery close to the face again. The weekly expenditure, including fuel, is about £200, which at 132 cubic yards per hour is two pence half penny per yard. Some difficulty was experienced here in stacking the tailings sufficiently high to avoid having to move the barge too often, and it was found that by setting the delivery pipes at a direct angle, a lift from 60 to 70 ft. was obtained without extra power.

The "McCoombe" is another of Mr. Wallace's claims and is situated about a mile from Staghorn. A very large sum is said to have been spent on this property before any gold was recovered. The ground is 40 to 50 ft. deep, and in parts it is very much deeper. There is a Kershaw pump with 12 in. suction and 14 in. delivery, driven by an old locomotive engine, which has indicated 360 horse power, with 76 pounds of steam. There are three locomotive boilers and two jackass boilers, and a second locomotive engine available as an auxiliary. The lift for the pump is 76 ft. 6 in. with a 24 ft. 6 in. suction, total lift 101 ft. At this claim, like at the Staghorn Flat, the water for the giant nozzle has to be pumped, it not being available by gravitation. For this purpose there is a 15 in. Robinson centrifugal pump driven by a 25 horse power Westinghouse engine, a pressure of 30 pounds per square inch is obtained. The water is returned to a reservoir and used again. The "McCoombe" is considered an expensive claim to work. The monthly pay sheet is about £550, including cost of firewood. One acre of 40 ft. ground is treated per month, which shows an average of 111 cubic yards per hour dealt with, which includes stoppages. With these figures the cost works out at about 2d. per cubic yard. The plant has been working for 12 months in one place.

In Victoria there are at work or in course of construction about thirty plants of this type, but the particulars given are those obtained from a personal visit to Yachandandah, and although there are modifications in the arrangements of each plant they are all about the same in principle. These remarks would also apply to the construction of the centrifugal pump itself. One hears of the Von Smidt, the Kershaw, the Hedley, the Robinson, and Jennings pumps, and many others, indeed their name is legion. Each has some modification, or supposed improvement, but in principle they are all the same. The action is that of centrifugal force.

Doubtless from experience men engaged working gravel pumps, see where there are defects, and can improve upon the pump for the particular class of material they have been treating. Jennings, in his patent, claims an improvement in the mounting of the runner excentrically, instead of in the centre of the case, in having adjustable liners between the face of runners and inside casing, in the introduction of a jet of air at the commencement of the uptake, besides many minor improvements. Mr. Jennings having been manager of one of Mr. Wallace's claims, would no doubt see where many improvements could be made, and others in similar positions would have their ideas of remedying defects.

To prevent grit getting into the main bearing, there is an annular groove next to the stuffing box, which is in connection with a small jet of water unner pressure; any pressure greater than that in the pump itself will keep out the sand and grit.

It is important that the material forming the liners and wearing parts should be made of well selected and tough metal, for it is here where the expense is felt for repairs. At No. 2 Rowdy Flat claim a new circular liner is required every twenty-four weeks, and a new "runner" every twelve weeks. There appears to be much room for improvement under this head, a tough material seems to be required rather than a hard one, on the same principle as that in the sand blast process of figuring glass, a piece of soft material (paper) covers the parts that are not required to be etched, while the hard glass is attacked. Perhaps gun-metal, bronze, or compressed cellulose would give satisfaction. Messrs. Tangye, Ltd., made some of their pumps with gun-metal discs and spindles of magazine bronze, or steel covered with gun-metal.

It is not proposed to deal at any length with the subject of engines and boilers required, as the same considerations would apply in designing a plant for this work, as for any other where economy of fuel and a high efficiency are necessary. Large plants are the most economical.

In several instances in Victoria mistakes were made in not having sufficient boiler power to start with, as I have shown, finally five boilers were put in at the McCoombe claim before enough steam could be obtained. It is better to start with a high-class boiler of the water-tube type, and save fuel from the start; old locomotive engines are not the ones to use for economical work. To give an idea of what might be installed on a very large plant I have taken from a late volume of "Engineering," some particulars of a suction dredge recently constructed for the Russian government. The runner will make 180 revolutions per minute, and is driven by a divided vertical triple expansion engine. Each cylinder has its own excentric and valve motion, being variable in the high pressure cylinder and fixed in the others. A throttling governor controls the speed. The diameters are: high pressure cylinder 21 in., intermediate 34 in., low pressure cylinder 39 in. in each, and the stroke is 24 in. The indicated horse power varies from 1,425 to 1,600, and the capacity contracted for was 1,600 cubic yards per hour. The engine weighs complete 45 tons.

The engine being built by the Austral Otis Engineering Company, Limited, for the new Argo plant at Sandy Creek, Victoria, has 16 x 32 in. cylindets with 36 in. stroke, and will indicate 450 horse power, at 85 revolutions per minute, with steam at 150 boiler pressure.

The question of employing electricity for the motive power deserves consideration, and Mr. Wallace is now installing an electrical plant for his claims at Yachandandah. The electricity will be generated by water power and transmitted by cable to the centres of utilization. But not alone where there are a number of plants at work, is a central installation the most economical plan, for would it not be advisable, when there is a large area to work, to generate electricity at a suitable position on the ground, by the consumption of coal or wood, and have only a small barge to carry the pump and motor. The advantages would be found to consist in the handling of a small dredge, and the main machinery would be on firm ground. In conclusion it is only necessary to say that the laying out of arrangements in connection with the plant require careful study, and it is essential to commence working the claim at the lowest point, enabling the material to be brought down hill to the pump.

Notes on Gold Dredging.

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By J. W. H. Piper, M.I.M.E.*

It gives me great pleasure to address you this evening on a subject which I think is likely to prove one of the most important branches of the mining industry of this Colony. I refer to bucket-dredging and in passing will also make a few remarks anent hydraulic elevating and sluicing.

I do not propose to dwell at length on the technical detail of a dredge, because to describe a dredge from beginning to end sufficiently clearly to be understood by the laymen would take too much time, nor do I intend to refer largely to the earlier history of bucket-dredging in New Zealand. I shall rather endeavour to illustrate to you the immense advantage of the bucket-dredge as a gold producer. As you are all aware there are immense tracts of country in this Colony known to be highly auriferous, but which, on account of their wet nature, have baffled all attempts of the miner to extract the hidden treasure. To overcome this difficulty the bucket-dredge has been designed and brought to its present pitch of perfection; although this class of mining has for some years been carried out successfully in New Zealand, it is only within the past eighteen months that it has made its advent into New South Wales. The modern gold-dredge as used so successfully in New Zealand, is the outcome of years of practical work, and the brains and experience of many inventors are embodied in its mechanism. Bucket-dredging is unlike all other systems of mining, the principal outlay being the first cost of machinery, very little preliminary preparation of the ground to be treated being necessary. The chief advantage claimed for the bucket-dredge is the enormous quantity of material which may be operated upon at a surprisingly low cost, owing to the economy effected in labour. Under favourable conditions two men can handle and treat, with a suitable plant, eight hundred loads in a shift of eight hours, at a cost of about one penny per ton, thus it will be seen, that ground containing one or one and a-half grains to the ton can be made to return a profit. I might mention in passing, that I know of a large dredge treating and handling ground at three-farthings per cubic yard.

The object of the engineer is to design a plant that will give the largest possible output per week combined with the smallest possible expenditure, and it is absolutely necessary for him to study all the possibilities of the operations, in order to provide for all contingencies in the class and character of the machinery, so as to secure the very best results. Although the main features are similar in almost every instance, at the same time, many details will vary greatly according to local conditions, and it is on the careful consideration of these conditions that the successful working of the dredge will largely depend. The principal points to be considered are:—The greatest depth of the ground to be worked below; and its height above the water level; the nature of the wash; whether fine or coarse; friable or otherwise; whether it contains many large boulders, sand, clay or bands of cement; the character of the bottom, whether it be hard or soft; the probable difficulties to be overcome in the shape of rocky bars or snags; and the quantity of water available. Last, but by no means least, it is always essential that the wash to be treated should be thoroughly tested by say inexpensive boring operations or other methods so as to give some idea of the character of the gold to be saved and to ensure success in the undertaking.

Care should be taken to obtain accurate results from every prospect, so that the engineer may be placed in a position to calculate the proper average value of the material, overburden, etc. If the preliminary investigations are only conducted in a proper and judicious manner, the investor need have no fear as to the ultimate result. It might be

* Paper read before the New South Wales Chamber of Mines.

interesting to note, however, that over-sanguine views as to possible returns lead to disappointment, as was the case in the early days of New Zealand dredge mining.

As regards the prospects of dredging in New South Wales, most of our rivers and flats appear to have been worked by fossickers and others in a crude and perfunctory way, consequently a large percentage of gold still remains to be recovered, particularly the fine gold. In proof of this statement and of the value of old and abandoned workings I will later on show you slides of modern dredges working at a profit upon areas, which in one case had been previously worked by an old type dredge and in other cases where the ground had been repeatedly turned over by Europeans and Chinamen. In New Zealand, where the more easily worked and richer ground has been gone over by the smaller dredges, it was recognised that there were still immense tracts of lower grade country to be worked, and to do this profitably the lifting capacity of the buckets was gradually enlarged from about two to in some cases seven cubic feet. [By means of the limelight a picture was thrown on the screen showing the various stages in the growth of the bucket. The picture was a photograph of seven buckets, each one having marked upon it, its capacity in cubic feet, and the year of its adoption.] Here fears were entertained as to whether a dredge, fitted with the latter sized buckets could successfully treat the enormous quantities of wash, which it lifted. All doubts on this score were soon dispelled, and although on the large modern dredge the gold saving tables usually have an area of about two hundred square feet, it has been found that practically the whole of the gold, including even the very finest is saved on one-fourth of that area. [Another slide illustrated the modern gold-saving appliances, the revolving screen and tables of Mr. C. L. Garland's dredge on the Macquarie River being shown. The photo was taken while the dredge was at work.] It is on account of this gold-saving power of the bucket dredge, that the modern machine, where it is possible to apply it, is rapidly superseding all other forms of alluvial mining

Of course where both fine and coarse gold occur, special provision must be made to save the whole of it, and this can also be done now without the use of separate screens or sieves.

