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Vol. XIV.—No 8 1895—OTTAWA, AUGUST—1895. Vol. XIV.—No. 8.

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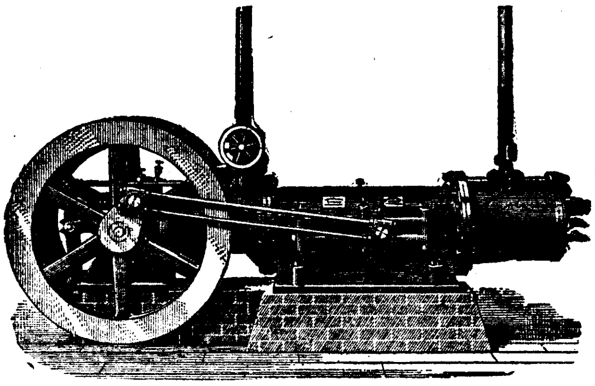

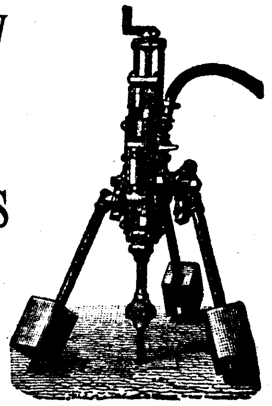

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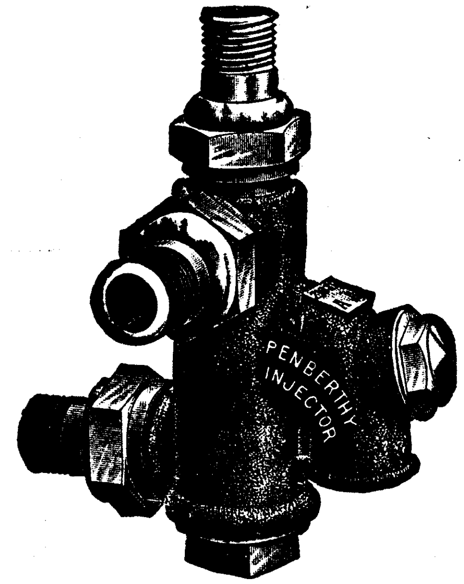

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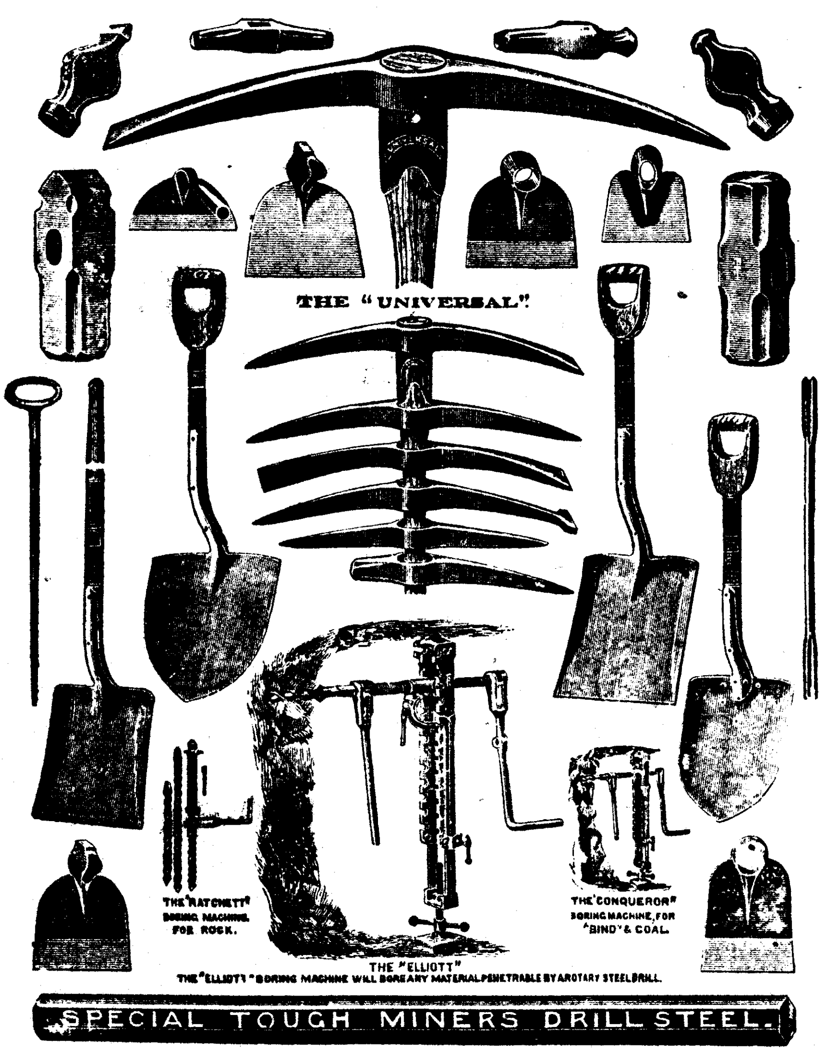

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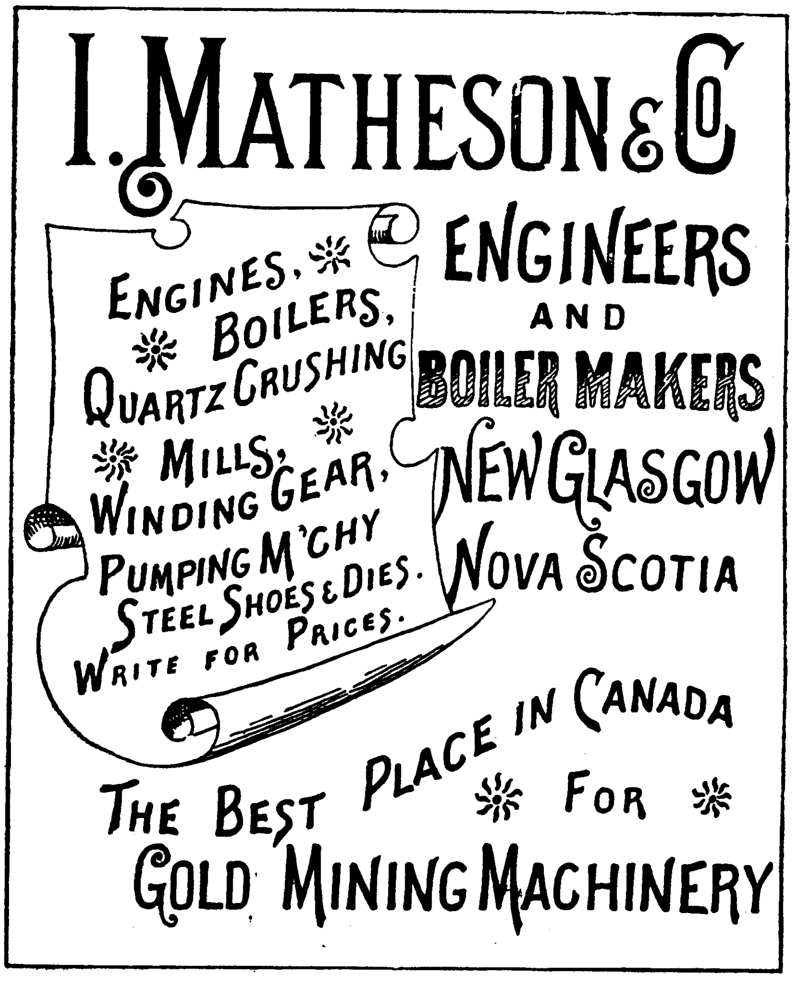
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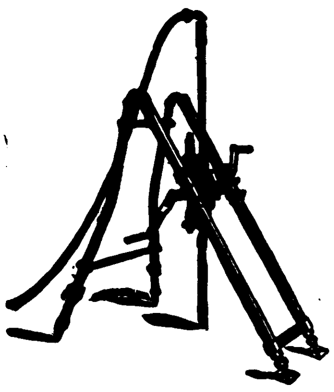

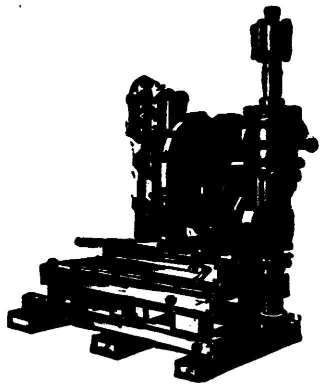

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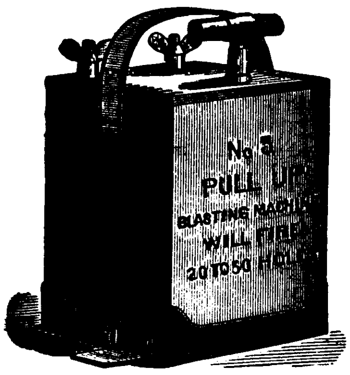

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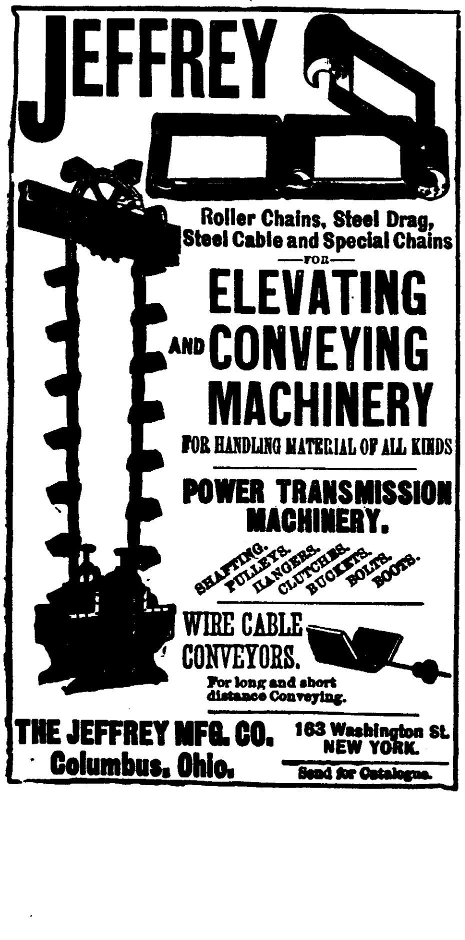

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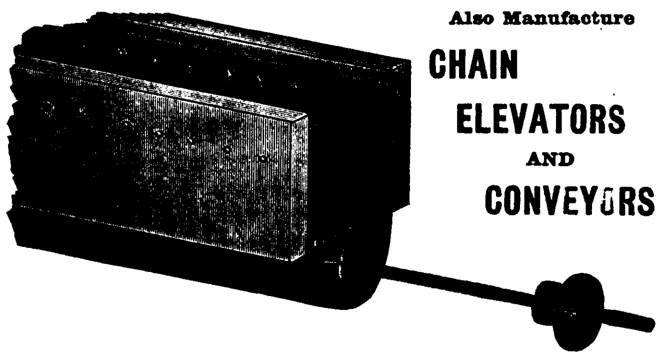

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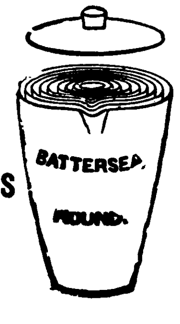

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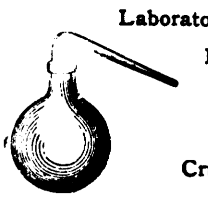

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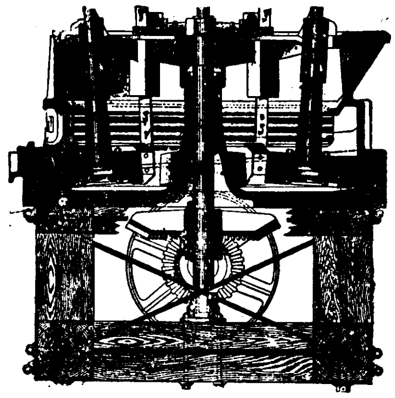

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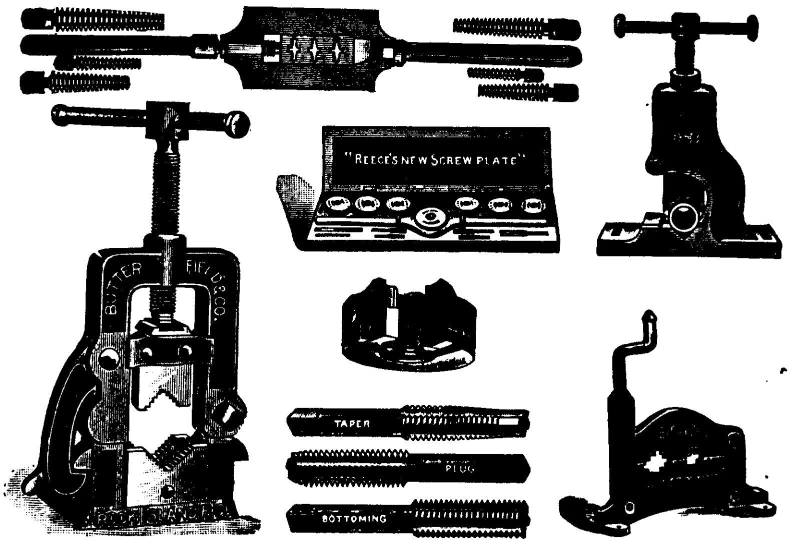

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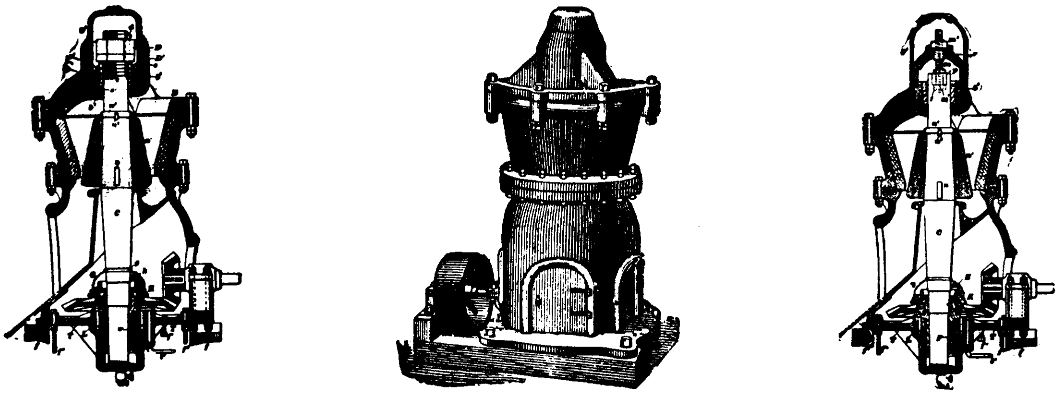

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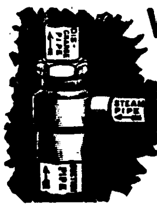

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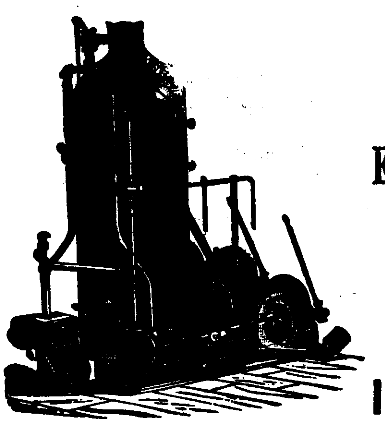

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B. T. A. BELL, Editor. Published Monthly. OFFICES: Slater Building, Ottawa.

VOL. XIV., No. 8 AUGUST, 1895. VOL. XIV., No. 8

CANADIAN COMPANIES.

Idaho Gold Mining and Smelting Co., Ltd.– Was registered at Victoria, B.C., under the Foreign Companies Act, with headquarters at Butte City, Montana, and a capital of $500,000. The objects of the incorporation are:—To carry on and conduct a general mining, smelting, milling and reduction business, and particularly to carry on and conduct such business in Trail Creek division of West Kootenay mining district, in British Columbia, and vicinity, and also more particularly to mine and develop that certain mineral claim in said Trail Creek division of West Kootenay mining district, British Columbia, known and called the Idaho mineral claim, and to reduce the ores extracted therefrom by concentration, smelting, milling and other processes; also to hold, own, purchase, lease, bond or otherwise acquire mining property or other property necessary to carry on the business of the said company; also to purchase, sell or in anywise to acquire or dispose of ores for the purpose of carrying on and conducting a general custom business in the reduction of ores of all kinds.

Cariboo Hydraulic Mining Co., Ltd.—Mr. John B. Hobson, M.E., in charge of the operations of this company at Quesnelle Forks, B.C., writing under date of 28th ultimo, says: "I intended to write you some mining news, but have had my hands full getting the Horsefly mine opened, besides looking after about 600 men here at the mine and scattered over 17 miles of wilderness through which we are cutting the Cariboo canal to a permanent source of water supply. This canal is 7 feet wide at bottom, 13 feet wide on top and 3 feet deep, and has a capacity for delivering 3,000 miners' inches of water. We calculate to have this canal completed by the 15th of August, when the water will be turned on and discharged through three 18-inch giants with 6-inch nozzles, to wash the gravel from the bank in the China pit of the Cariboo mine. After the water is on a month look out for reports of the biggest gold bar that ever went down the Cariboo road."

Cariboo Reefs Development Co., Ltd.—Was registered at Victoria, B.C., on 7th August, under the Foreign Companies Act, with a capital of £20,000 sterling, to carry on mining operations in the Province of British Columbia.

Lookout Mining and Milling Co., Ltd.—Was registered at Victoria, B.C., on 1st August, with headquarters at Spokane, Wash., and a capital of $250,000, to carry on mining and smelting operations in British Columbia.

Mild Brook Mining and Reduction Co., Ltd., has been incorporated under the laws of New Brunswick, with an authorized capital of $500,000, and headquarters at Moncton, N.B. Directors, G. Barret Latz, Isaac N. Wilbur and Robert M. Dryden. Operations are to be carried on at Mild Brook, in the parish of Alma, Albert County, New Brunswick.

Nova Scotia Coal Mining Co., Ltd., has been incorporated under the laws of Nova Scotia, with an authorized capital of $50,000, in shares of $50 each, for the purpose of acquiring a tract or tracts of coal areas in that province. The incorporators are, C. F. W. Bell, E. Lawrence, W Macdonald, Truro; A. McKay, Kingston; A. H. Learment, Truro; J. L. Stevens, Kingston: L. B. Crowe, and A. C. McKenzie, of Truro.

Canonto Mica and Mineral Mining Co., Ltd., has been incorporated under Ontario statutes, with an authorized capital of $22,000 in shares of a par value of $44 each, to carry on mining in the Counties of Frontenac, Peterborough, Hastings, Addington, and Lanark, and the chief place of business in the city of Toronto. The property to be acquired includes a lease of mining rights in the township of South Canonto, in the County of Frontenac, dated 17th, April, 1895, made by the crown to C. A. Dade, of Weston, York Co. The directors of the new concern are, George Taylor, Village of Weston; Thos. Pier, Lambton Mills; Arthur Clayton, Lambton Mills; and F. P. Brazill, Toronto.

Van Winkle Consolidated Hydraulic Mining Co., Ltd.—This company had a clean-up recently, the result being about $1,300. The run was for 27 days, and the total quantity of water used is stated to have been 43,822 miners' inches. Of the period mentioned it is, however, stated that 4½ days were used in grading and putting in 240 feet of main sluices, so that the actual for running time was only about 22½ days.

Horsefly Hydraulic Mining Co. Ltd.—Advices from the claims of the Horse Fly Hydraulic Mining Co. state that hydraulic operations have been steadily carried on since our last report, three 8-hour shifts being employed. There was only one short interruption necessitated by the stoppage to extend the branch flumes. There is plenty of water, the ditch running full and everything in good shape. The extension of the flumes, the superintendent writes, "enables us to move the boulders and gravel much quicker than before. So far this last week has seen better progress made than at any time before this season."

Le Roi Mining and Smelting Co. Ltd.—The straightening of the shaft in the Le Roi mine is nearly completed. This work has interfered with the output of ore from the lower levels. The new machinery is in place and will be in operation by this time. By means of it 100 tons of ore can be hoisted easily in 24 hours and the producing capacity of the mine will be largely increased thereby. The company expects to begin delivery of the 75,000 tons of ore, for which they are under contract, about October 1st, next. Some very high assays have been obtained recently from specimens taken from the west drift of the 350 foot level. One sample gave a return of 24½ ounces of gold to the ton.

Kootenay Mining and Smelting Co. Ltd.—The Pilot Bay smelter has started up again, smelting recommencing on the 29th ultimo. It is stated that there is no probability of the smelter being compelled to shut down again soon, as the Skyline mine alone is furnishing enough dry ore to keep it running. An ample supply of wet ores is being received from different points.

Iron Horse Mining and Milling Co. Ltd., was registered at Victoria, B.C., on 10th instant, under the Foreign Companies' Act, with headquarters at Spokane, Wash., and an authorized capital of $1,000,000, to carry on mining operations in British Columbia.

Crown Point Mining and Milling Co. Ltd., was registered at Victoria, B.C., on 10th instant, with headquarters at Spokane, Wash., and an authorized capital of $1,000,000, to carry on mining in the Province of British Columbia.

Mount Hood Consolidated Mining Co. has been organized at Spokane, Wash., to take over and work the "Mount Hood," "Only One" and "St. Patrick" mineral claims in the Trail creek district B C The officers of the new company are: Lane C. Gilliam, President; F. C. Bellamy, Vice-Pres. and Treasurer; W. W. McCalley, Manager; W. E. Blackmer, Secretary.

Hall Mines, Ltd.—This company is reported to have contracted with Fraser & Chalmers, Chicago, for the construction at Nelson of a 100-ton smelter. The ore bins of the Nelson and of the Silver King tramway are under construction. The receiving bin at the end of the tramway will be 25 feet wide, 40 feet long, and 30 feet deep; below it will be another bin 25 by 30 feet and of the same depth. About 100 feet to the west will be eight bins of a uniform size (25x30x30 feet). The floors of all the bins, except the receiving bin, will be high enough from the ground to allow of a dump-car track being laid under them. The bins will also be so constructed that a railway track can be laid alongside them. Their construction will require over a quarter million feet of timber and lumber. In order to get a secure foundation for the eight bins that are built together, cribbing will have to be put in, in one place 26 feet high. The cribbing will require over 35,000 lineal feet of timber. This timber will be cedar, and it has all been cut on the flat near the tramway line. Hugh Nixon, one of the most experienced millwrights in the country, is in charge of the work. He has 20 men at work, and expects to have 40 when the framing begins. The tramway contractors have about three-quarters of a mile of towers erected.

War Eagle Gold Mining Co.—This company, operating at Trail creek, B.C., has declared another dividend of 10 cents per share, or $50,000, making the third since the first of the year. The first was paid 1st March, and was $32,500; the second on June 15th, $50,000, and now she comes forward again with another $50,000, making a total of $132,500, the profit of seven months' production. A first-class showing indeed, though it does not fully and clearly represent the actual capacity of the mine, as the Customs house squabble in January, and the impassable state of the roads in March and April, materially hindered the output, and again there is a very considerable quantity of ore, both at the smelter and on the way there, for which returns are not yet to hand. This dividend shows the mine up to be a producer that can be relied upon to pay $250,000 a year to its owners, or about eight times its original cost.