In the near future attention will doubtless be given to dredging those auriferous drifts, which lie away from and at a higher level than the watercourses. This can be easily accomplished and the dredge worked almost as economically as is being done at present. An excavation sufficiently large to allow of a dredge being manœuvred in, say one hundred feet square by eight or ten feet deep could be made The dredge could then be built in or beside this hole and a small pumping plant erected to convey water from the nearest convenient stream. The hole or paddock once filled, the additional water, necessary to compensate for loss by soakage, evaporation, etc., would not be very great, and the cost of pumping would then be a trifling item. The chief advantage that may be claimed for this particular class of dredging and one that would almost counterbalance the cost of pumping, is that the dredge would be immune from floods, which in a river are always more or less dangerous and certainly detrimental.

So far, I have discussed more particularly the continuous bucket-dredge. There is yet another type of dredge which has occasionally been experimented with as a gold winning machine. I refer to the Shovel and Grab Dredge. As excavating machines these dredges have done and will continne to do for many years no doubt admirable work, but where very heavy boulders or submerged trees are met with and where continuous feed is necessary, these machines cannot be compared with the modern bucket-dredge. Again, the labour necessary to operate the dredges in question is about twice as great as that required for the continuous bucket plant. Various other methods have been adopted, such as pneumatic caissons and dredges, but without success.

One type of alluvial mining erroneously called dredging, is that in which a centrifugal pump is employed to lift the wash, after it has been broken down and conveyed to the intake pipe of the pump by water under considerable pressure. This should rather be designated: "Steam Hydraulic Elevating." A very able paper on this latter subject has been given before the Chamber by Mr. A. J. Bensusan. I do not therefore intend to discuss it further.

The construction of a pontoon suitable for bucket dredging is not so easy a task as it may seem to the layman, as it requires great strength at special points to bear the great and unequal strains, which may be put upon it. A visit to the hold of a well-constructed pontoon is an object lesson and is a surprise to most people, who see it for the first time. [The photograph of the pontoon of the Braidwood Proprietary Company's dredge was here thrown upon the screen, which showed the hull in course of construction.] It will seem as if literally a whole forest of timber has been used to obtain the great desideratum of strength and utility. The arrangement of the plant is an important point, requiring careful consideration. When it is neglected, it is a cause of much inconvenience in the conduct of operations and often leads to loss of time, which of course means loss of money. Improvements are being continually effected, and it is necessary for the engineer to be well posted in designing a dredge of the most modern type.

"Spoon" and "Grab" Dredges.

By J. W. Jaffray, J.P.

The subject allotted to me for this short paper is "Spoon" and "Grab" Dredges, but my remarks will more especially have reference to what was set forth about those types of dredges at the last meeting, and as the discussion which followed the reading of Mr. J. W. H. Piper's excellent paper is not recorded in the transactions of the Chamber, I must claim forbearance while I recall some of them.

In the paper referred to, the "Shovel" and "Grab" dredges were described as being good excavating machines, but, where very heavy boulders or submerged trees are met with, and where continuous feed was necessary, these machines could not be compared with the modern "Bucket" dredge. Again, the labor necessary to operate these dredges would be about twice as great as that required for the "Continuous-Bucket" plant.

I would point out that as dredging machines, both the "Spoon" and "Shovel," as well as the "Grab" type of dredges occupy a rather more important place in the dredging world than that attributed to them. The "Spoon" type is largely in evidence, especially in America, and in Europe and many other countries. The "Grab" dredge has proved itself to be the cheapest means of lifting material from the bottom of harbours, docks, rivers, etc.

I admit that so far for gold dredging, the "Bucket" dredge has been first favorite, and I wish it every success still. But it may be that there are other types of dredges, if properly tried, and without any prejudice, that might prove themselves quite as efficient, if not more profitable even for gold-dredging than the "Bucket" type of dredge. To my mind, it appears that the first and most important point to consider is, which type of dredge will raise the most stuff at the least cost, and then to consider which type is the most suitable for dealing with beds of rivers. Then comes into consideration, the first cost of a plant, the cost of keeping such a plant in good working order against breakages as well as the ordinary wear and tear, the *actual* capacity of the machine in delivering solid materials, its fitness for encountering obstacles, such as trees and boulders, and in general, being able to deal with all the intricacies of a river, or other dredging ground, including sharp bends, corners, deep holes and such like. For the lifting of material from the bottom of rivers, etc., the "Bucket" dredge has not a reputation for economy outside New Zealand and Australia. As for the gold-saving appliances in connection with "Spoon" and "Grab" dredges—that has been overcome, and an arrangement designed, which is as simple as with the "Ladder" type.

Spoon Dredges.—So far as I have been able to ascertain, nothing in the shape of a modern "Spoon" dredge has ever been tried for gold-dredging. We find it on record, that a very primative arrangement was made with an iron ring at the end of a long pole, the ring forming the mouth of an ox-hide bag, and this pole with its bucket or bag attachment was thrust down into the wash at the bottom of the river, and hauled up by a winch arrangement by hand; and in one or two cases, I believe, it was tried with an ordinary steam winch, fixed on to a ponto ., and no one is surprised that make-shifts of that description did not turn out a success; but these cannot be for a moment compared with the modern "Spoon" dredge, as it is now so extensively, I might say almost universally used in America, and the reports we have of its economical working--the low cost per ton of solid matter raised—will compare favourably with any achievements we have heard of from the favourite "Bucket" dredge.

It has been asserted that this "Spoon" type was used in America as an excavator, and not as a dredger, but this is not quite according to fact, and in proof of this, I am prepared to submit photographic illustrations, taken directly from a whole series of such dredgers, varying in capacity from half to ten yards dippers, and now being used by the principal dredging companies, navigation companies, state canal departments, engineers corps, contracting companies, etc., in the United States. In connection with that class of dredge, I also find that what the Americans call "Clam-Shell" dredge is also a favorite, and a good many of them are at work, and in many instances are used in conjunction with the "Spoon" dredge, and are termed "Combination" dredgers by the builders. There are a few of the "Bucket" types of dredgers there also, but very few as compared with any of the others, and this being so, it naturally leads us to think that evidently our American friends have found the "Spoon" and "Clam-Shell" type of dredgers the cheapest and most economical means of raising the materials from the bottom of their rivers, etc., or they would not give them such a preference. One of the reasons for this is, that they are much better adapted for dealing with obstructions in the bottom of rivers, less liable to damage from such, and in general, much less wear and tear than the "Ladder" type.

Grab Dredges.—Again, with reference to the type of "Grab" dredge, which has become so popular all over Europe, as well as in China, India, Brazil, and the Australian Colonies. Considerably over six hundred of them are in use by the various Governments, thirty-seven of which are found in Australian waters, and two others building at the present time for Australia, one of which will be employed dredging for tin.

In South America these dredges have been used very successfully for gold-dredging.

I have been told that some years ago one of them was tried at Araluen for gold-dredging, but was not a success. Carrying investigations further, I find that the open type style of "Grab" was used, which was not capable of closing tight on the material, and being of a sandy nature, of course much of it escaped, but I am not aware that one has been tried in this country with one of the new "Solid-Closing" grabs, from which nothing escapes, and which is eminently suitable for retaining any class of gold-bearing material.

It is claimed for the "Grab" dredge that it is the cheapest and most economical arrangement of raising mud, sand or other materials from the bottoms of rivers, harbors, etc., and that if the output of actual solid matter only is taken into account, it will bear very favourable comparison with any other type of dredger.

For example: The Liverpool Dock Co., who do more dredging than any other company in the world, have practically discarded the "Ladder" dredgers in favour of the "Grab" system, and they, in one of their reports, say that dredging and removing mud with these "Grab" dredges has cost on an average during the past five years 1.73d. per ton, and the place of deposit averages ten miles from the docks, and the removing barge has to steam against the flood tide going out, and the ebb tide returning.

In one of the New South Wales Government Reports on dredging, we find it stated that eighteen of these "Grab" dredgers have been working at various ports and rivers, and that the first cost and annual expense of working the "Ladder" dredges is so considerable, that many of the rivers would have remained unimproved had not the "Grab" dredge been built.

The Victorian Government also say: That many of their rivers would have remained unimproved had not the "Grab" been introduced; and before a London Royal Commission, it was stated that the "Grab" Dredge System had saved the Millwall Dock Co. £3,000 per annum.

These and other similar evidences all go to prove that the "Grab" type of dredge has, to say the least of it, a very good reputation for economic working, and that being so, its application for gold-dredging purposes is only a question of providing a continuous feed arrangement for passing the stuff over the gold-saving appliances, and that has also been provided.

The cost for wear and tear in the "Grab" type is very much less than the "Ladder" type.

Another important consideration, especially to small companies, who may not be able to invest in a costly "Ladder" type dredge, is the very low price at which these can be obtained, and in cases where a punt is not actually required, they can be fixed on to a raft or timber float, which can generally be arranged at a very little outlay; and they are eminently suited to clear the water-way of large boulders, old trees, and other impediments. I have heard it said, that supposing the "Grab" did encounter a snag, what then, would it not let out all the gold-bearing material? Of course it would, but it would bring up the snag without any damage to the machine, and without any delay, and leave the ground clear for the next dip. The same applies to boulders. Indeed, I understand that the New South Wales Government used one of them for a considerable time, specially for lifting blasted rocks, some pieces several tons in weight.

I have also been told that "Ladder" dredgers do not "shy" at big obstructions, such as old trees, etc. I have seen a photograph of a big log with one end in a bucket, and the other end fixed into a hoisting tackle, said to have been raised by the said ladder, and a marvellous piece of work it appeared to me, but on referring to Government and other reports, both from New Zealand and other parts, I find that snags are the terror of "Bucket" dredgers From the New Zealand Government Reports relating to mining for the year 1899, with reference to dredging, I take the following remarks, from which it will be seen that the "Bucket" or "Ladder" type of dredge is not all that could be desired where there are any obstacles to contend with. On page 135 of the said *Report, we find the following*:—

"The dredging system is most suitable for the Otago District, "where the land is entirely free from timber; but in some parts of "Southland, where forests are not yet banished, and throughout the "Nelson and Westland fields, the presence of roots and trunks of trees "will prove a great obstacle to dredging." There is an example in New South Wales where a stoppage of something like six weeks was caused on account of breakages from such an obstruction.