The Prospecting Syndicate of British Columbia, Ltd.—This company has been incorporated in British Columbia with an authorized capital of £10,000 in 10,000 shares of £1 each, for the purpose of acquiring gold and other mineral properties in that province The functions of this company will be not only the acquiring of suitable properties, but the working up of connections with the London market for their disposition. Quoting from the prospectus, we learn: "There will be no charge for promotion money, underwriting, commissions or brokerage in connection with the formation of a company, except a sum of £100, being actual cash out of pocket for lawyers' fees, expenses incurred in England and British Columbia, including registration, and a small commission in case any shares are placed through English brokers, which commission will be payable to them." The directors of the company are Edward Mahon, J. W. McFarland, and Gilbert Mahon, all of Vancouver, B.C. The chief place of business is at 519 Hastings street, Vancouver, the secretary being Mr. T. T. Scott.

Eustis Mining Co.—The annual meeting of this company was held on 15th instant.

Nova Scotia Steel Co., Ltd.—The following is an excerpt of the directors' report submitted at the annual meeting of shareholders this month :—

"The directors, in submitting the first annual report, balance sheet and revenue account for the year ended 30th June, 1895, have satisfaction in reporting that the sale to this company of the franchises, property and assets, of the Nova Scotia Steel and Forge Co., Ltd., and the New Glasgow Iron, Coal and Railway Co., Ltd., as authorized by the shareholders of said companies, at the special general meetings called for that purpose, has been confirmed by Acts of the Dominion and Provincial Legislatures respectively.

The extreme depression of the iron industry, particularly in the United States during the past year, had the effect of reducing prices so much below former years, that profits were greatly decreased.

Owing to the large accumulation of unsold pig iron, and the necessity of a partial relining, the furnace was out of blast during five months of the year.

The output of the steel works was largely curtailed during the month of July, 1894, owing to the cogging mill engines having broken down, involving a large loss through the stoppage of the works, and cost of repairs.

As to the future—prices have improved considerably during the past three months, orders for a large quantity of steel have been received. Pig iron during the past two months is being sold as fast as the blast furnace is producing it, and we enter the new year with very fair prospects.

The accounts herewith submitted deal with the operation of the amalgamated companies for the twelve months ended 30th June, 1895.

The profits of the year ended 30th June, 1895, were..................	$ 22,578 35
To this must be added the balance at credit of profit and loss account N. S. Steel and Forge Co., Ltd., 1st July, 1894....................	3,886 75
Also balance at credit of profit and loss account New Glasgow Iron, Coal and Ry. Co., Ltd., 1st July, 1894	90,814 59
	$117,279 69

Canadian Mica Co., Limited.—This company is vigourously pushing its mica business, operations at present being mainly confined to the Dacey lot in the township of Hull, worked on royalty with option of purchase, and the Murray Bay mine. From both of these properties mica of excellant quality and size is being obtained, the shipments being almost entirely to England. Mr. H. Baumgarten is managing the company's affairs on this side.

Danville Slate and Asbestos Co., Limited.—This company has imported from the Farrell Foundry and Machine Co., Ansonia, Conn., three large rock breakers for their new mill. The sizes are respectively 36 x 24, jaws 8 in. to 7; 40 x 10, duplex, jaws 3 to 2¼; and 40 x 6, jaws, ½ to 1.

Ingersoll on Top.

Coal Cutting Test at Dominion No. 1 Colliery of the Dominion Coal Co., Ltd., C.B.

During the fortnight ending 10th August, '95, a test to ascertain the capacity of the Ingersoll, Yoch and Harrison percussion coal cutting machines was made at the above mine. The conditions were that the machines should work in adjacent rooms, commencing each day at 7 p.m., and ceasing work at 4 a.m. The rooms were 21 ft. in width, and the height of the coal about 7 ft. 6 in. The seam is known as the "Phalen." The trial was organized and carried out under the control of Mr. Wm. Blakemore, the Company's Mining Engineer, and Mr. John Johnston, the manager at Dominion mine. At the end of the fortnight it was found that the Ingersoll machine had achieved the best result, having cut 6,038 square ft., which for 11 full days was equal to 549 ft. per day, and for 97 working hours an average of 62.24 square ft. The Yoch machine was second on the list, having cut 5,929 sq. ft., an average of 539 sq. ft. per day and 59 88 sq. ft. per hour. The Harrison machine cut 4,940 sq. ft., an average of 440 sq. ft. per day and 49.89 sq. ft. per hour. Averaging the work of the three machines we get per day 509 sq. ft., and per hour 57.30 sq. ft. It is hardly necessary to say that this is by far the greatest amount of work which has ever been done with this class of machine in similar hard coal, and shows the absolute efficiency and adaptability of such machines for narrow room work. The total number of tons cut during the fortnight was 4,460, a daily average of more than 400 tons for the three machines. The machines were worked by compressed air, which was maintained at a uniform pressure of 70 to 75 lbs. per sq. inch. Although the Ingersoll and Yoch machines had so nearly the same amount of work the Harrison was a long way behind, but by way of explanation it is only fair to point out that the latter is a much smaller machine, having only a 3 in. piston, while the Ingersoll has a 4 in. and the Yoch 6 in. It may also be interesting to give the weight of each machine, which is as follows :—Ingersoll, 800 lbs.; Yoch, 1,100 lbs.; Harrison, 500 lbs.

Of course in making use of the above figures it should be borne in mind that this was a special test and not an ordinary run. It is not reasonable to assume that a man could continue to cut an average of more than 500 sq. ft. per day, but as demonstrating the absolute capacity of the machines when worked by an expert runner the above is a reliable and satisfactory test.

LEGAL.

Reynolds and Another vs. The Attorney-General of Nova Scotia.

(Before the Judicial Committee of the Privy Council.)

This was an appeal from a judgment of the Supreme Court of Nova Scotia sitting *in banco*, dated May 12th, 1894, confirming a judgment of the Hon. Mr. Justice Meagher, dated June 1st, 1893, by which judgment it was held that the appellants, William K. Reynolds and Edwin C. Fairbanks, were not entitled to the renewal of a licence to work a certain coal mining area in Cape Breton. That renewal had been granted on August 21st, 1889, by the Provincial Commissioner of Mines; but Mr. Justice Meagher declared that it was wholly unauthorized and void, and that Hugh St. Quentin Cayley was entitled to have a lease of the said mining area granted to him by the Commissioner.

Mr. R. B. Finlay, Q.C., M.P., and Mr. George Elliott, appeared for the appellants—Reynolds and Fairbanks; Mr. Herbert H. Cozens, Q.C., M.P., and Mr. R. M. Bray and Mr. R. L. Borden, Q.C. (of the Nova Scotian bar), appeared for the respondent—the Attorney-General of Nova Scotia.

The facts of the case may be briefly stated as follows :—On December 3rd, 1866, a lease was granted by the Commissioner of Mines of the coal area situate at Little Bras d'Or in Cape Breton county, which is now in dispute, to one Patrick Collins for twenty years from August 25th, 1866. On March 17th, 1874, the said Collins assigned the lease to John Beverley Robinson, who on November 2nd following, in his turn assigned the lease to Andrew Thornton Todd, who on April 18th, 1882, assigned it to the Toronto Coal Mining Company of Cape Breton, Ltd. By the terms of the lease the lessees were entitled, upon giving notice in writing to the commissioner six months prior to the expiration of the lease, to a renewal for twenty years upon the same conditions as were in the original lease, and to like renewals upon the same conditions for a period not to exceed sixty years. The company omitted to give the six months' notice, and on August 23rd, 1887, the appellants obtained a licence to work the said coal area. On August 21st, 1889, the appellants obtained a renewal for a year, and in August, 1890, they were granted a lease of about 670 acres by the commissioner. On April 14th, 1890, Hugh St. Quentin applied for a lease of part of this area, and renewed his application on August 22nd, but the commissioner decided that the ground was covered by the appellants' application. On February 15th, 1892, an information was brought to the Supreme Court of the Province by the Attorney-General on the relation of Hugh St. Quentin Cayley and John d'Arcy Cayley, Frank Cayley, John Strachen Cartwright, executors and trustees of the will of the Hon. W. Cayley, deceased, and Andrew Thornton Todd and the Toronto Coal Company of Cape Breton, Ltd., plaintiffs, against William K. Reynolds and E. C. Fairbanks to obtain a declaration in substance that the relators or some of them were entitled as against the appellants (the defendants in the action) to a lease of certain mining rights, and that the decision of the Commissioner of Mines in favor of the appellants was without jurisdiction and wrong. The action was tried before Mr. Justice Meagher without a jury, and on June 1st, 1893, he delivered judgment, declaring that the extension of the appellants' license for a year from August 21st, 1889, was null and void, as the commissioner had no power to grant a renewal, and that the appellants' rights with respect to the area expired on August 23rd, 1889. An appeal was taken to the Supreme Court, which, on May 12th, 1894, affirmed the judgment of Mr. Justice Meagher (Justice Townsend dissenting.)

Mr. Finlay, in asking that the judgments appealed from should be reversed, pointed out that the Crown, after inquiry, in the presence of all parties, as to their respective rights, confirmed the appellants' title to a lease for twenty-one years, granted on their application of August 20th, 1890. He submitted that his clients had a vested right to the lease.

Mr. George Elliott also addressed their Lordships on behalf of the appellants.

After consultation with his colleagues Lord Watson intimated to Mr. Bray that their lordships would not trouble counsel for the respondents to address them, but would deliver their judgment at a future date.

METALLURGICAL NOTES

M. Moissan, the French chemist whose name is associated with the isolation of fluorine, has recently been experimenting on the rarer metals. Moissan has succeeded in preparing pure molybdenum and has investigated some of its properties. Molybdenum has a specific gravity 9, and has properties very similar to those of iron; it is soft, malleable and may be forged at a red heat; like iron, it forms a carbide, which may be tempered like steel. Curiously, too, cast molybdenum contains several per cent. of carbon, and is hard and brittle, like cast iron; it may be softened by puddling it with its oxide, similarly to cast iron. Moissan suggests that it may find a use in the manufacture of Bessemer steel, and would have the advantage over manganese or aluminium that the oxide, being volatile, would go off with the gases instead of being retained in the converter like these metals.

Estimation of Chromium in Chrome Ore. By Edmund Clark (Journal American Chemical Society).—0.5 gram of the finely divided sample is weighed into a 50 c.c. platinum crucible, covered with 25 grams of pottassium hydrogen sulphate and fused over a Bunsen burner protected from draughts; the heat being gradually increased to sputtering, and finally kept at a moderately red heat for 40 minutes. The contents are poured into a platinum dish, and, when cold, boiled with 35 c. c. of hydrochloric acid and 25 c. c. of water The liquid is then introduced into a beaker into which has been placed the crucible and its cover, to dissolve the remainder of the sulphates. After settling, the clear liquid is decanted and the residue treated with another 15 c. c. of acid; finally, the liquid is filtered, ammonia added in slight excess and the mixture heated until the odor of ammonia is scarcely perceptible The precipitate freed from lime and magnesia, is re-dissolved in hydrochloric acid, and re-precipitated with ammonia, is dissolved in 50 c.c. of nitric acid (sp. gr. 1.42) heated over a Bunsen flame, and from time to time small quantities of potassium chlorate are added, the gradual oxidation being accompanied by a change from the green color to a clear orange red; a little more chlorate is added to insure complete oxidation. The iron and allumina are now separated from the chromic acid by means of ammonia, but to render this complete, the precipitate must be re-dissolved in nitric acid and re-precipitated with ammonia; the united ammoniacal filtrates contain all the chromic acid, from which it may easily be precipitated as chromic hydroxide, by adding hydrochloric and sulphurous acid and then ammonia. Or the liquid may be acidified with acetic acid, precipitated by lead acetate and the chromium weighed as lead chromate. The process admits of the accurate estimation of the iron and other impurities in the ore.

M. Moissan has recently prepared a nitride of titanium, having the composition $Ti_2 N_2$. This compound was prepared by the action of an electric current of from 300 to 350 ampères and 70 volts on titanic anhydride placed in a platinum crucible. With a current of 100 ampères and 50 volts a lower oxide is formed, but by increasing the current the nitride is produced. Titanium nitride, thus prepared, is of a bronze yellow color, has a specific gravity 5.18, and will scratch rubies and cut diamonds. This compound may possibly find a use by replacing diamond in the bits of boring drills.

M. Moissan has also produced a boron steel containing 0.58% boron, 0.17% car-

Mr. A. Dick, Joggins Mines,
General Manager Canada Coals and Railway Company, Ltd.

bon, and 0.30% manganese. The steel is made by first fusing together boron in an amorphous state with reduced iron, when a boride of iron containing 10% boron is formed, and this is added to soft steel in a fused state. Boron steel can be rolled, is readily worked at a dull red heat, but crumbles under the hammer if too strongly heated.

Mechanical tests show that as regards the increase in the breaking strain by tempering, boron steel behaves like a decidedly harder carbon steel, although the diminution in the elongation is decidedly more marked in the latter. It is very remarkable, that tempering has no appreciable effect on boron steel, hence the influence of boron is quite distinct from that of carbon.

Richard Oehmichen has shown by a series of experiments that the direct cupellation of alloys containing zinc, tin, silver and gold, that the results obtained are considerably below the truth.

Mr. J. E. Stead read a paper on the effect of arsenic upon steel, at a meeting of the Iron and Steel Institute, which is of the utmost importance to steel manufacturers. Mr. Stead has conducted a very elaborate series of experiments on steel containing small percentages of arsenic, and he finds that 0.10% and 0.15% of arsenic in steel for structural purposes, does not materially affect its mechanical properties. The tenacity is but slightly increased, while the elongation and the reduction in area of the fractured test pieces is practically the same as a similar steel containing no arsenic. With 0.20% of arsenic, the bending property of the steel is slightly impaired. With 1.0% of arsenic the tenacity is increased and the elongation slightly reduced. The bending properties are, however, fairly good. When steel is required for welding purposes arsenic is very injurious.

Prior to this paper arsenic has been considered equally injurious to phosphorous, to which element it is closely allied, and many steel manufacturers have been satisfied with steel analysis in which the arsenic and phosphorous are bracketed together, thereby saving the long and tedious method of separating them.

In the *Mining and Engineering Journal*, Mr. E. Andreoli gives an account of a solvent for gold, which he has found in some old papers, and with which we think the majority of people are not familiar :—

"If a few drops of liquor ammonia be added to 20 or 30 grains of iodine, and the compound be slightly heated and stirred over the flame of a spirit lamp, the result is an ammonical solution of iodine, having iodine largely in excess. The fluid thus obtained is an instantaneous solvent for gold leaf, and when saturated with the latter metal it yields upon spontaneous evaporation four-sided prismatic crystals of ammonio-periodide of gold.

"These crystals have very much the colour of iodide itself. The application of a gentle heat disengages one element of iodine and leaves ammonio-iodide of gold as a white crystal.

"A higher degree of heat volatalizes all the iodine and ammonia and metallic gold remains. If a few drops of the solution be crystallized rather quickly on a watch glass, aborescent metallic gold may be obtained under the application of heat.

"The common method of forming the ammonio-iodide is by placing an iodide of the metal in liquor ammonia, or in ammonical gas.

"The method which I adopt is to place the pure metal in direct contact with iodine when dissolved in ammonia. Some caution is required in forming the solution, but with ordinary care, to secure a large excess of iodine which dissolves the teriodide of nitrogen if formed, the explosion of this terrible compound may be avoided.

"Gold leaf placed in the iodine solution instantly turns black (or purple if the solution is diluted), and immediately dissolves like sugar in water."

"The solution of iodine in ammonia may also be successfully used in separating the pure metal from gold ore, obtained in the diggings where the percentage is small. In a commercial point of view, this solution may be in some cases even more available than mercury, and the iodine could be easily collected and used for further experiments."

The above is very interesting from a scientific point of view, but whether it can be used for the commercial extraction of gold from its ores is a matter of considerable question. We notice also that the writer has fallen into the popular error that the black explosive substance formed by the action of ammonia on iodine is a teriodide of nitrogen, the reaction which really takes place may be expressed by the equation :

$$2N\,H_3 + 2I_2 = 2N\,H\,I_2^2 = 2H_2.$$

This represents the usual formula, but its composition is liable to vary with differ- methods of preparing it.

Mr. A. H. Harris, of Birmingham, England, has patented a method of electroplating with aluminium. He prepares two solutions, one a solution of aluminium nitrate, to which ammonia is added so long as a precipitate is formed; a saturated solution of bi-sulphite of sodium from 30 to 40 times the bulk of the first solution. The two solutions are mixed together, boiled for an hour, allowed to cool and settle, the clear liquid is decanted off and ammonia added to the residue until alkaline. This solution is used in an electro-plating bath, preferably with double aluminium anodes.

Finely divided aluminium is finding considerable favor amongst chemists as a reducing agent. It will reduce carbonic oxide and carbonic anhydride to carbon. If heated with the carbonates of the alkalies it will reduce them to the metallic state. The yield of lithium and potassium is good and as the carbonic oxide compound is not formed in the latter case, the process promises to become of commercial value. With sodium carbonate an atmosphere of hydrogen is necessary.

A carbide of aluminium is formed when the finely divided metal is heated with lamp black, which yields acetylene in abundance when treated with dilute hydrochloric acid. If the finely divided metal is heated with red lead, reaction takes place with explosive violence, and the charge is ejected from the crucible.

A new mineral has been discovered in the Laurium mines in Greece, and is called lossenite, in memory of the late C. A. Lossen. It occurs in minute brownish red crystals belonging to the rhombio system, and has the formula :—

$$2\,Pb.\,So_4,\ 6\,As_2\,O_8\,(Fe\,O\,H)_3,\ 27\,H_2\,O.$$

We have received from Messrs. A. B. Fleming & Co., of Edinburgh, Scotland, a book giving a very interesting account of agalite, for which substance they are sole European consignees.

Agalite is a natural silicate of magnesia and is very free from sand, grit and iron, it is a fibrous mineral and is used as a "loading" for papers requiring a high gloss. It has the advantage over china clay, gypsum and barytes as a loading, inasmuch that not only is a very much larger per cent. of the agalite retained in the paper than is the case with the above named minerals, but a larger amount of the actual pulp is saved, the fibrous serrated edges of the agalite seizing hold of the pulp fibres and retaining them in the paper. Comparative experiments with agalite and china clay, made by Professor Ivison Macadam, showed that while 63% of china clay passed into the "effluent," only from 5% to 7% of agalite was so wasted.

The mineral is composed of silica, 62·1 ; magnesia, 33·1 ; water, 4·3 ; oxide of iron, 0·1; alumina, 0·3; undetermined, 0·1.

A Pass-Bye in a Shaft.

At a meeting of the North Wales branch of the National Association of Colliery Managers, Mr. W. H. Wilson, M. E., read a paper on "A Pass-bye in a Winding Shaft." The paper gave a detailed description of a pass-bye arrangement at present in course of construction at the Llay Hall Colliery, Cefn-y-bed, near Wrexham, the object of the arrangement being to run two cages in a shaft where formerly it was only possible to run one, the same result being attained at a cheap cost combined with as much safety as in a shaft of large diameter. The system of pass-bye is applicable only to a shaft with wooden guides, and in this particular instance is a shaft of 9 ft. diameter and 270 yards in depth. The pass-bye from its commencement to its finish covers a vertical length of 100 yards and is subdivided into the following sections, viz., 8 yards, 35 yards, 14 yards, 35 yards, and 8 yards; the 2nd and 6th measurements are inclined inwards and outwards from and to the centre 14 yards, the other measurements being vertical. The cages are 5 ft. by 2 ft. 7½ in. over all, and are double decked single tub cages (the same can be made to suit either single, double, or treble decked), with one tub on each deck, and taking a tub of the following dimensions:—20 in. gauge, 2 ft. 3 in. wide, 2 ft. deep, and 4 ft. 2 in. long, being 4 ft. 6 in. over the buffers. Each cage has eight cast-iron shoes fixed on—that is four shoes on each square of the cage; those on the ends of the cage are half-shoes only, well bracketed, bolted on to the angle iron of the cage with bolts with counter-sunk heads, and have lock-nuts with cotters through same; the four shoes on the sides of the cages are the ordinary shoes which run on wooden guides in any shaft. The cages are steel throughout, and are of the most improved and latest design, and are in every way made suitable to work on this system of guiding.

Commencing from the top of the shaft in a downward direction the bearers are placed in the centre of the shaft—that is, equidistant from each side of the shaft, the same being 4 ft. 5½ in. between them, and are 9 in. by 5 in. pitch pine. They have wood brackets 1 ft. 6 in. by 9 in. by 4½ in., bolted on them, and with their edges in a longitudinal direction rounded 2 in. from the square of their length and thickness respectively at each end; on these are bolted the guides with slightly rounded edges, and are bolted to the brackets and bearers with T-headed ¾ in. diameter bolts. The guides are 5 in. by 4 in. hard pitch pine, and project the 5 in. way into the shaft. There are two guides to each cage immediately opposite each other the same being 7 in. centre to centre, being 3½ in each way from the centre of the shaft, and thus allowing 3 in. clear space between each, so that each cage has its own guides and only travels on those. If you stand facing the pit head on its front the right and left-hand guides in each case run right through, from top to bottom of the shaft—that is, the two guides diagonally opposite to each other, the other two guides diagonally opposite the whole (being four in number)—to a point 8 yards below the commencement of the pass-bye, and there finish, the terminal of each being a cast-iron block of the same section as the guides and bolted on to the bearers 5 in. long and 4 in. wide, and tapered each way to an apex; these same two guides commence again in the same centre line of each other 8 yards from the finish of the pass-bye, and commence with a cast-iron block and run from thence to the bottom of the shaft. Mr. Wilson states that it would not be necessary in every case to make the shaft oval at the pass-bye; this would depend solely on the size of the tub required to be used.

Joints for Steel Wire Ropes—Usually the weak portions or broken ends of wire rope are spliced to extend the life of the rope, but in each splicing 6 or 8 feet of rope are wasted. Mr. W. Seaham has devised a strong joint which will connect the two ends by a single piece of slight dimensions and one which can be made by unskilled men with ordinary tools. A steel block of ovoid form is drilled with two conical holes slightly oblique to the direction of the rope and the conicity opposite to each other. After the rope ends are introduced into the holes a tapered drift or pin is driven into the heart of each rope end which thus splays out the wires. The space is further filled by driving in small tapered nails until no more will enter. For haulage ropes the block may be cylindrical to form also a stop for hitching behind the fork of cars to be drawn along. Any number of these may be added without impairing the utility of the rope and yet materially prolonging the life of the rope.

Mining Bureau for British Columbia—Hon. Col. Baker, in his capacity of minister of mines, has caused to be sent out to the various mining recorders throughout the province, circulars requesting them to gather every possible information as to mines and mining operations in their districts. This information will be forwarded through the gold commissioners of the districts to Victoria, with samples of ores from the mines, also samples of the rock from the hanging and foot walls. This is the first move towards establishing a bureau of mining for the province. A portion of the provincial museum will for the present be set apart for the specimens of ore from the different mines, and the fullest information obtainable as to the nature of the ore, the workings of the mine and the geology of the vicinity will be kept on record. Then when any inquiry is made as to any mine, or of the progress or prospects of any district, from the data at hand the fullest information obtainable will be furnished. This will be of enormous benefit, especially to would-be investors, and will aid greatly in the development of the British Columbia mining industry. The records will be kept up to date and made as accurate as possible.

Shot Firing.—In a paper before the Midland Institute of Mining Engineers Mr. George B. Walker described an invention of Dr. Rob's, the inventor of robrorite, by which chlorine gas, generated in a suitable vessel, was allowed to pass through a tube inserted in the stemming of the shot-hole to a detonator charged with metallic antimony and fulminate of mercury. The chlorine reaching the detonator, combined with the antimony, produced heat which exploded the fulminate mercury, and the explosion being produced entirely by chemical combination no spark or flame was produced. It was claimed that the method was a cheap one as compared with electric detonators, but whether this was so or not, and whether the necessary conditions could be carrred out in practice by ordinary workmen, would have to be tried, but the method was undoubteply an ingenious one.

The Late Mr. John M. Reid,
Manager, Oxford Gold Mining Co.