It has been admitted, even by advocates of the "Ladder" dredge, that the "Grab" would come in very handy for working in sharp turns and corners, which would not be accessible to the "Ladder" type, and and that is no doubt the case, and it will also be admitted that it is more suitable than any other type for clearing out deep holes and pockets in rivers, which often occur, and as such are of eminent importance, being most likely to hold most of the precious metals in gold-bearing rivers, is one point distinctly in favour of the "Grab."

Before leaving the "Grab," I would also remind you that in comparing actual capacities of it with any other kind of dredge, that account should be made of the solid matter only, that is raised in each case. The "Bucket" and "Spoon" types do not always come up full of solid matter; if they did, their capacities would be all that is claimed for them, but the fact is that they often contain a good proportion of water, whereas in the "Grab," all that it brings up is solid matter, actually compressed by the action of the closing of the "Grab" on it, and there is no possibility of any gold-bearing materials escaping.

In Conclusion.—With reference to an equal and regular distributing arrangement of the bulk dump of material from the "Spoon" and "Grab" types of dredgers, through the revolving gratings and over the tables, I would like to say that this is all provided for in a simple and effective manner. The material is first dumped into a receiving hopper, in which there is a grated rocker, which is made to oscillate for the purpose of separating out the larger stones and other material, after they have been cleaned, and which it would not be desirable to allow to pass through the revolving screen. In connection with this said hopper, there is a proper feeding arrangement, which can be regulated at will for delivering into the revolving screen, which, of course, will be made of a similar construction to those now in use on other dredgers, as well as the other usual gold-saving appliances.

On Safety Appliances and Precautions Necessary in Mines.

By J. .. Godfrey.*

The mining industry to the lay mind is one which appears peculiarly dangerous, partly because the accidents which take place are usually of a very tragic nature, and partly because other industries claim victims more from disease than from violence, and their fatal nature is not advertised to the same degree—so that in spite of this idea of unusual risk, it is a fact that mining will compare favourably, as regards vital statistics, with nearly all other trades requiring special training.

Nevertheless there are a larger number of fatal and serious accidents occurring year by year than one would like to see, and could the deaths which take place by accident be eliminated, it is safe to say that mining would become one of the most healthy of all species of skilled labour. If we examine the accidents appearing yearly in the reports of the Mining Departments of the various colonies, it will be at once admitted that many of them need not, and in many cases ought not to, have occurred.

It is, therefore, the object of this essay, to pass under review the ordinary precautions which should be adopted to minimise, as far as possible, the dangerous factors whereby fatalities are brought about.

Mining accidents may be broadly classified as *Non-preventable*, or those against which no human foresight could have guarded; and *Preventable*, are those which are caused by negligence, mistake, or forgetfulness—the latter class being further divisible into those due to unconscious mistake, and those due to criminal negligence.

It may safely be said that 90 per cent. of the accidents are preventable. Probably the greater part of these are due to mistakes for which no one is legally to blame; but the very fact that they *are* preventable, and *do* occur, emphasizes the necessity for using additional precautions when experience shows that they are required.

Mines should be worked economically; but mine owners should be always ready to spend money on appliances which can be shown to protect the men.

Most accidents arise through mistake—the most careful and skilful man may sooner or later make such a mistake. A man will wind up his watch every night for ten years, but one night he will forget—similarly an engine driver will manipulate his winding engine for years without an accident, and will then pull the cage to the poppet heads, and very probably be unable to say how it occurred. On the railways this possibility of error has years ago been recognised, and has caused the adoption of all kinds of automatic safety appliances, such as interlocking points, to protect the men against themselves, to force them to remember in spite of themselves, and, what is far more important, to protect people against danger not caused by themselves.

In other words, we should try and protect men against danger arising from *personal error*.

There is no pretence made in this essay at originality; the appliances mentioned here are to be seen on nearly all large mines, and are known to all competent mine managers—but the fact that they are not always adopted, points either to a certain amount of ignorance, or to a culpable negligence amounting to callousness on the part of some managers, as regards the welfare of the men, and is therefore a sufficient excuse for pointing them out here.

The various points discussed will be arranged as follows:—

Machinery—Winding Engines, including drums, brakes, clutches and indicators.

Boilers—Including hydraulic test, blow-off, various precautions, and safety valves.

Poppet Legs and Surface—Bird cages, chairs, overwinding gear, safety catches, guides, cages, ropes, shackle.

Shafts—Gates and guard rails, chairs and bumpers, pent houses, underlay shafts, skid boards, sinking frame or "jack."

Whips—Man rope, boatswain chair, open hooks

Whims—Brakes

Ladders.

Timbering—Its principle, laths and false sets in loose ground, face boards in running ground, picking up timber when stoping.

Explosives—Rules in handling, tamping bars, magazines, mixing explosives, firing.

Ventilation.

Signals.

Miscellaneous.

Machinery.

Winding Engines—Where steam power is used, the winding engine should be strong enough to lift its load easily and smoothly, and the throttle valve, brakes, reversing gear, etc., should all be within reach of the driver without moving.

Drums—The drums of any winding plant should be large enough to take the lap of the rope, without bending it round too small a circumference, and the use of small drums with large ropes is dangerous. The modern steel ropes are wonderfully flexible, but they have a limit; if the drums are too small, the wires nearest the drum are in compression, those on the outside are in tension, and consequently the wires break. A new rope bent round too small a circumference will break across the outside wires in a few weeks.

In the majority of winding plants, the drums are side by side, the rope on one drum passes over, and on the other under the drum,

*Paper read before the Australian Institute of Mining Engineers.

and it is invariably the case that (other things being equal) the latter is the first to wear out

What is true of the drum is true of the head sheave or pulley at the poppet heads, which should be large enough to allow the rope to pass over it without undue bending. A good rule to adopt is to make the diameter never less than one thousand times the diameter of the individual wires of which the rope is composed.

Under no circumstances whatever, should a wire rope be changed from a *larger* drum to a *smaller*, or if it has been lapped on *over* the drum, should it be afterwards lapped on *under* it; to do this is to court almost certain disaster. After a rope has worked for a certain time round a given curve, the wires seem to become set to that curve; if the rope be changed on to a smaller drum, the sharper bend sets up molecular strain, and the rope breaks—it is analogous to breaking a pieee of fencing wire by bending it backwards and forwards. This danger is well known to metallurgists and should be well known to mine managers—but as two accidents have happened from this cause within the last eighteen months, there is ample excuse for mentioning it. The rule therefore is:—Always change a rope from a smaller to a larger drum; *never* from a larger to a smaller.

Brakes—Many of the older types of winding engines have only one cylinder, and a loose eccentric, the drums being driven by crown and pinion wheels, and a large fly wheel is required to carty the engine over the dead centre, and to steady it in running. Now it is a common practice to have a brake on the fly wheel, and none on the drums; or where there are brakes on the drums, the levers for controlling them are placed opposite the drums, and out of reach of the driver, unless he leaves his engine; the fly wheel brake-lever being the only one placed under his feet. This is very defective for two reasons: Firstly, because should anything go wrong with the engine, and the cages get away, the whole strain of the brake-acting on the periphery of the fly wheel, is thrown on to the engine shaft, which is thus subjected to great torsional strain, and may result in fracture, which would place the drums out of control; or, secondly, because should the clutch slip out of gear or the crown wheel become stripped. the brake on the fly wheel is useless, the driver has to leave his engine, rush across to the levers of the drum-brake, and by the time he has done this, the cage is probably a mass of tangled iron in the bottom of the shaft.

Fig. 1 represents a loose eccentric engine. A is the eccentric lever, B is the fly-wheel brake-lever, G and H are the levers of the drum-brakes as they should *not* be, but as they are usually placed; while C and D show how they should be. By having the levers at B, C and D, as shown, the driver can handle his engine and manipulate his brakes without moving. Should the fly-wheel brake become useless he has the drum brakes under his feet, and the drums are always and instantly under control. It is safe to say that nine out of ten of this class of engine have their levers wrongly placed, as at G and H

In the more modern form of geared winding engine (winding winches) where there is no fly-wheel, the brakes are under the driver's feet, but the levers are often too short, and he has to stand with all his force on them to make the brake act, or again, the diameter of the brake-drum is too small and not proportional to that of the rope drum.

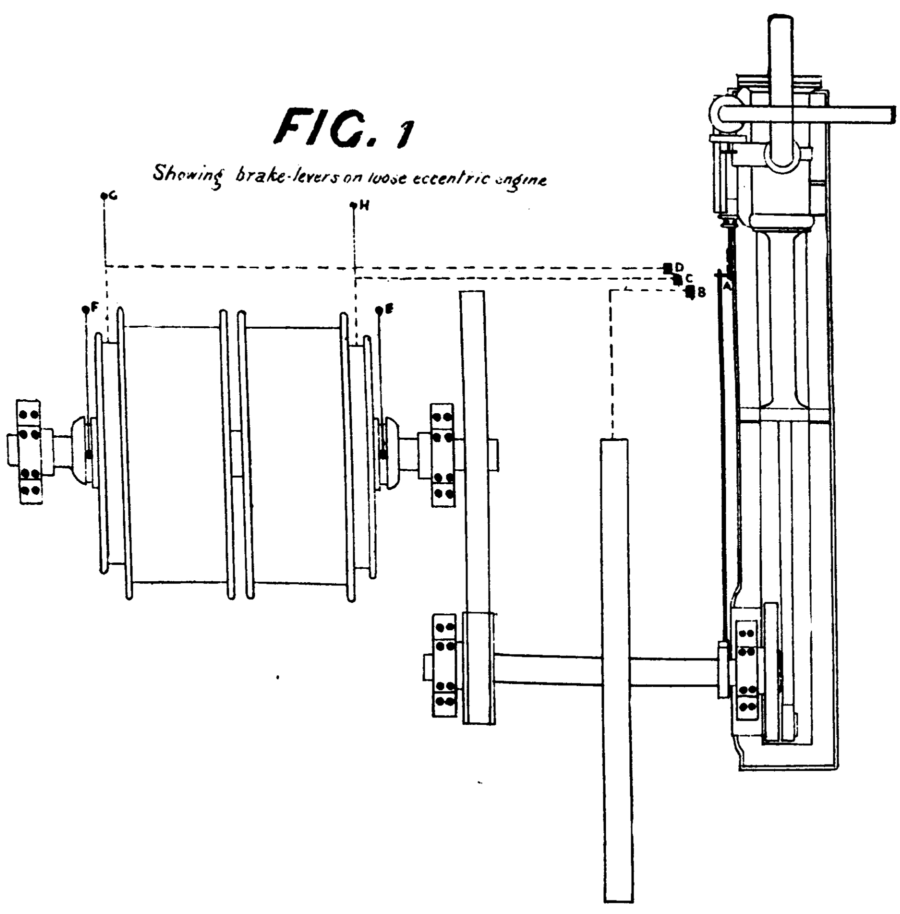
The leverage should be sufficient for the driver to spring his brakes down with ease, and the diameter of the brake-drums large enough to hold the heaviest load put on the engine without slipping, and nearly, if not quite as large in diameter as the rope drum; as shown in Fig. 1. Some first motion engines have the brake-drums of greater diameter than the rope drum, and flush with the flanges of the latter, which gives great leverage and can therefore be recommended.