ST. LAWRENCE COAL DELIVERIES.

The following is a comparative statement of the quantities of bituminous coal delivered at the ports of Montreal, Sorel, Three Rivers and Quebec, for the first three months of navigation, compared with the same period last year. The figures show a decrease of 13,868 tons from Cape Breton, an increase of 29,362 tons from Pictou County, and a marked increase in the imports of foreign coal, amounting to 21,471 tons. Of the Cape Breton imports about 220,000 tons came from the collieries of the Dominion Coal Co., while the whole of that credited to Pictou, was from the Drummond Colliery of the Intercolonial Coal Co. The Royal Electric Co., Montreal, we believe, are the largest importers of foreign coal this season, about 30,000 tons of so called slack having been brought in for them :—

FROM.	PORT OF MONTREAL.				PORT OF MONTREAL.				SOREL.		THREE RIVERS.		QUEBEC.		GRAND TOTAL.	GRAND TOTAL.
	1894.				1895.				3 Months.		3 Months.		—		May, June, July.	May, June, July.
	May	June	July	Total	May	June	July	Total	1894.	1895.	1894.	1895.	1894.	1895.	1894.	1895.
Cape Breton........	47,736	83,329	114,216	245,281	35,254	87,503	95,806	218,563	7,794	11,459	5,191	7,618	25,706	32,454	283,972	270,104
Pictou County.......	7,815	7,951	7,281	23,047	5,950	10,539	15,920	32,409	..	....	..	..	...	....	23,047	32,409
English, Welsh, Scotch & Amer'n Bituminous	11,354	6,363	5,651	23,368	13,216	15,421	22,187	50,824	1,932	....	..	..	11,925	7,872	37,225	58,696
	66,905	97,643	127,148	291,696	54,420	113,463	133,913	301,796	9,726	11,459	5,191	7,618	37,631	40,326	344,244	361,209

Improvements in Water Spraying Apparatus for Damping Dust in Mines.

Mr. Wm. Saint, one of H. M. Inspectors of Mines, at a recent meeting of the Manchester Geological Society, conducted a number of experiments descriptive of water-spraying in mines, in explanation of which he said that the spraying system of watering mines was adopted at about forty collieries in South Wales alone, and it appeared to him that the reason why it had not been more extensively applied was mainly due to the difficulty in obtaining a spraying apparatus which would work satisfactorily without close attention, and at the same time give a fine spray free from drops of water. The coarse spray and drops fell to the floor immediately on leaving the nozzle and saturated and softened the floors of most mines, thereby causing them to heave and greatly increasing the expenditure necessary to maintain the roads in good working order. Apparently, therefore, if they could find a suitable sprayer that would give a uniformly fine spray capable of being distributed by even a moderate current of air, they might reasonably hope to arrive at a satisfactory solution of the problem of watering mine roads in the most convenient and economical manner. With this object in view, he had applied to Mr. Hugh Bramwell, the agent of the Great Western Collieries, near Pontypridd, for samples of the sprayers used in South Wales mines, and he very kindly, not only sent several spray fittings, which he, (Mr. Saint) was about to show, but also some notes describing the arrangement of water pipes, etc., in those extensive collieries, which would be read to them later on. Other forms of sprayers he proposed showing, consisted of Bray's gas burners, which he had seen used in one or two Lancashire mines, and a new form of sprayer which they saw running would also be described. The water was obtained from the town's main at a pressure of about 65 lbs. per square inch. They would begin with gas burners.

1. Bray's gas burner 000. This gave a fairly good spray and also a considerable quantity of solid water.

2. Bray's gas burner 00. This showed a better spray, but with solid water in about equal volume.

3. Bray's gas burner 0. This gave a more copious supply of spray with a larger proportion of solid water.

4 and 5. Bray's gas burners 1 and 2. Gave similar results to No. 3.

The next experiments were with fittings from South Wales.

6. Half-inch iron T piece, with an adjustable brass plug fitting into a countersunk hole in the iron pipe. This is liable to corrode and choke up, and unless there is a separate cock in addition to the plug it cannot be kept in order. It gave a good spray, accompanied by a heavy leakage of water at the back end of the plug.

7. Brass sprayer with single needle hole and brass plug. When provided with a separate cock it is considered a fairly satisfactory sprayer, but it also discharges a considerable amount of solid water.

8. Brass rose, with removable face for cleaning, and quarter-inch gland cock with numerous holes. For thorough watering, say when shot firing, this has been found most useful, and it is used frequently for the purpose at the end of a hose pipe which the waterman attaches to the mains as required. The holes vary from one-sixtieth to the one-hundredth of an inch, and they give a large supply of very coarse spray.

9. Brass sprayer with three needle holes and one adjustable brass plug. This is another form of No. 7. It does not become choked up so easily, but has no other particular advantage. It gave three jets and appeared to be difficult of adjustment to form spray.

10. Brass sprayer with screw plug and removable sprayer or nipple, with five holes. This has been designed by Mr. Bramwell to take the place of both a sprayer and stop cock. The advantages claimed for it are ;—(*a*) A separate stopcock is not required. (*b*) The spray nipples can be easily removed for cleaning or renewal at any time. (*c*) It can only be put in or out of action by a special key. It is said to act satisfactory in the mine, but possibly owing to the limited pressure at our service to-day it gives five jets of water and very little spray.

11. A sprayer of novel design. Inside the head of the fitting was a chamber, in the wall of which a hole was drilled in such a manner that the water entering it under pressure whirled and issued through the discharge hole in a spiral form, and immediately broke up into a mass of fine spray, free from drops of water. As they had seen, it had been running during the course of the preceding experiments, and give a superabundance of spray, equal to about 9 gallons per hour, and appeared to work satisfactorily. But if the hole in the loose cup became choked with dirt or the cup was removed a powerful jet was the result.

The experiments had been conducted under somewhat favorable conditions as regards the purity of the water. With impure water, such as was generally used for watering purposes at collieries, worse results might be expected. The sprayer discharge holes were necessarily so fine that a particle of dirt was sufficient to stop the spray, and the water then oozed out and fell to the floor beneath the nozzle. In order to meet this difficulty he had designed a small filter which might be made of any porous material. The one before them attached to the new sprayer contained a sponge and was of a compact form and could be fitted to any type of sprayer. It effectually separated any mechanical impurities contained in the water, whether due to dirt or corrosion of the pipes, and insured the constant running of the sprayers for a long time. He had tested the filter with sludge and grit in the water and found the sprayer was not affected in the least.

The object of the experiments had been to demonstrate the defects in the fittings at present being used in mines for spraying purposes, and also to show the new method of producing a superior spray, by which they might reasonably hope to overcome the objections which existed on the part of many to the introduction of the spray system of watering dry and dusty mines.

The members then re-assembled in the Mining School, and Mr. Saint read the following description of the arrangement of the water pipes, &c., at the Great Western Collieries, by Mr. Hugh Bramwell.

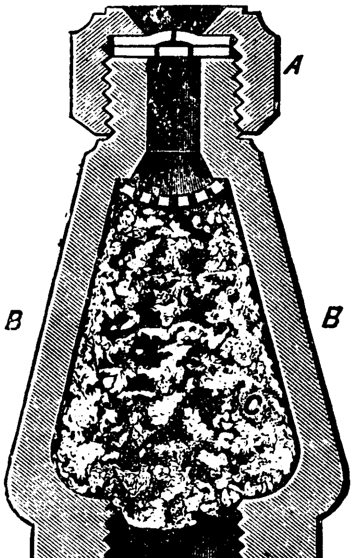


FIG. 1

PIPE SYSTEM.—The watering pipes were specially put in for dust laying and supplying horses, in 1885.

They consist of 1¼ inch wrought-iron main pipes, tested to 2,000 lbs. per square inch, with ½ inch upright pipes for the sprays every 40 yards. The distance of 40 yards is, under ordinary circumstances, unnecessarily short, but as the sprays are liable to get choked it is advisable to have plenty. Part of the pipes in the shaft have been replaced by 2 inch ones, and it is intended to renew them with 3 inch pipes.

The pipes are connected at the surface with the main from colliery reservoir. The head of water in the various seams is as follows :—

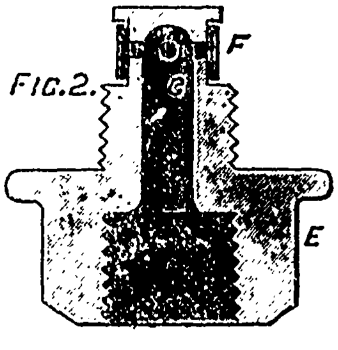
4 ft. seam........ 1,055 feet head, or 458 lbs. per sq. in.
6 " .... 1,225 " " 532 " "
5 " .... 1,475 " " 640 " "

At present there are 12,000 yards, or about 7 miles, of pipes in the shaft and spread out along the main roads in the seams above mentioned. There is provision for about 250 sprays, but we are watering principally at present by means of a "rose" on a "hose" pipe, which can be attached at intervals to the mains. There are also about thirty 1¼ inch cocks for filling cisterns for horses, and as fire hydrants at the underground engine houses.

Mr. Saint added that the improved spraying apparatus would, in its complete form consist of a back-pressure valve, filter and sprayer, and where required to reduce excessive pressures a regulator [illegible], and beyond setting it would require no further adjustment. With this combination and a reliable sprayer it would, he thought, be an easy matter to arrange for the watering to be done automatically and intermittently, and he had patented such combination and arrangements by which the sprays might be automatically run or stopped for any required length of time, either by mechanical or electrical means, or the water may be turned on and off by hand at the main or branch valves, without the necessity of employing a waterman to operate each individual nozzle tap as at present. He would, where practicable, prefer the watering to be constant; but unless they could obtain a good sprayer, which would discharge a small volume of water in a finely divided state into the air current, it seemed to him that the supply would necessarily have to be regulated and applied at fixed intervals, as he thought there might be objections on the part of the workmen to the watering being done whilst they were travelling the main roads.

Mr. Mawson said with a spray of that sort in an ordinary mine an hour's working would be quite sufficient, and he asked whether, instead of having so many sprays, it would not be possible to have them taken along the workings, taking the sprayer off and connecting it to another stand-pipe, and then to another, and so on. At present they had to have a man constantly watching the sprays to see that they worked properly, and this new system, especially with filters, seemed to overcome that.

FIG. 2.



Mr. Saint replied that, in his opinion, to manipulate the nozzles as suggested would be a needless expense. He thought the sprayers should be stationary, and the water having been turned on, the air current should be utilized to distribute the spray. The fine sprayer was quite new, and had not been tried in any mine up to the present, but he should like some gentleman to allow a few of them to be put to work in a dry and dusty mine, so that they might be thoroughly tested. What they wanted to do was to damp the road and leave it for a time, and give it another damping before it got dry, and they might regulate the mechanism accordingly, so that it would work automatically, and not be under the control of a workman in the mine. The system he proposed would be cheaper to install than that at present in use, which required the use of pipes capable of withstanding high pressures. Besides it would be reliable, and comparatively inexpensive to operate.

Mr. Crankshaw proposed a vote of thanks to Mr. Saint, and said it seemed to him that Mr. Saint had solved the problem of the effective damping of dusty mines. The system, which had been explained to him, was automatic and simple, and would do its work without causing any damage to the floor, roof, or sides of the mine. Mr. Saint was to be congratulated on developing a system which was infinitely superior to anything in use at the present time.

Mr. Hall, who seconded the motion, said he always thought when he heard these descriptions that the danger was that it became too intricate. He had expressed the opinion that in the long run the best method would be to have a long hose, and to let a man apply the water with it. Since then he had had an opportunity of seeing a hose down the pit, and found it answered most excellently. They walked at the rate of about two miles an hour, and watered everything in front of them. When they had sprays running in different parts of the pit continually the men got drenched in passing through the mist, and they got in the habit of turning off the taps to avoid it. But when the man with the hose saw the men coming he could desist. Since trying those experiments under ground, he was more convinced that it would be the best method to have a system such as Mr. Saint had shown them, but to use it with manual labor.

The Superficial Alteration of Ore Deposits.*

By R. A. F. Penrose, Jr.

The modern idea of ore deposits teaches that formations of this kind represent a process of concentration of mineral matter, either by chemical or physical means; in other words, that they are unusual localizations of certain minerals which are often found disseminated in smaller quantities in many common rocks, and that they differ from the same minerals situated in other conditions only in their degree of concentration. It is not, however, the purpose of the present paper to enter into the discussion of this subject, and the following remarks are confined to what happens in the superficial parts of ore deposits, and, to a less extent, of allied formations, after the materials forming them have been brought into their present, or approximately their present positions.

Ore deposits are generally more or less changed in their upper parts by atmospheric influences, so that very rarely do the same mineralogical and physical features that are found in these parts continue to very great depths. This superficial alteration is a subject analogous to the secular decay of rocks, but the latter involves only a limited number of common rock-forming minerals, while the secular decay of ore deposits involves a great variety of minerals, not only the oxides, carbonates and silicates, common in most rocks, but also sulphides, tellurides, selenides, antimonides, chlorides, bromides, iodides, fluorides, sulphates, phosphates, tungstates, molybdates, and numerous other classes of minerals, many of which, under surface influences, give rise to intricate chemical changes. The altered surface outcrops of ore deposits are known among the Cornish miners of England as gossan, a name which has also been adopted into American mining nomenclature, though other special names are given in special classes of deposits; in France it is known as "chapeau de fer;" in Germany, as "eisener hut;" among the Spanish Americans as "pacos" or "Colorados."

The superficial alteration of ore deposits, as of any rock, results from a combination of mechanical and chemical disintegration, brought about by the combined action of the atmosphere, surface waters, changes in temperature, and the various organic and inorganic materials contained in the air and water. In nature we never deal with perfectly pure water, but different waters contain different ingredients derived from the air and from the different materials with which they come in contact. Among the most important of these ingredients are oxygen, numerous organic acids like carbonic, nitric, oxalic, malic, citric, formic, propionic, butyric, acetic acids, etc., certain inorganic acids, such as sulphuric, hydrochloric, hydrobromic, etc. Some of the acids mentioned occasionally occur in the free state, but most of them are generally combined with some of the bases present, such as the alkalies, lime, magnesia, iron, alumina, etc.

Surface waters thus charged with various chemical ingredients percolate down into ore deposits, and there meet various materials which are even less stable under their influence than most of the common rocks. From a chemical standpoint, the first effect of this superficial influence is usually the oxidation or hydration, or both, of certain ingredients, followed generally by the formation of other chemical combinations, and by the leaching of certain materials. The action is sometimes one of reduction, which, however, often follows a previous oxidation. The process of alteration also frequently causes a leaching of certain ingredients of the ore deposit, either with or without previous oxidation, as in the removal of iron pyrites, calcite, etc. It also sometimes renders a hitherto worthless material valuable by the introduction of a valuable constituent, as in the replacement of carbonate of lime by phosphate of lime. It also causes the concentration, by capillary action in soils, of certain deposits like nitre, etc. The materials in surface waters affect different bases differently, and, therefore, there is a great difference in the classes of salts formed by the same surface waters on the ores of different metals. In the same deposit there may be formed an oxide of one metal, a carbonate of another, a chloride of another, etc. As a result of these various changes, certain materials are sometimes leached from the upper parts of ore deposits, which have become porous by alteration, and carried down to the less previous unaltered parts Here they are precipitated by meeting other solutions or in other ways, and hence the richest bodies of ore in a deposit often occur between the overlying altered part and the underlying unaltered part. This is not always the case, but it is true of some copper, silver, iron and other deposits.

From a physical standpoint, the effect of superficial alteration is generally to make the deposit more open and porous, to cause it to shrink, and, in some cases, to convert it to a loose material of the consistency of sand and clay. In some cases, however, especially where considerable hydration goes on, an expansion may be caused. Surface decomposition has in many places not only affected the ore deposit itself, but also the country rock in the immediate vicinity, and has converted it into a loose material of a sandy or clayey conistency.

When surface waters percolate into the rock, their influence is more active near the surface, because they carry large quantities of oxygen in solution, and because the oxygen of the air itself has some influence. As they sink deeper the effect of the oxygen of the air becomes less active, and the oxygen dissolved in the water is consumed in oxidising various materials which it meets on the way, until finally most of the oxygen is lost, and active oxidation ceases. Theoretically, this oxidizing action may extend down as far as, and sometimes below, the level of the drainage of the surrounding country, which is called also the zone of permanent saturation. Above that level there is a constant circulation of water from the surface downwards, thus affording means of active oxidation; but when the water reaches that level, not only has most of the oxygen contained in solution generally been used up, but also the circulation of the water is much more sluggish, so that oxidation is less active.

The process of hydration, when the materials affected do not require oxidation before they can become hydrated, may, as in the kaolinization of feldspar, extend down indefinitely below the limit of oxidation; but when oxidation is necessary before hydration is possible, the latter process, of course, can extend no deeper than oxidation. The various materials other than oxygen in surface waters are also more active above the drainage level of the country than below it. Though theoretically, therefore, alteration may extend down to, and in some cases much below the level of permanent saturation, yet in many, if not most, cases it has not yet reached that level. The actual depth to which alteration does extend varies with the topographic conditions of the region, the chemical nature and the porosity of the deposits affected, the character of the climate, and other minor conditions.

As a result of all these influences, surface alteration is found to extend in different ore deposits to depths varying from only a few inches, or in fact only a fraction of an inch, to several hundred and even a thousand or more feet. In glaciated regions the products of decay have often been swept away by glacial action, and the time which has elapsed since then has not been sufficient for alteration to have extended to any great depths; while in regions of moist climates, the erosion sometimes, though not always, keeps pace with the alteration, so that the depth of the change is shallow. In those regions, however, which have not been recently glaciated, and which have dry or only moderately moist climates, but which, on account of their topography, are not subjected to very active erosion, the products of alteration collect, and the changes are traceable downwards often to great depths.

Most workable iron deposits are the result of a concentration subsequent to their deposition, while very few are due to a direct deposition during the formation of the enclosing rocks, though some may be due to a process of differentiation in the cooling of eruptive magmas. The original presence of the iron in sedimentary rocks was doubtless due to a direct precipitation during the formation of the enclosing rock, but it was then in a finely disseminated condition, and it was only by being subsequently taken into solution again by percolating waters and concentrated that it was converted into bodies of greater or less purity. Generally, though possibly not always, this process is superficial, and though it may extend to a depth of several hundred, or even a thousand feet or more, it can be traced directly to surface influences, and its effects are seen to decrease gradually with depth. Most, if not all, the iron deposits of the Lake Superior region, the Appalachian Mountains, and other places are probably due to such causes. Manganese deposits are affected by superficial influences in somewhat the same way as iron deposits.

In many copper deposits superficial alteration has produced very remarkable chemical and economic results, and this is especially well seen where copper sulphide deposits have been affected. Such deposits are usually associated with much larger quantities of iron pyrites, and when this mixture is oxidised the result is a brown or black ferruginous mass with brilliantly colored oxidized copper minerals, such as cuprite, malachite, azurite, chrysocolla, &c., while below, at depths varying from a few feet to several hundred feet, the deposits usually pass into a mixture of copper pyrites and iron pyrites, the latter usually being far in excess.

In the case of lead deposits, the mineral galena, which is the commonest ore, is frequently more or less altered on its surface outcrops and converted to the sulphate (anglesite) and the carbonate (cerrusite). The first product of oxidation is anglesite; but this readily unites with carbonic acid or soluble carbonates in surface waters, forming carbonate of lead, or cerussite. In rarer cases, other lead materials, such as phosphates are also formed.

In the case of zinc, the most common ore is the sulphide known as blende. This material, like galena, is generally oxidized on the surface, and forms by chemical changes the carbonate (smithsonite), the basic carbonate (hydrozincite), and the basic silicate (calamine), in a manner similar to that described in copper and lead ores.

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*Abstract from an article in the *American Journal of Geology*.

Deposits of argentiferous galena and other silver minerals are, when oxidized, altered with the formation of native silver, chloride of silver (cerargyrite), bromide of silver (bromyrite), iodide of silver (iodyrite), and various other minerals.

The typical unaltered condition of gold in nature is in association with iron pyrites in quartz, and the effect of surface oxidation on such a deposit is first to convert the iron pyrites into hydrated oxidized iron minerals which permeate the quartz and turn it into a rusty brown mass. The next stage is the gradual leaching out of the iron minerals by the action of surface waters, while the gold, which was originally in the iron pyrites, mostly remains, though it may have been partly dissolved in one or more of several ways. Sometimes, especially in the Rocky Mountain region, gold occurs in the form of telluride instead of in iron sulphide, and in such cases superficial oxidation causes the telluride to be oxidized and the gold to be set free from its combined state. When such deposits as those described are eroded, the particles of gold separate from the quartz and are concentrated in the streams as placer gold.

In tin deposits, the typical mode of occurrence of the metal is in veins, dykes, or country rocks in the form of the oxide known as cassiterite. Cassiterite is not easily affected chemically by surface influences, but for this very reason its concentration is most markedly affected by surface alteration, for in the erosion of tin-bearing deposits the masses of cassiterite are broken up and carried off mechanically by surface waters, to be deposited somewhere else in the form of gravel beds, instead of being dissolved and possibly disseminated.

Superficial alteration like that already described in various deposits occur also in many others, such as antimony, bismuth, mercury, aluminium, nickel, cobalt, chromium, tungsten, molybdenum, and many rarer deposits, but the changes already described show the general features of the subject.

As soluble chlorides, and sometimes other haloid compounds, are common in surface waters, chlorides and the allied salts are not at all uncommon as alteration products, especially in such cases as that of silver, where the chloride, bromide and iodide are comparatively insoluble compounds, and are not leached out. For this reason, such ores of silver are found to a greater or less extent in almost all silver districts in America, Europe and elsewhere. The occurrence of such compounds in very large quantities in certain arid parts of America is probably due to the action of saline compounds, derived from wholly or partly dessicated lake basins, on the pre-existing ore deposits of the region. This transition to haloid compounds is not confined to silver ores, for similar compounds of copper and other metals also occur.

Rock Drills.*

It is observed that Andre, referring to rock drills in his work on "Coal Mining," states concisely the requirements of a good rock drill, as follows:—

1. A machine rock drill should be simple in construction, and strong in every part.
2. It should consist of few parts, and especially of few moving parts.
3. It should be as light in weight as can be made, consistent with first condition.
4. It should occupy but little space.
5. The striking part should be relatively of great weight, and should strike the rock directly.
6. No other part than the piston should be exposed to violent shocks.
7. The piston should be capable of working with a variable length of stroke.
8. The sudden removal of the resistance should not be liable to cause any injury to any part.
9. The rotary motion of the drill should take place automatically.
10. The feed, if automatic, should be regulated by the advance of the piston as the cutting advances.

Having assented to these requirements, the catalogue continues: The power of a rock drill is in direct proportion to its diameter of piston. It is of the greatest importance that a drill of proper size is purchased for the work it is to do. It is impossible to determine by figures that a rock drill of a certain diameter of piston will be best suited for a particular piece of work. This can only be learned by experience.

It is a common thing to see rock drills of too small a size used in work where a larger drill would save money. We have also seen large drills used where small ones should be. It is a common thing for salesmen inexperienced in the rock drill business to advise the purchaser to buy a drill of a smaller size than will be best suited to his work. This is sometimes done by salesmen and manufacturers of experience, but whose interest in effecting the sale binds them to the real interests of their customer. It is easier to sell a small drill because the price is lower, and many men who have been tempted by the low priee have purchased smaller drills than they should have, and some are to-day using them satisfactorily, but are really losing money, as a large drill might do more work in the same time and at the same expense in labour and fuel. It is like putting a boy to do a man's work. It costs as much to feed the boy, but the man accomplishes more in the same time.