Brakes are often placed on one side of the drum only. All band bakes should pass round the drum, all block brakes should be on two sides; for the brake then counteracts its own pressure, and no strain is thrown on to the plummer blocks.

All brakes should be fitted with easily adjustable set screws; some engines have none and in time the blocks become worn, the brake has then to be taken off to adjust it; time for this cannot always be spared, and the engine is run with defective brakes, and should an

FIG. 1

Showing brake-levers on loose eccentric engine



emergency arise they are useless—or where there are set screws, the driver loosens them to get his engine to run easier, with the same result. Have set screws and lock nuts, test the brakes once a week, and discharge any driver found altering the proper adjustment.

CLUTCHES—Nearly all modern winding engines have one loose drum (many for extra convenience have two), which is thrown in and out of gear by a clutch sliding on the drum shaft, and operated by a lever (Fig. 1, E and F), which should always be securely pinned, either by a pin passing through the rack on which the lever slides, or by means of a locking bolt and hand screw. If the levers are not thus secured, there is danger of the clutches coming out of gear, or being improperly thrown into gear.

The portion of the drum shaft on which the clutch slides, should be square, in preference to having key or feathers, as the former is stronger. The clutch itself should be squared as shown in Fig. 2, A, and not bevelled (Fig. 2, B). In the former case they are very unlikely to slip out of gear; in the latter they are certain to come out when the drum is working against the bevelled side. It seems absurd that winding engines should ever be designed with bevel clutches; but quite a number of them are, probably to render it easy to throw them

FIG. 2

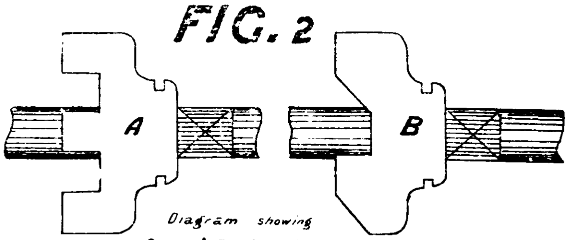


Diagram showing Square & Bevelled clutches

in and out. A fine American engine at Broken Hill had this defect, and a wedge had to be designed to drop into a slot in the shaft behind the clutch to prevent it from springing out when the engine was running against the bevelled side.

Indicators.—It is strange how few winding engines are made with proper indicators, even when designed by the best firms. Often there are none, more often there is merely a spindle on the end of the drum shaft, round which string or webbing is wound, and attached to a weight sliding on a board; string and webbing expand and contract under climatic influences and are never reliable—at the best, the indicators work off the shaft. Where loose drums are in use, the indicator should work directly off the drums, and not off the drum shaft. In the former case it always shows where the cage is, no matter how often the cages are changed to wind from different levels. In the latter case the index finger must be altered with every change of levels, and where webbing is used, it has to be lapped on or off a certain number of times; this at once introduces the factor of danger already mentioned under the name of personal error, and is therefore defective. The rule therefore is:—Have your indicators attached to the drums and *not* to the drum shaft.

Many methods are adopted, either by bevel wheels, worm wheels, or chain and sprocket—perhaps the most accurate is the drum indicator, where a vertical cylinder is revolved by suitable means off the drum, it has a spiral groove running round it, and an index finger slides up and down in a vertical slot—consequently this index must move along the spiral groove, always in view of the driver. There is thus room for any number of levels to be marked along the spiral, the spaces between them can be some distance apart, which gives increased accuracy, and there can be no confusion. In the dial indicators all the levels must be shown on the circumference of a circle (*i.e.*, while the index finger travels through one revolution), the figures must be closer together and there cannot be the same fine adjustment. It is more important than many managers suppose to have good indicators, so that the cage can be stopped level with the platts, as it not only ensures greater safety, but economises time which is otherwise lost in knocking the cage down or up.

Boilers.—The management and treatment of boilers could furnish an essay without considering any other subject. It is impossible here, to do more than mention the more common precautions to be observed in connection with mine boilers.

Hydraulic tests are insisted upon in all the colonies, and are very necessary as they often give valuable information as to leakages and hidden defects—but it is a serious and common mistake to put too great a pressure on a boiler. A hydraulic test, even with warm water, is far more severe than the more elastic steam pressure, and all that it is required to do, is to prove the fitness of the boiler to stand the steam working pressure—therefore, in testing, the pressure should never be more than *half as much again* as the highest working pressure to which the boiler is subjected. If a boiler works at 40 lbs., test it to 60; if it works at 60, test it to 90, and so on; though in high pressure boilers, working up to 120 or 130 lbs., it is advisable not to exceed one-third as much again. To double the working pressure (a very common practice) is altogether too severe, and may do more harm than good, by springing the joints, straining the plates, and perhaps injuring the boiler permanently, and making it actually unsafe.

The hydraulic test by itself is not sufficient, and in bricked-in boilers is of very little use, and should be invariably accompanied by a thorough internal inspection, the boiler plates being carefully sounded with a hammer.

Owing to the constant expansion and contraction going on in boilers, and the unequal temperature inside and out and different parts, they are certain to undergo serious deterioration in the course of a few years. The natural fibre is destroyed, molecular strain is set up, and the plates become perished, and yet show no defect to the eye; in such cases the boiler may stand a hydraulic test, but will fail to ring true under the blow of a hammer.

One boiler in New South Wales stood a hydraulic test without showing any defect, and within three days collapsed along the top of the flue—fortunately it came down over the crown of the fire box, and at the other end almost simultaneously. The two concussions counteracted one another, and the boiler was not moved six feet. On examining the torn plates after the explosion, they were found to be their full thickness (half-inch), no corrosion was visible, but the iron was distinctly laminated like the leaves of a book, and was visibly perished when seen across the torn section. This boiler was twenty years old, and its explosion proves the uselessness of a hydraulic test by itself, and the danger of running an old boiler for ever. The hammer would have shown the rotten state of the plates.

Another boiler in New South Wales was nearly new, it was a steel Lancashire boiler, 7 feet diameter, 27 feet long, $\frac{1}{2}$-inch shell plates, double riveted, and bricked in; it stood a test of 80 lbs. by water pressure—it was then cleaned out and was found to be badly corroded on all the lower plates—one corrosion was 18 inches long, $1\frac{1}{2}$ inches wide, and $\frac{7}{16}$ inch deep, leaving only $\frac{1}{16}$ inch of steel plate! and yet it stood the test. Can anyone doubt but that, had no internal inspection been made, a terriffic explosion must have followed? The locality was a dry one, and they used water from the mine, full of ferrous sulphate; the heat probably generated sulphuric acid, which attacked the plates.

These examples are quoted to show the fallacy of looking upon the hydraulic test as a sovereign precaution against boiler explosions.

Another very common defect is to have the blow-off at the top of the boiler. Many multitubular boilers for some reason are designed in this way. The blow-off pipe passes from the bottom of the boiler to the top like a syphon, the consequence is that the heavy slimes and silt are not blown out, and collect, cone-shaped, round the bottom of the pipe, or if a longitudinal perforated pipe is placed along the bottom, the slime forms a ridge on either side of it, the plates are destroyed and the boiler bursts. The writer knows of three new boilers which became dangerous within 18 months from this cause. The top blow-off should be unhesitatingly condemned and the bottom blow-off substituted.

Never slake ashes in front of a boiler, as this generates gases detrimental to boiler plate, and will destroy a 3/8 inch plate in less than 18 months.

Always make an exceptionally careful examination of the bottom shell plate beneath the fire box, both inside and out, especially in Cornish and Lancashire boilers, as this is very liable to corrosion, owing to moisture and leakages from the gauge cocks, etc.

Blow the water gauge out hourly, keep it under constant super, vision, try the water taps regularly, and if stopped up, clean out with a wire.

If fusible plugs are used, keep them free from incrustation and soot, and change them every year.

If the water gets low, and uncovers the crown of the fire box, damp down the fire with moist ashes if at hand; if they are not available, draw the fire as rapidly as possible, commencing at the front, close the damper door, and open the furnace doors, and then get out of the way, especially if the crown of the fire box has come down; and do not, under any circumstances, feed water into the boiler; for since the crown plate is probably red hot, it will convert the water which touches it into steam. For a few moments nothing serious may happen, as a cushion of steam will probably be formed between the plate and the water, but as the plate cools a little, the water impinges on it once more, and immediately flashes into steam; the internal pressure jumps up with explosive rapidity, and the boiler is blown into fragments.

If a drop of cold water be allowed to fall on a red hot plate, it will be noticed that for a time the water will run about like a globule of quicksilver, because a film of steam forms a cushion between the plate and the drop, and protects the latter. After a few more moments this steam will disperse, the water will again touch the plate, will begin to splutter, especially when it touches a slightly cooler part, and will then disappear in a flash of steam. This condition is technically known as the spheroidal state, and depicts on a small scale, the condition set up in a boiler where water is fed in on to a red hot plate, and probably accounts for many explosions which have been apparently surrounded with mystery. It also illustrates the danger of feeding in water under such circumstances, and this danger requires to be strongly emphasized because it is the first idea of the ignorant to do this very thing.