There is distinct tendency of late years among the most successful and experienced quarrymen, miners, and contractors toward the use of heavier and more powerful machines than were used for the same work only a few years ago. A light drill is, of course, the choice of the drill runner, because he thinks it will be easier for him to move around, and many quarrymen insist upon having a light machine, for precisely the same reason. A drill too small for the work it has to do is never a paying investment, and the slight difference in first cost between a small drill and one of proper size should never be allowed to influence the matter, as this small difference will, in many cases, be made up every week in the difference in work done. Again, experience shows that the larger machines are much more durable and economical in repairs, not as apt to break down, and will outlast several of the smaller ones at the same work.

On the other hand, large drills should not be used for shallow holes of small diameter in soft rocks, where the time taken to move the machine is out of proportion to the time it takes to drill the hole. Many are using rock drills, as they think satisfactorily, when a larger or smaller, or a different pattern of machine, would be a surprise as to its greater capacity. Good machines are sometimes condemned when the only trouble is in their being unsuited for that particular work.

There are many kinds of bits in use, each having its specific value when applied to certain kinds of work. Obviously the best bit for use is that which is the simplest in construction consistent with efficiency. It may be stated as a general rule that the single-edge bit should be used everywhere that it is possible to apply it, so great is its simplicity. It cannot be used with percussive drills in hard rock because the blow is so strong that the edge will not stand. Here is where double-edging comes in to advantage, for, having plenty of power behind it, we may distribute that power over two or three edges, and thus gain an advantage.

A straight edge, when used for hole drilling, brings most of the work upon the outside points of the bit. These points turn around through the largest circle, that which limits the diameter of the hole; and, besides, they have to break up the stone at the wall, where it offers the greatest resistence. The taper or curve eases this condition of things by changing the bottom of the hole so that it has no sharp corner.

Sandstone has a singular effect on drill bits. Though sandstones are usually soft the bits cannot be finely pointed, but, on the contrary, should be flattened. A bit with a knife edge when used in sandstone will have its edge sharpened like a razor, the faces of the bit gradually becoming concave. This is natural, because, as the bit embeds itself in the grit of the rock, it is rubbed as though on a grindstone. The stone is not usually hard enough to dull the sharp line of the edge, so that the more this bit is used the sharper it gets. It cannot, however, be used very long, because the point or outside ends of the bit become flattened and dulled, and what is a still greater objection, the ends become tapered. All this arises from the hard work and the great rubbing experienced at the walls of the hole.

The most successful sandstone bit is undoubtedly that with the flat edge. This bit is nothing more than a flattened-out piece of steel, with no more edge to it than there is to the side of your finger. It is sometimes called the stub bit. Exact dimensions of this bit cannot be given that will apply in all cases, but the most popular dimensions are about 1½ inches length of face, and from ⅜ to ⅝ inch in width. The cutting face should be square and rectangular. The bit should be kept thin to insure fast cutting, but, if a cornered hole results, thicken the bit a little. It is usual to simply dress it up by heating it and hammering it to square edges, the chief work having to be done upon the outside ends in order to keep them square and up to gauge.

There is so much metal in the sandstone bit that it is not rapidly worn away by the grit. It is, therefore, a common thing to see one of these bits in use for half a day, drilling a great many holes in different places, without having to be sent to the shop. When starting a hole it pounds upon the rock like a bass drum, and an inexperienced looker-on would naturally suggest a sharper edge.

There is no question about the advantage of the flat bit in sandstone, so far as the blacksmith work is concerned. It will actually put in a hole faster, and it does it because, when drilling sandstone, the process is not a chipping, but a crushing one. Marble, or any other hard crystalline substance, needs a sharp edge to throw a chip, whereas sandstone will crush.

Prior to the use of the percussive drill there were few, if any, drill bits which had much value above that with the single edge. Even in artesian well boring, where the blow is heavy, the single edge bit has held its place against many patented bits. The single-edged bit is generally flattened or grooved at its centre for the purpose of discharging the cuttings. As the centre of any bit performs but little work, it may be readily cut away without reducing the efficiency. Besides the single-edged bit, the +, × and Z bits are the only really important bits in use with percussive drills.

The + bit is the most popular percussive drill bit in use. It seems to be a happy medium in that it accommodates both the drill runner and the blacksmith, though we are quite sure that, were the blacksmith's wishes not consulted, the × bit would replace it almost everywhere. Out of several hundred enquiries recently sent out among mining and quarrying men as to which bit was preferred, the + or the ×, opinions differed largely, but the weight of evidence was in favour of the + bit.

It may be stated as a general rule that the × bit will do good work in any kind of rock where the + bit is used, but the + bit cannot be used to advantage in some rock where the × bit gives satisfaction. Another rule is, that the + bit had better be used wherever the rock will admit, for the simple reason that it is more readily dressed by the blacksmith.

The two bits are very much alike in that they have the same extent of cutting edge, but they differ in that the edges in one case cross at right angles, and in the other at acute angles. As the bit, when at work, turns round after each blow, it is obvious that in the case of the + it may strike four times in the same place while turning the circle, while with the × it can only strike twice in the same place. A + bit, when turned one-quarter of the circle, or 90°, may embed itself in exactly the same groove that had been made by a recent blow, and, if this striking in the same place is frequent, and the rock is soft enough to admit of rapid drilling, the hole will become rifled, that is, it will not be round. Anyone who has much to do with drill holes knows that a rifled hole is a great nuisance. As the × bit has only half as much chance to strike in the same place as the +, it offers only one-half the opportunity to rifle the hole. It is a common thing for percussive drill manufacturers to receive complaints that "the drill will not put in a round hole;" the invariable remedy is to change the bit, and, as a general thing, the × bit is the thing to use.

In the blacksmith shop, the + bit is invariably preferred. In using the dolly the blacksmith finds that by turning it one-quarter it fits the bit, and, owing to the rectangular and uniform construction of the bit, he has no difficulty in keeping it at gauge, while with the × he must turn his dolly one-half of the circle, and in doing so the bit must either be turned around, or he must send his helper on the other side of the steel. It is because of this very condition of things as illustrated in the blacksmith shop that the × bit when turning around in the hole is less liable to strike in the same place, and drills a better hole. Persons using the + bit and having difficulty with rifled holes can try the experiment by simply knocking the flanges of the bit together in the blacksmith shop, while the steel is hot and after it has been dressed. If they find that this bit will drill a more satisfactory hole, they had better throw away their + dolly and send for an ×, the blacksmith to the contrary notwithstanding. In trap rock, granite and other uniform rocks the + bit does good work and drills a round hole because the rock is uniformly hard, and the drilling is consequently slow.

The Z bit is designed and used to a moderate extent in soft rocks, or in work where seams and soft places are found in the line of the hole. This bit is sometimes modified by having the middle edge straight across, thus making an Ξ instead of a Z, but there is little preference between the two, and either one is bad enough for the blacksmith to dress.

A matter which frequently receives too little attention from the drill runner is the keeping of the bit in the proper shape. Generally speaking, they should be as thin and sharp as they can be made without breaking or sticking. It is a common thing to run × or + bits till they are battered or worn so blunt as to make cutting out of question; it is then a matter of brute force. Two or more sets of steels should be used, so that a sharp set is always available without waiting for the blacksmith. Always remember to keep the bits dressed for as small a hole as will do the work; there is just four times as much rock in 2 inch holes as there is in 1 inch; an eight of an inch difference in the size makes quite a difference in the drilling time. The size of the bit or its sharpness affects the speed every time a blow is struck. When a drill is striking 200,000 blows per day these little differences count up to a great deal every day, to say nothing of months or years. A great point is to keep the machine pounding every possible minute of the time; lose as little time moving and changing as possible. The rule is to have the bits as thin as possible up to where they begin to make cornered holes, in which case the remedy is to thicken the bit $\frac{1}{16}$ inch or more. If the + bit rifles the holes, try the × shape. If the drill sticks, it is a thousand to one that the trouble is with the bit, or in the hole, and not in the machine. See that the corners are dressed well back where the side of the bit touches the wall of the hole, so that the rubbing surface is small. A dulled bit often takes twice as long to get down as a sharp one, and a good driller can accomplish twice as much as a poor one by

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* Excerpted from the new catalogue of the Ingersoll-Sergeant Rock Drill Co., which contains a large amount of practical information respecting the use and care of rock drills.

making his moves and changes quick, keeping his bits sharp, and giving the machine its fullest stroke without striking the head. Keep the hole clean, the pressure high and dry, and the machine well oiled, and every last quarter of an inch stroke, so the piston is almost "nipping" the head every blow, unless in seamy or treacherous rock.

It is frequently quite as difficult to drill a straight hole as a round one. The shape of the bit has something to do with the alignment of the hole. It is an invariable rule that the edge of the bit should never be tapered in rock of uneven or irregular formation. The marble bit is of no use, except in a material like marble, which is uniform. It is obvious that with a tapered bit passing through a flint seam or other irregularity in rock, the tendency would be to glance, and this would result in "running of the hole.

Where drill holes tend to run out of line, the bit should invariably have a straight edge, that is, at right angles to the axis of the drill steel. It makes no difference whether the drill is a + or an × bit, so far as the alignment of the hole is concerned. In some difficult places where the hole passes through soft spots or seams running diagonally across the hole, it is advisable to upset the steel for a distance of about 6 inches above the bit. In other words, the steel should be very nearly the full diameter of the bit for a distance of about 6 inches at the bottom. The purpose of this is, that the steel may be guided by the wall of the hole, thus preventing "running" until the pocket or seam has been passed. This is readily undersood when it is known that the steel used with percussive drills is usually about 1 inch diameter octagon with a bit of about 2¼ inches diameter; thus there is a space of about three-quarters of an inch between the steel and the drill hole, and should the condition of the bottom of the hole be such as to tend to thrust the bit to one side, it will gradually work the steel up against the side of the hole, and will result in a crooked hole, which will give trouble through binding and sticking. If the bar of steel were nearly equal in diameter to that of the bit, it would, as it were, force the hole to run straight. It will not do, of course, to carry so much weight of steel; hence, where trouble is met, it is best to upset the steel at the bottom.

In the ordinary course of drilling, the runner sometimes finds that his hole is going crooked, and, without waiting to get a special piece of steel, he attempts to pass through the obstruction. The first thing to do is to reduce the speed of cutting. This is done by either throttling the steam, shortening the stroke of the drill, or by dulling the bit; but whatever is done, it is necessary to "go slow" with the drilling. An effective means by which to prevent "running" is to pull out the steel and throw some iron filings, or small pieces of iron in any shape, into the hole, then put in the steel and go ahead. This not only reduces the speed of cutting, but the pieces of iron are thrust into the softer place, and thus the bit cuts through the obstruction and keeps the hole in line.

Let us assume that a cobble stone of the size of an egg or larger is encountered by the bit in the line of the hole, but a little to one side of the centre. Obviously, as the flange of the bit strikes this obstruction, it will be thrown off at a tangent and will gradually cut away the side of the hole farthest from the cobble. It is now simply necessary to drill a few inches more of the hole, without losing the line, and a few pieces of iron, or even a nut thrown in the hole, will retard the "running" until the bit cuts through the obstruction.

A drill hole will sometimes "run" in a most unexpected manner, and in rock of uniform texture. In a case of this kind, the runner should at once stop his machine and see if his bit is in good shape. Sometimes one of the flanges breaks off and serves the same purpose in throwing the steel out of line as though a "hard head" was encountered. If the broken piece is large, it will sometimes get in one corner of the hole and give considerable trouble, even after the bit has been repaired.

It is of much importance that the hole be well started, that is, it should be started straight. In stone quarries, the mouth of the hole should be preserved at about the diameter of the hole, and not cratered or broken. This can be done by starting with a light blow and a short stroke, lengthening the stroke and the force of the blow after the hole has been made a little deeper than the length of the stroke.

The machine should be oiled often, and good oil used. The driller should have a system of oiling every time a certain number of feet are drilled. This varies with the rock, but an observant driller can soon learn how often to oil. "Little and often" should be the rule.

System of "Long Wall" Used in Northern Illinois Coal Mines.