Blow the boiler out every twenty-four hours, as this will clear the silt and slime, and, to a large degree, prevent scale from forming; and, if possible, use clean water; it is cheaper in the end to go to considerable expense to procure clean water, than to use mineralized mine water. A boiler is an expensive apparatus; and some kinds of water, as already shown, will ruin it in less than two years, so that it is not always economical to use the water which can be most cheaply procured.

SAFETY VALVES—Should be properly made, so that when the weight is at the end of the lever, the boiler shall blow off at its highest safe working pressure.

Nearly three out of every five boilers sent out from the makers are supplied with defective valves, not designed for the boiler, owing probably to their being all made to one pattern, and then fitted to the boiler irrespective of the pressure to which it is meant to work. The weights are generally too light, and the levers are then loaded on the mine with the first weight which comes handy—old hammer heads, angle iron, or battery dies, put on anywhere and anyhow, by someone who has not the remotest idea what pressure he is loading it to, or at best taking the pressure gauge as a criterion.

When such valves are found to be wrongly weighted, they should be set by calculation (a simple matter) by a competent engineer, and preferably, single new weights should be cast, so that the lever shall only have one weight on it, which will load the boiler to its highest safe pressure when at the end of the lever, and be easily shifted to put any lower load on the valve, without a fresh calculation for each adjustment.

No inexperienced man should be allowed to interfere with the valve, nor should it be set by the pressure gauge, as the latter always has some error, which changes at different pressures—check the pressure gauge by the safety valve, and *not* the valve by the gauge, and test the gauge every year against a column of mercury and note the error.

In dead weight valves and spring valves the same remarks apply. In the one case never have more weights than will load the valve to the highest safe pressure, and never allow any weights but those made for it to be used. In spring valves see that they are screwed down to the correct pressure and locked there, keep them clean and test them yearly.

The safety valve should always be set to blow off just above the highest pressure at which the boiler requires to be worked. If a boiler can work safely at 60 lbs. but is not required to work above 40, set the valve at 42 or 43, and not at 60; if it is set at the higher figure, every time stoppages occur, the pressure rises, constant and large variations are taking place in the internal pressure, the boiler undergoes unnecessary expansion and contraction, which means wear and tear, and its life is shortened.

Keep the valve clean from incrustation and dirt, lift it every 24 hours, and when released, see that it dances a little on the cushion of escaping steam before reseating itself, as this ensures its being free; if it fits badly and leaks, it should be ground in with fine emery powder and oil.

Never attempt to empty a boiler when the gauge shows that there is any steam pressure in it.

Further considerations go beyond the scope of this essay.

POPPET LEGS AND SURFACE.

The engine-driver should always have an unobstructed view of the poppet legs from the surface to the pulley. The entrance to the shaft at the surface should always be protected by gates, and the brace and all elevated tram lines should be strongly fenced, so that the braceman and truckers cannot fall off, especially when landing and trucking at night time.

The entrance to the shaft at the brace should be carefully covered over; and the best method of doing this is by means of the "birdcage," which is simply a light skeleton frame covering the opening, lifted by the cage as it comes up, and dropping back automatically into place, as the cage descends. This system being automatic, the shaft is never open—the chance of personal error is impossible, and the braceman is always safe.

Fig. 3 represents a birdcage covering the opening of the shaft, and Fig. 4 shows the ascending cage lifting it off the brace. The two drawings clearly illustrate the method—the birdcage is fitted with shoes which slide upon the guides, and therefore cannot be displaced. Sometimes sliding gates are used instead of birdcages, but they are heavier,

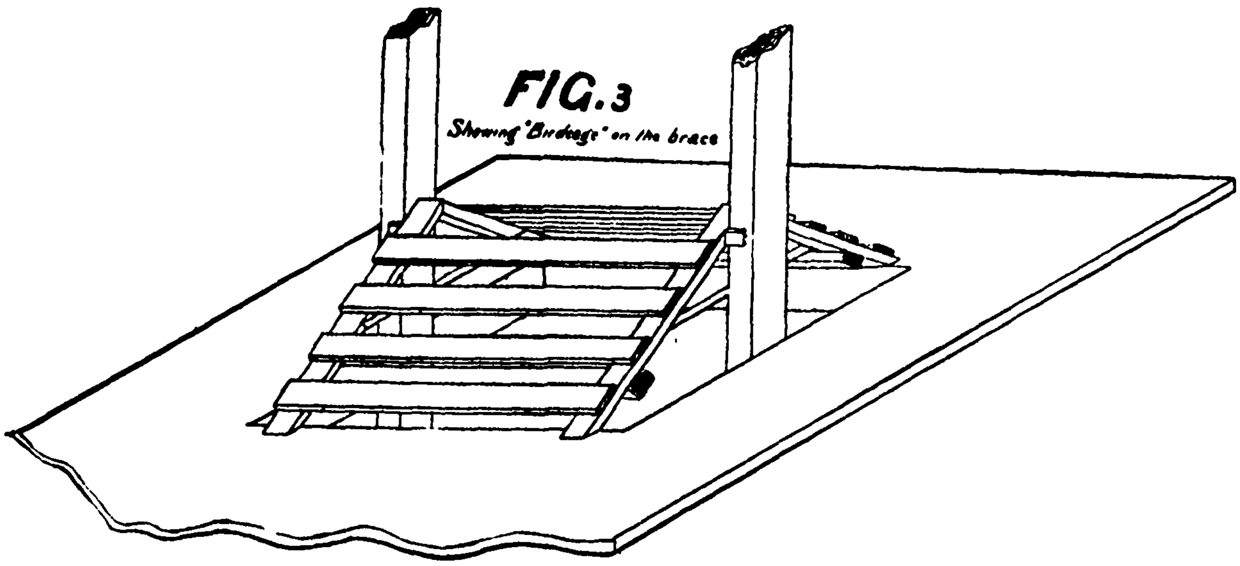


FIG. 3
Showing "Birdcage" on the brace

take up more room, require special guides, and must be on both sides of the shaft, or else one side must be permanently closed, which is not always desirable.

Proper chairs should be placed at the brace and surface for the cage to rest on; they should be automatic, so that they drop into action when the cage comes through, and have to be pulled away to allow it to pass down.

Fig. 5 shows these chairs diagramatically, both in and out of action; A A are the chairs, hung on hinges B; C C are iron plates bolted to the dividers against which the chairs rest; D is the lever for moving them

When men are going below, they should never be allowed to get on the cage while it is resting on the chairs; before they get on, the cage should be lifted three or four inches, as this proves that the cluches of the drum are in gear, and that the driver has his engine under control, the men then get on and the chairs are withdrawn.

Over-winding Gear is not insisted upon in all the colonies, though it should be, as it protects the driver against the chance of personal error, and has more than once saved the lives of men. Middleton's and Humble's over-winding gear have stood the test of time, and may be safely adopted. Their description is unnecessary, as they are figured in every text book on the subject.

Safety Catches are also highly necessary, not to induce carelessness in the examination of the ropes, but as an additional safe-guard against accidents.

All safety catches are designed either to grip the sides of the shaft,

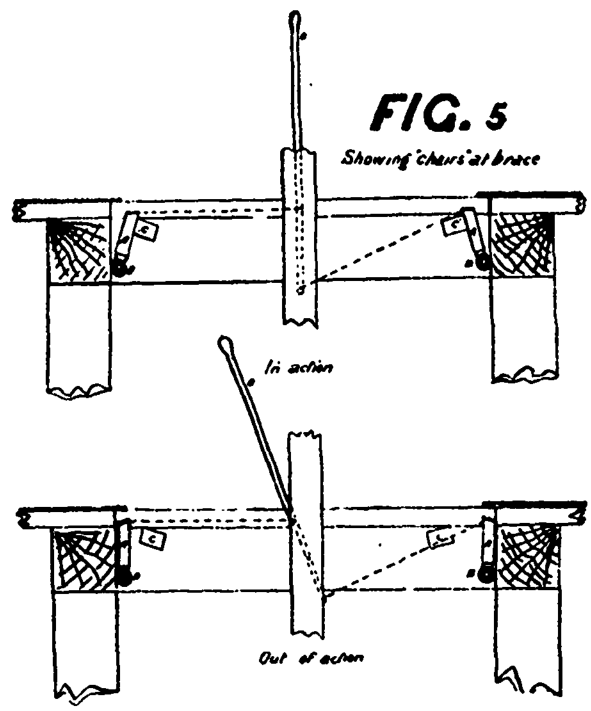


FIG. 5
Showing "chairs" at brace

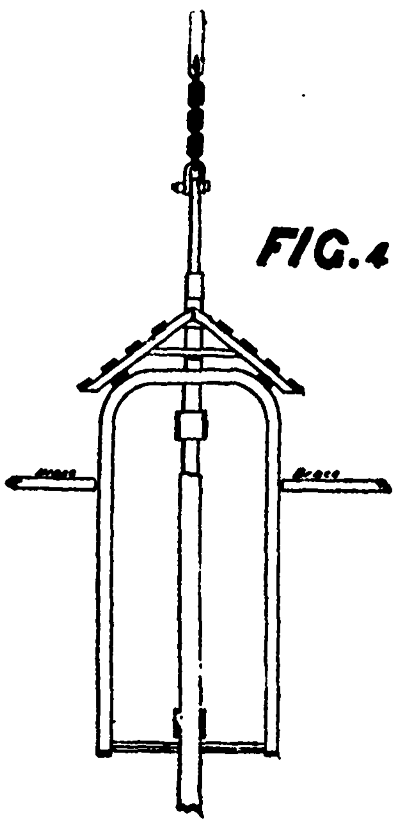


FIG. 4

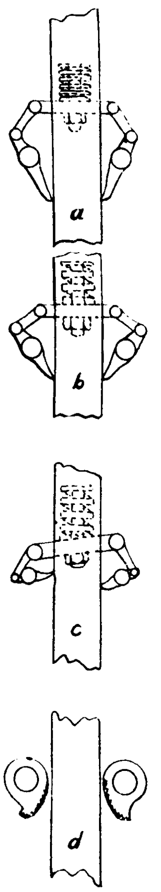
Showing cage lifting "birdcage"

or to grip the guides, the latter plan being now almost universally adopted The catches are either chisel grippers or cam grippers, and are kept clear of the guides by the tension of the rope and the weight of the cage, and thrown into gear by springs should the rope break (Fig. 6, *a*, *b* and *c* and Fig. 7 *a*), or are merely counter-balanced, and thrown into gear by their own inertia, should a sudden drop in the cage take place (Fig. 6 *d*).

The latter system has never failed to work on any occasion when it has been tried by the writer, and as the catches do not depend on the weight of the cage to keep them out of action, a lever can be placed in the cage, so that the men riding in it can throw them into action by hand; this is impossible with spring catches, except those of very complicated design. The only defect in these catches is their extreme sensitiveness, even a spring on the rope, or a lap on the drum will make them act, and hang the cage up in the shaft. This can be obviated by having them set well clear of the guides; a stop pin must be placed to keep them in front of the centre of gravity so that they will always tend to close on to the guides, and not away from them. Whether free or spring catches are adopted, the main precaution to attend to, is that of adjustment.

Should the gripping arms be too long (Fig. 6, *a*) the reaction of the guides will throw them off and they will not act; if too short (Fig. 6, *c*) they will pull through and turn inside out. Fig. 6, *b*, shows about the correct adjustment, and Fig. 6, *d*, shows the cam catches hanging

FIG. 6



Safety-catches

free. The cam catch is, in many respects, preferable to the chisel gripper, as the curve of the cam makes it impossible for them to pull through, the gripping surface is larger, and acts almost at right angles to the guides, and is therefore less likely to strip them, especially as the catches on either side, counteract each other's pressure, and squeeze the guides between them. The chisel grips require far more accurate adjustment, are more likely to get blunt and out of order, and are certainly more likely to strip the guides. Really good catches should not allow the cage to drop more than two inches.

(To be continued.)

Coal Washi g.—This is a process which is receiving increased attention in the United States. Under the direction of Professor S. W. Parr, of the University of Illinois, Mr. F. C. Koch, of the Department of Applied Chemistry of that institution, is carrying on an investigation of Illinois coals, with special reference to this process It is found that the process of washing ordinarily removes fifty per cent. of the slate and ash ingredients, and fifty per cent. of the sulphur, the reduction in sulphur rendering them probably fit for gas-making. According to "Power," there are some half-dozen established washeries in Southern Illinois. Our contemporary says that on the Susquehanna river, fleets of boats may be seen in which are men standing operating with long poles as one rakes for oysters. They are scraping the river bottom for coal which has been washed down from the mines, and it is said that quite a proportion of the coal used by some of the river towns is supplied in this way.

COMPANY NOTES.

The Molly Gibson.—The annual general meeting was called at the Windsor Hotel, Montreal, Sept. 24th, with Pres. S W. Ray in the chair. There were approximately one million shares represented by proxies and by shareholders in person. Reports made by independent engineers showing the condition of the properties were read. An aerial self-acting tramway 8,300 ft. long is nearing completion and is expected to be in full operation by Nov. 1st. It has a guaranteed capacity of 12½ tons per hour and will greatly facilitate shipment of ore, its upper terminal being at portal of the new No. 5 tunnel (which when completed will be the main working adit of the mines), and its lower terminal being at upper end of the Company's new wagon road to Kootenay Lake. The total development to date is about 2,000 lineal ft.; approximate stoping, 810 cubic ft. The properties now owned by the Company are as follows:—Molly Gibson, Florence and Aspen, all full claims; and Nashville, Charleston, Westminster, Florence, La Plata, Little and Little Duke Fractions; and a mill site with a water power having an available head of 220 ft. On this mill site as soon as possible n xt spring a concentrator will be erected for treating everything but the smelting ore. Forty men are employed at present, but as soon as the tramway is working the force will be gradually increased to 125, as this number can then be economically employed. The retiring directors were:—Lt. Col. S. W. Ray, R. H. Pope, and Hon H. J. Macdonald; Lt.-Col. Ray and R. H Pope were re-ele ted, and J. H. Brock, Winnipeg, was elected to fill the other vacancy. The auditors' report, together with the accounts and the managing director's annual report will be distributed to shareholders shortly.

Old Ironsides and Victoria—The main cross-cut on these properties is in 960 ft., and is said to be in ore for practically the whole distance; neither wall has as yet been encountered. The stopes are said to be revelations in point of size. As far as the Miner-Graves Syndicate's properties are concerned there can be no doubt of an abundance of ore in sight, and if the average is as high as stated, namely, $8 per ton, there is a great future for these mines. It may, however, be open to doubt whether $8 expresses the approximate average value of *all* ore in sight; perhaps $5 would be nearer the correct figure, but as to this we may safely leave it to the future—the question at present is, can these enormous bodies of ore be mined, shipped and smelted at a profit? Presdt. Miner says they can, and that, too, without concentrating or even sorting the ore. If so, then there is a bright future in store for them. Shipments from Old Ironsides to Oct. 1st approximated 8,850 tons, and from Victoria 4,500 tons. The plant comprises two 80 h.p. and one 60 h.p. boilers; one 10 drill Rand compressor; six 3¼ in. Little Giant drills; three air receivers; one 50 h.p., one 30 h.p., one 20 h p, and two 8 h.p. hoisting engines; one Knowles station pump; one Cameron sinking pump; one Snow duplex pump; safety platform cages in shafts 1 and 2; and electric plant consisting of one 15 h.p. engine; one 180 light dynamo, and one 5 h.p motor. The Old Ironsides workings to date consist of 645 ft. of shafts, 2,390 ft. of drifts, 950 ft. of crosscuts, and an upraise of 100 ft., besides two stopes on the 200 ft. level and one on the 300 ft., making a total of 4,085 ft. of development. The Victoria workings comprise 1,974 ft. of crosscuts, 323 ft. of drifts, and an upraise 100 ft. high, making a 2,379 ft. of development. There are stopes on the 200 and 300 ft. levels.

Knob Hill.—The 10 drill compressor ordered last May is now installed. The two 80 h.p. boilers were bricked in during September and the new 9x12 hoisting engine is giving satisfaction. With this addition to the plant an increased output amounting to perhaps 200 tons per day is expected and in addition to this development work will be vigorously pushed. Since shipping began Aug. 21st, development has practically ceased owing to the necessity of using all the drills for stoping, but with the new plant working it will take but a short time to catch up and even as it is the development done before shipping began is in a sufficiently advanced stage to preclude the possibility of stopings overtaking development The ground already blocked out for stoping measures in feet 1,000 x 400 x 100. Formerly there were but 10 drills for the Knob Hill, Ironsides, Grey Eag e and the Granby's Victoria, but now each will have five drills. The ore shipped to Oct. 1st, amounting to approximately 4,500 tons, is reported to average between $7 and $9 per ton gross; if from this we deduct the estimated cost of mining, shipping and smelting, $5.15, the net profit is $1.85 to $3.85 per ton, or say $13,000 per month, which, under the poor facilities must be considered good. However, the gross smelting value will undoubtedly fluctuate and will perhaps go as low as $5 per ton, but even so, if we take Presdt. Miner at his word, this value will be eventually treated at a profit. Tenders have been called for a 60 drill plant for the joint use of the Syndicate's four properties. The Knob Hill plant at present consists of two 80 h.p. boilers; one 10 drill Rand compressor; six 3¼ in. Little Giant drills; two air receivers; one 30 h.p. and one 20 h.p. hoisting engine; one No. 5 Knowles sinking pump; one Snow feed pump, and all accessories The main tunnel on the Knob Hill is in 1,242 ft. with additional work as follows:—Crosscuts, 773 ft.; upraises, 300 ft.; drifts, 774 ft., and a winze down 213 ft., a total of 3,302 lineal ft. of development. There are three stopes, one each in crosscut No. 1 west, crosscut No. 2 west, and in the tunnel at a point 1,000 ft. in from the portal Ore blocked out 1,537,000 tons.

Granby Smelter.—Since the first furnace was blown in Augast 21st an average of 300 tons per day has been smelted this amount being the limit of present production of the mines tributary to this smelter. Now that the number of drills in the Syndicate's mines has been doubled, the output has increased to such an extent that the C. P. R., unable to supply sufficient ore cars, has been obliged to put on a night crew and thus delivers 600 tons per day from Phœnix. Two hundred and e'ght tons of matte were shipped to American refineries to Oct. 15th; this has 38 per cent. metal content. When the Syndicate builds its own refinery copper, so Presdt. Miner claims, will be made at a cost of 4½ cents per lb., a saving of at least 100 per cent. over present cost. This Syndicate is by far the largest operator in the Boundary District at present, and by continually acquiring new properties in the shape of prospects, smelter sites and water powers it seems to be their intention to maintain their supremacy. They were the first to prove the low grade ores of the Boundary profitable—if we may take it for granted that they have already proved such to be the case. They are reticent as to what values are being obtained from their ores, except to say that they will average between $7 and $9 per ton. This reticence may be accounted for by the fact that theirs is a new enterprise as far as the Boundary is concerned. No doubt in due time full statements will be made public, for on the successful working of their plant depends in great measure the future of the whole district. Presdt. Miner claims that eventually he will treat $5 ore at a profit; this he should be able to do, for the Hall Mines smelter at Nelson treated its ores during the past year at an average cost of $2.96 per ton, and this would leave a margin of $2.04 for mining, shipping, and profits on $5 ore. The Hall Smelter paid for flux an average of 19.6 cents per ton of ore; this charge would be dispensed with at the Granby, leaving, instead of $2.04 per ton, $2.236; the estimated cost of mining, 75 cents, and of shipping, 90 cents, makes a total of $1.65, which leaves 59 cents per ton profit on $5 ore. This latter figure will probably be surpassed, for already plans are under way for increasing the capacity of the Granby Smelter to 2,000 tons per day, an amount which the Syndicate's mines alone will soon be able to supply. On the staff of employees are men who take front rank each in his respective line of effort. In such men as A. B. W. Hodges, Gen. Supt. of the Granby Smelter, and A. C. Flummerfelt, Asst. Gen. Mgr. of all the Syndicate's properties, they have two men second to none; while in Presdt. Miner they have a man whose courage in opening up these low grade deposits in face of almost universal pessimism and skepticism shows a faith meriting the greatest measure of success.

Standard Copper Co. Limited.—Incorporated under B. C. Charter April 28th, 1900, with capital of $500,000 in shares of $1, assessable to par; all stock is Treasury stock. This company owns the Standard (adjoining Mother Lode and Crown Silver); the Marguerite and fraction (adjoining Great Hopes and Sunset group; and is working under bond the Moreen (adjoining Buckhorn), all in Deadwood Camp, Boundary, B.C. It also holds controlling interest in Standard Pyritic Smelting Co., and in the Quebec Copper Co., subsidiary companies. This is another exemplification of the fact that gradually all the better things of this district are being absorbed by strong syndicates. Already there are two such owning their own mines and smelters; the Standard is the third, and it seems quite probable that the future will see still other groups of mines placed in similar positions. This seems to be the solution of the question of profitably treating the low grade ores and we may reasonably expect that as soon as more of the promising prospects develop into mines there will be more amalgamations and more smelters. The Boundary in a few years will undoubtedly outgrow its present facilities and expansion must result not only in increasing the capacities of the then existing reduction works but in the building of others.

Standard Pyritic Smelting Co., Limited.—Incorporated under B.C. charter with capital of $500,000 in shares of 50c. Head office, Quebec. Smelter site, three miles below Greenwood, B.C. The question of the practicability of the pyritic system of smelting seems to have been gone into very thoroughly by this company before the contracts for their machinery were let. Briefly stated, the pyritic system differs from the ordinary smelting process in that it uses the sulphur in the ore for the main fuel supply instead of coke. Coke is used, but it is claimed that the pyritic smelter at Leadville uses an average of but 5 p.c. of coke, while the latest and best furnace of any other type now operating in Canada is using 10½ p.c. of coke per ton of ore. The question of percentage of coke depends however on the quality of ore. Samples from several Boundary properties were shipped to Leadville, Col., and were reported to be eminently satisfactory for the pyritic system. It must be borne in mind that as sulphur is the fuel in this process if ore submitted for treatment does not contain the requisite amount of sulphur the deficiency must be made up by the smelter's buying ores that do contain sulphur, irrespective of their metal content. With the pyritic smelters at Leadville, Col., Bingham, Utah, and at other places it has been found necessary to buy these ores high in sulphur even though the metals were not present at all in such ores. This necessarily reduces the capacity of the smelter, for these sulphur ores take up room that otherwise would be available for pay ore. But to offset this it must be remembered that there is no roasting or calcining of the ore—it is delivered direct to the furnace without any preliminary process and this means a saving of about ... cts per ton on ore that would under any other system have to be roasted. To be sure many of the Boundary ores do not require roasting. Knob Hill and Ironsides ores are delivered direct to the furnace from the crushers. Pyritic smelters have not been highly satisfactory heretofore—had they been it stands to reason that they would have been generally adopted for all sulphide ores. However, the Standard Company's furnace is of the latest type, known as the Standard New Combined Hot and Cold Blast Pyritic, an improvement on the Loder system, and as a distinct departure in Canada results will be watched with interest, for should the process prove successful in this experimental plant others will be erected at suitable points throughout the Dominion. The Denver Engineering Works are building the furnace, which has a guaranteed capacity of 200 tons per day. The contract was awarded June 21, 1900. Thirty men are now employed grading and doing other preliminary work at the smelter site.

Asbestos and Asbestic.—Annual Report issued from the London office shows for year ending March 31st last, total profits of £7,206, while expenses were £7,865, leaving a net loss of £659 for the year, which deducted from balance of Profit and Loss brought forward from 1899 leaves a balance of £1,323 to credit of Profit and Loss, March 31st, 1900. The report states that in the matter of asbestic the demand did not warrant the continued production in quantities, and as the amount of asbestos produced depends upon the production of asbestic it follows that not only were the mining operations lessened but the manufacturing as well. The falling off in receipts from manufactures was due in part to the disastrous fire at the works at Danville, Quebec, in March, in consequence of which all production was stopped pending the rebuilding of the works. A continuation for five years more of the contract with the H. W. Johns Co. of New York has been entered into. The success of the Asbestos and Asbestic Co., said the chairman, depends upon the large sale of asbestic, the merits of which as a wall plaster are said to be unequalled.

MICA MINING IN THE LIEVRE DISTRICT.

(From our own Correspondent.)

The Glen Almond Mica and Mining Company is an American company incorporated at Providence, in the State of Rhode Island, for the purpose of mining and dealing in mica, in the Dominion of Canada and elsewhere. Its officers are Edward F. Childs, of Boston, Mass., President; A. Livingstone Mason, of Newport, R.I., Vice-President; Joseph P. Burlingame, of Providence, R I., Treasurer, and Charles Nicholas Snow, of Providence, Secretary. The company's General Manager is Mr. Fredk. S Shirley, who is no stranger in the Dominion, as he, associated with Edward F. Childs, President of the present company, was largely interested in mining here during the phosphate boom in the Ottawa district. This company commenced operations the latter part of the fall of 1899, on lot No. 3 in the 2nd range of the Township of Derry, by opening up a lead showing some fine large crystals; from this working (called Newton's Notch) a large quantity of mica was taken out amounting to upwards of 60 tons; the vein followed a slip and was badly twisted, so that the crystals, though of large size, did not fulfil the promise of large returns, being so split, bent and broken up that the results were disappointing, though there is no question from the indications exhibited but that sinking deeper will uncover large deposits of good mica. However, the company decided to defer operations at that point for a time and test results in other property they were interested in, viz.: lots 3, 4 and 6 in the 3rd range of the same township. Lots 3 and 4 are known as the Shirley lots. These had been previously leased, and a large quantity of fine quality mica had been removed from the several pits opened up, but the lessees working only with a view to secure the greatest output left the property in poor condition and needing a great amount of dead work to be done before any productive mining could be carried on. This property is now in such condition as promises a good supply of mica for the labor expended. The formation the crystals occur in is composed of pyro calcite, mica rock, limestone and pyroxene, and indicates a lasting supply. In August of the present year this company acquired another extensive property, consisting of the west half of lot 1 and the whole of lot 2 in the 1st range of the Township of Portland east, containing 300 acres. This property was formerly worked under lease by the well known High Rock Mining Company, who took out large quantities of phosphate from it. The experts and many experienced practical miners who have examined it declare this property to be one exceedingly valuable. The formation is of gray limestone combined with pink limestone, pyroxene, mica rock, and phosphate runs through the whole property and is said to be identical with the property of the well known Blackburn mine in the Gatineau Valley. The company have commenced working on this property in a thoroughly systematic manner, stripping and developing the various shows, of which there are 30 already located that promise excellent results; there is a gang of ten men already working under the immediate supervision of Mr. George Wallingford, a practical miner of many years' experience in the mica belt, and formerly of the Wallingford mine at Perkins Mills. The company who commenced the working of this property on Aug. 17th are pushing the work, though on so extensive an area as this property covers, a very great amount of labor must necessarily be expended before profitable results can be expected. Mr. Shirley, the general manager, who resides on the property, states that it is the company's intention to largely increase their present force and push the work with vigor. Our correspondent was fortunate in being able to secure snap shots showing one of the workings, taken on the 24th and 25th of August respectively, the first taken before the blasting, the latter showing result of same and crystals taken out. This is the first opening on the property and designated the Lottie N.; from this upwards of four thousand pounds of good rough mica was taken out in the first week's working, which culled a good average percentage of marketable mica of 2×3, 2×4, 3×5, and some 4×6 sizes, all of which has been pronounced by dealers in same to be the best quality of amber mica. The company is to be congratulated on its favorable prospects for an early success, and the district on the company's having found sufficient inducements to locate there and start up active work by which a new era of prosperity has been practically inaugurated, for results will undoubtedly prove by the returns made that this section warrants the investment of capital and labor to much greater extent than it has received for many years past.

On the east half of lot 1, 1st range, Portland East, a mine is already opened, owned by and operated for W. J. Poupore, of Ottawa; this is showing fine results in the quantity and quality of its production. This property was opened up in a small way about four years ago and is now being actively worked with a small gang under the supervision of Mr. Hogan. The opinion expressed of this property is that it will be a big producer of merchantable mica. In the adjoining range, lot No. 7, 1st range of Derry, Mr. Dan Cameron has prospected and opened up some promising shows of good quality of amber mica, and is making arrangements to work same. On lots Nos. 9 and 10 in the same range the "Golden Reef" Company have started in with extensive preparations for working, having uncovered some very fine deposits of amber mica of good quality and size, and will soon commence active working. This property is in charge of and being worked by Mr. Bush Winans, assisted by his brothers and several men, and the indications appear to warrant the belief that their enterprise will be crowned with success.

These various enterprises and the success they have already met with appear to justify and confirm the opinion that this particular district will prove favorable and highly remunerative to investors, and we look for some very favorable reports from these properties as the work progresses.

MINING IN QUEBEC.

Three views of the mica deposits being worked on the Lievre Que.

MINING IN NOVA SCOTIA.

Copper.—At Cape d'Or the Colonial Copper Co., Limited, who purchased a property from J. C. Mahon *et al.*, are doing a considerable amount of development work, and have been getting out some very good ore. The ore is native copper occurring in trap rock. The same company are also doing some prospecting at New Annan, where gray copper ore is found associated with lignite in beds of carboniferous sandstone.

The Wallace River Copper Co. have closed down operations at Wallace River and Malagash Point and are now testing some gold properties at Block House, Lunenburg County.

No reliable information can be obtained as to the operations of the Copper Crown Co. This company were to have started smelting last year, but up to date have returned no results at the Mines Office.

Iron.—Messrs. S. M. Brookfield and others have been doing a lot of development work at Torbrook and have opened out some excellent leads of magnetite and hematite. They now have one of the Government drills in operation and are boring to cut the leads at a depth of 500 ft.

Messrs. J. A. Pushie and others are continuing prospecting at Arisaig, Antigonish County. Three veins have been opened, 7, 9 and 16 ft. in width respectively, and things generally are looking very satisfactory.

Gold.—The Tunnel Company at Waverley are so satisfied with the results obtained from their 40-stamp mill that they are putting in an additional 40 stamps. The 50-stamp mill at Gays River has been dropping steadily for the past two months, and although no returns have been declared up to date, the manager informed your correspondent that the owners were quite satisfied with results obtained up to now.

At the Dufferin mine, Salmon River, a number of test runs have been made recently.

The Guffey-Jennings Company, at Caribou, have struck excellent ore at a depth of between 500 and 600 ft. This is by far the best developed mine in the province. The company have wisely put their money into the mine instead of into machinery. The 10-stamp mill which was on the property when the present owners purchased it has only been used for testing purposes and for crushing such rock as had to be taken out in carrying on the development of the mine. There are now some two hundred thousand tons of ore blocked out, and the owners intend sinking an additional 400 ft. before putting in a suitable crushing plant.

The Voglers Cone mine, Lunenburg County, has been purchased by an American syndicate.

The Napier mine at Oldham and the Tudor mine at Waverley are likely to be restarted shortly.

The old Pictou Development Company's mine at Renfrew has been turning out some extraordinary ore; the last crushing was 735 ounces from 53 tons, and it is estimated that quite 2,000 more ounces have been taken out, but no crushing has been done recently on account of lack of water.

It is expected that the new mill at the Royal Oak mine, Goldenville, will start next month.

The Richardson Company have shipped 50 tons of concentrates to Pictou, 80 tons to North Brookfield, and have contracted to ship 400 tons to Boston. The company have found some difficulty in getting these concentrates treated, the cost of treatment, shipping charges, etc., swallowing up more than half their values.

Lead.—Mr. S. M. Brookfield and others have restarted operations at Cheticamp. A number of tests are to be made, and, if satisfactory operations on an extensive basis will be started.

Other Minerals.—Messrs. Mason & Askwith and others have been opening up a deposit of fire-clay at Middle Musquodoboit, and quite extensive boring operations have been carried on and samples of the clay shipped to the States and England to make trial bricks from.

Mr. Patrick has reopened the old Pendergras baryte mine at River John for an American syndicate.

Personal.—Mr. F. H. Mason has recently made an examination of the Clementsvale iron areas.

Mr. W. R. Askwith is in Cape Breton examining copper and manganese properties near Cape North.

Mr. Frederick Taylor, of Boston, is in the province in connection with re-opening the Napier property.

LARDEAU DISTRICT.

All the indications seem to point out that the coming winter (of whose approach there are already unmistakable signs on the foliage) will be a very quiet one in Revelstoke. Most of the companies working in the Big Bend district during the past season have decided to shut down for the winter, chiefly on the ground of unnecessary expense, as it is useless to extract ore and sack it when there is no transportation, or at least only such as is most inefficient and unsatisfactory. The claims have all been steadily developed, and the regular assessments more than amply performed, with the view of course of showing any prospective purchaser a fairly well developed property, and not as is too often the case a mere scratch on the surface of the ground. The day indeed has gone by when a prospect with no work done would be eagerly picked up, and it is a good thing for the country that it is so, as the chances of success are far better than when blind buying was all the fashion. It is possible that some of the very promising placer diggings on Smith Creek will be worked during the winter, but even that is uncertain, and everything else will be practically idle till next year.

The Albert Canyon and Illecillewait camps will be in no more prosperous a position than Revelstoke, as matters are being wound up at the celebrated (or notorious?) Waverley and Tangier mines, and the aerial ropeway at the Lanark has been removed to the Molly Gibson near Nelson. Of course it by no means follows that there is no ore in these terribly mismanaged properties because the late superintendents could not find it; indeed those well qualified to judge believe that there is plenty of money in the claims yet; but for all that the utter failure of them so far helps to give the country a "black eye" and discourages the advent of capital.

Hence we have to fall back upon the Lardeau district for good news, and there sure enough we find it, and lots of it. The Silver Cup is planning to ship a great deal of ore this winter, and other mines are following suit, notably perhaps the Nettie L., whose late new and rich find was noticed in these pages very recently. This strike is worth remark, as it was an instance where what was supposed to be the footwall of the vein (and lots of firstclass ore was extracted therefrom) proved to be the hanging wall of a far more valuable vein and immensely increased the value of the mine. This has occurred not unfrequently elsewhere in British Columbia, and it shows plainly that we should not rest content in the belief that the apparent wall is the real one, but crosscut through it and see if there is anything on the other side. A very small force of men has been working on the Nettie L. for the last few months, as on account of the expense and difficulty of transportation it was useless to extract all the ore that could have been won, but now with the approach of winter and reasonable hopes of snow, the force will be considerably increased. It is satisfactory to be able to state that a recent visit to this mine by the writer showed that the reports had not been exaggerated, there are 2 ft. of solid shipping, and about 5 ft. more of concentrating ore, all of which is carefully sorted before being put on one side to await cheaper transportation and possibly also lower smelting charges.

Another property that has come very much to the front lately is the Triune, which is one of the youngest claims in the camp, being hardly three months old, and yet sent a trial shipment of some 20 tons to the Trail smelter which gave the handsome return of $290 nett to the ton. This is a record hard to beat, but what this incipient mine has done, others are likely to do, such is the wonderful richness of the district. In this case (of the Triune) there was no company at the back of it with money to spend, but it was worked by the owner and a very few men who held an interest in the concern. As an illustration of the expense of transportation, this ore cost $25 per ton to get it to the shipping point, and then $22 per ton more for freight and treatment at Trail. No wonder those interested in mines are agitating for the completion of the railway as far as Trout Lake at least, though even then but a small section of the district will receive much benefit. It is not unreasonable for a railway company to try and size up the amount of freight it is likely to get from any locality before building into it, but on the other hand there are dozens of small mines that are anxious to ship but find it impossible to do so economically till the line is built, and so there is something of a deadlock. Of course only the very best product of the various mines will pay to ship as matters stand at present, and the very richest ore is not the most plentiful, commonly five times as much concentrating ore being present as there is of shipping. A great deal of prospecting and of assessment work has been done in the Duncan-Lardeau this summer, but the extreme roughness of the country makes any but the very highest grade ore more of a loss than a profit by the time it reaches the smelter. Leaving the Lardeau now for the present, we may turn to the Fish River district, some 10 or 15 miles west and nearer Revelstoke. The Fish River flows into the end of the north-east arm of Upper Arrow Lake, taking its rise in the mountainous district of Illecillewait, and on all the numerous creeks running into the river are located hundreds of mineral claims. One of the most important tributaries is Pool Creek, and on that creek are situated the properties known as the "Wide West," the "Black Bear," and the "Bear Creek" claims, on which the owners intend to work all the winter. On Lexington Creek—another tributary—the Banner group is situated, and this as well is preparing for a winter siege, the owners being well satisfied with their prospects. On Boyd Creek and Sable Creek also are many very promising claims, the Trilby group being located some distance up the latter creek, and showing very rich argentiferous galena. This country is very difficult of access, and the prospector who ventures through its wilds in search of mineral treasures most surely deserves all he can get, as it is a continued risk to limb and life. The proposed railway will go through this district, and will be of inestimable benefit; indeed without some such means of easy transportation it is hard to see how its known wealth can be made available. But what a mining country it will prove when that long-wished-for railway actually runs through it!

A. H. H.

REVELSTOKE, B.C., Oct. 16, 1900.

ROSSLAND DISTRICT.

The shipments of ore from Rossland's mines this year will only show a slight increase over last year's total. This is due primarily to the labor trouble, which compelled a total cessation of shipments for nearly two months, and the fact that the War Eagle has not yet resumed, while the Centre Star has only recently done so. The fact that the Northport smelter is swamped with ore, requiring a temporary suspension of shipments from the Le Roi No. 2 and the curtailment of the Le Roi's output, and the further fact that no agreement has yet been arrived at other than a modus vivendi, between the War Eagle and Centre Star on the one hand and the Trail smelter on the other, regarding freight and treatment on the output of these properties, have been the chief factors in keeping the camp's output for the past few months so much below the capacity of the mines.

At present the shipments average about 6,500 tons per week. The Le Roi sends down about 4,500 tons; the Centre Star about 2,000, and the Iron Mask, I X.L. and Giant lesser quantities.

By the first of January it is hoped the difficulties at the smelter will be overcome, the Le Roi's new hoisting plant in operation, and the War Eagle once more a producer. The weekly shipments should then run about as follows:—Le Roi, 6,000 tons; Centre Star, 2,000; War Eagle, 1,500; Le Roi No. 2, 1,500; Great Western, 1,000; Iron Mask, 300; I.X.L., Evening Star and Giant at least 25 tons each, or a total of over 12,000 tons, the mines working only six days out of the seven.

In all of the mines of th s camp attention is, and has been for some time past, p incipally directed to more thorough and systematic development and equipment. This work has resulted in great discoveries in the Le Roi, Le Roi No. 2, Great Western, Centre Star and Iron Mask, and also in marked improvement in the Evening Star, Giant, and War Eagle.

The Le Roi now ranks as one of the great gold mines of the world—its ore chutes being of unusual length and width. In some places the ore is being stoped out for a width of 100 feet. The new hoisting plant and sampling works are being rushed to completion, and operations will shortly be shifted to the new 5-compartment shaft which is now completed to the 900-foot level. The new head works comprise a sampling mill and sorting apparatus. Two 40-drill air compressors are in operation, and a third of the same capacity is being installed on the Great Western, the three plants to be worked in conjunction to supply the Le Roi, Le Roi No. 2 and Great Western mines.

The surface improvements on the Centre Star are now nearly completed, and the old machinery of the War Eagle is being overhauled.

Besides the mines referred to above, work is being prosecuted on the New St. Elmo, Iron Colt, Homestake, Spitzee, and several small properties.

The Velvet Mine, on Sophie Mountain, is being equipped with a new hoist and 5-drill air compressor, and will be a steady shipper this winter, as will probably be its neighbor, the Portland.

Work is very active in all the camps tributary to or surrounding Rossland, and especially is this true of the Boundary country. On Norway mountain two free milling properties of promise—the Cascade and Bonanza—owned by Rossland companies, will be working this winter.

H. W. C. J.

Blast Furnaces in America.—An indication of the decline in the demand for pig-iron in the United States is afforded by the reduction of the number of furnaces in blast. In August there were 240 as compared with 296 at the commencement of February, and 244 at the commencement of August, 1899. Production has diminished very notably during the last two months. While this great curtailment in the output has been taking place, stocks have largely increased, having risen from 197,532 tons at the commencement of April to 241,077 tons at the beginning of May, 334,680 tons in June, 427,038 tons in July, and 504,301 tons at the commencement of August.