By G. S. Rice, E.M.*

The system of mining which is to be described has been developed by the special conditions of the "third vein" of the northern Illinois coal field. This "third vein" is so called because usually third from the top, but geologically it is No. 2, numbering from the bottom.

In this district the other seams are only occasionally developed, and are worked in but few places. The "third vein" is very permanent and uniform, and is workable through the large district north of the Illinois river, and its annual output is between three and four million tons. The coal is a moderately hard bituminous coal of good quality; in fact, one of the best of the Illinois coals, its actual evaporative power being eight to nine pounds of water per pound of coal under a good boiler. The thickness of the seam is from 2 feet 10 inches to 4 feet, but the greater area only varies from 3 to 3½ feet. While the "third vein" is somewhat rolling locally, the general plane is nearly horizontal, having but a slight raise toward the outcrop at the north.

The coal is underlain with sandy fire-clay, which, at times, is so sandy as to be very hard. The roof is a light drab colored shale of fine texture, called by the miners "soap stone," from its soapy touch. It is of this character for 10 or 12 feet over the coal. Above that, bands of slate are interspersed with the shale until the upper coal seams are reached about 150 feet above. The total cover above No. 2 vein varies from 100 to 500 feet in thickness in going from the eastern to the western part of the northern district. The surface is rolling prairie. The sand and gravel drift, often several hundred feet thick in the western portion, contains much water, but the shale strata, as a whole, is not fissured or broken by the long-wall working, and so the mines are quite dry, even in the case of one mine which passes underneath the Illinois river.

The only exceptions to dryness are in mines at Braceville, which is near the outcrop. There the solid covering is thin, and in a few mines of that neighborhood the roads have to be corduroyed.

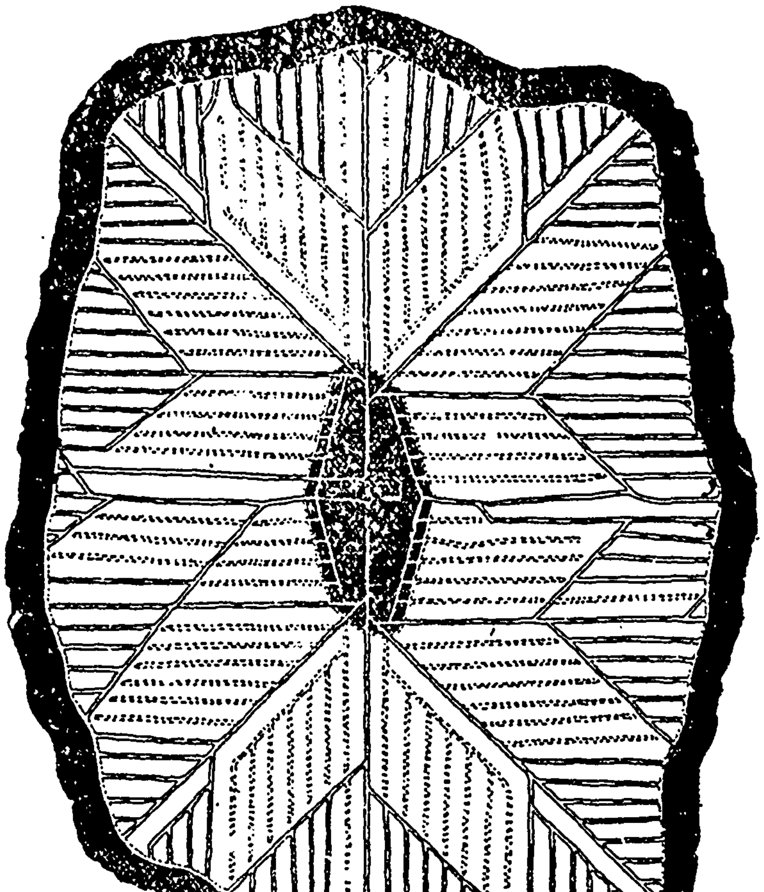
In selecting the position of a shaft, in most any part of the "third vein" district, there is usually no natural obstruction to prevent its being placed in the centre of the given tract. Besides the central hoisting shaft there must be an escape shaft, the present State law says 300 feet away. This distance may be lessened with the permission of the mine inspector. This is usually granted for the long-wall system, as it would be an unnecessary hardship to require such a great distance between the shafts, on account of the large pillar which it would necessitate.

Having selected the position of the shafts, the next point to determine in the planning of the mine is the size of the shaft pillar to be left. Of course this will depend chiefly upon the depth of the shaft, and the nature of the material gone through. The danger is in making the pillar too small, and in a number of cases there have been bad results following this mistake.

Observation of the shaft pillars of mines now open, leads to the conclusion that the strata of this district require, for a safe pillar, that its minimum diameter should be not less than the depth of the shaft. On the other hand, some advocate leaving no pillar at all, expecting that the whole shaft will sink so gradually and evenly that no danger will result; but the writer believes that the risk of racking the shaft is greater than the advantages that might be gained in more quickly opening the long-wall face. The usual plan of the district is to make the shaft pillar diamond-shaped, the "main bottoms" (termini of the main entries) occupying the long diameter. The escape is placed near the line of the short diameter; and it has been usual in the past to make it about 100 feet away from the main shaft.

After the shafts have been sunk, and connection has been made by driving headings from one to the other to establish a current of air, the "main bottoms" are pushed forward. If the diamond lies north and south, these will be the termini of the "main north" and "main south" entries. For a mine which is to have a large output, the "bottoms" are double-tracked for 250 feet on each side of the shaft, and, if practicable, are made with a down grade toward the shaft. These grades cannot always be established at once; the mine must be developed sufficiently to find how the seam is running. It may be necessary in some cases to lower the shaft if it is found that it has been sunk on the hill of a seam. At the end of the switch of the double track, the entry is narrowed to single track width, and just beyond two entries are turned off, one 45 degrees to the left, the other 45 degrees to the right, with an interval of about 40 feet between them. These form what are called "main 45 degree" entries, and run on the diagonals, so to speak, of the tract.

FIG. 1



After the latter four entries have advanced about 30 feet, from each an entry is turned off at 45 degrees to run due east or due west respectively, and these complete the main permanent entries, making ten in all. From the east and the west entries, entries are turned and directed towards each other to block out the shaft pillar. Single entries are usually used in blocking out the pillar, but there is much difficulty in airing even when boxes are used, to carry the air to the face, and if the pillar is large, it becomes very severe on the miners.

A better way with large pillars is to have double entries with "cross-cuts" between, spaced at the right intervals for room-roads, then, connections having been made all round the shaft pillar, all is ready to begin the long-wall face at once from the side of the outer block entry.

When the blocking-out entries are single, the rooms are started narrow for a certain distance, then are broadened till they meet and form a continuous face around the block. Still another plan is to use a broad entry, packing on each side of the roadway, and starting rooms off it at once. This plan was used at the Ladd mine (see Fig. 1), where the width of the entry or room was 33 feet. The method was successful, except for a difficulty in airing, in spite of the air-boxes.

The spacing adopted for the branch roads in this district is 42½ feet from centre to centre of road, measuring at right angles. This makes an even 60 feet, when measured along the 45-degree entries, from which all the room-roads are afterward turned. Although not properly "rooms," the branch roads are so called locally, and we use this term in describing them.

Two miners work in each room in "getting" coal. They first prop or "sprag" the coal-face, then undercut the coal in the fire-clay to a depth of from 16 to 20 inches;

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* School of Mines Quarterly.

to do which the miner must lie on his side. The sprags are then knocked out, letting down as long a strip of coal as was undercut. At the beginning of the "long-wall," before the roof weights down the coal, the undercutting is hard, and, indeed, where the fire-clay is very sandy, the cutting may have to be done in the lower part of the seam itself, and the coal require to be wedged down.

The room-track is laid up to within five or six feet of the face, and the car is brought in as close as the brushing will allow. The track is in the middle of the ground 42½ feet wide, as already mentioned) apportioned to each pair of miners. The coal has to be carried or rolled along the face to load it into the car. After the coal has been loaded out walls are built up to the roof on either side of the roadway, and to within a couple of feet of the face. The walls are built with the rock taken down in the roadways to give height. This is called brushing. The method of doing it is, to carry the face of the brushing full thickness and up to a bedding plane, cutting with picks at the sides and pulling down the slabs.

Before the mine is well started, there may not be enough rock to build the walls and fill the "gobs;" in that case, soft-timber "cogs," which are sticks of timber laid log-cabin style, must be built. After the mine is well opened there is, usually, too much rock; and in some mines it averages one car of rock to every four or five of coal that must be taken out of the mine. Behind the walls, or "buildings," which must be six feet thick, are the "gobs," as they are called, which are filled as nearly as can be with the clay cuttings. If none, or not enough rock is at hand, timber cogs must be put in, for, in this system of long-wall it is very essential that the roof be supported evenly all over; if it is not, the weight is taken from the face, and also the sides of the entries are liable to be pushed in. Where other supports than clay or rock are used, they must not be too rigid. This is the object of the soft-wood cogs, which yield in much the same proportion as the walls and gob-filling.

After the main entries have progressed about 210 to 270 feet, depending upon local position, "cross-entries" are turned at 45 degrees. These cut off the room-roads, but new ones, off the last entry, are started at the same intervals, that is, 60 feet measured along the entry. The distance between the "cross-entries," or in other words the length of the room-roads, is determined by the rapidity with which the roof settles. This varies somewhat in different parts of the district, as it is necessarily proportional to the overhead weight; but the room is made as long as possible, just so that it does not require additional brushing to make headroom for the mule and loaded car before being cut off and abandoned.

The roof settles most in the first few months, but it is several years before it is entirely settled, by which time the gob has been squeezed down to one-half or one-third its original thickness.

The cross-entries themselves are cut off by the cross-entries started further in, thus making large diamond-shaped areas of "gobs," untraversed by open roadways; for as soon as a roadway is abandoned, it, in a few months' time, falls from the roof and the squeezing in of the sides fill it up.

If the mining conditions are at all equal throughout the mine, the form taken by the long-wall face is that of a rough circle, and on this account the system is sometimes called "the circular long-wall."

This "third vein" is quite free from strongly-marked slips or faces; and as it makes no difference in its mining what direction the work may progress, provided the face has no sudden bends, which would take off the necessary roof weight, the circular form is of no disadvantage. The roof is also very free from slips, and vertical cracks or joints, until the coal has been mined below it; but when the coal is brought down in a long strip, it marks the roof just where the break of coal has occurred, and along these marks the roof afterwards breaks. These "breaks" seem to run up indefinitely, and oftentimes they can be followed up to the "black slate," 8 or 10 feet above. This peculiarity has had a marked influence in adopting the system of mining. When the "breaks" do happen to run parallel with the course of an entry, there is endless trouble from the slabs dropping out. The roof is apt to cut away over the side walls, and then, the only thing that can be done is to fill the top with timber. This, of course, is expensive, and were it the condition prevailing throughout the whole mine, would prevent the commercial success of the mine.

On the other hand, if the breaks run across the entry, pieces may splinter off, and there may be a festooning down of these pieces where there is no timber; but they interlock overhead, and there is nothing like the difficulty in keeping the entry in condition. From this, it is evident that it is necessary to have the roadways head on to the coal-face as nearly square as possible. The 45 degree system more nearly allows this than any other arrangement of roadways; and indeed, all of the other systems, both long wall and room and pillar, that have been tried in this seam, have been unsuccessful.

The mode of ventilation is very simple. Usually, the hoisting shaft is made the upcast, and one compartment of the escape shaft is made the downcast. The air is split at the bottom of the downcast into two currents, running east and west, respectively, in the example selected. When they reach the face they split again, moving north and south. The currents travel around the face of the workings, each having a quarter-circle to go. They come together again at the heads of the north and south entries, respectively, and passing to the hoisting shaft escape upwards. It requires but a few doors, which are placed near the main bottom, to make these currents, and as the splits are of nearly equal length, no regulators are needed. The ventilation is very effective, as fresh air is brought to just where needed, that is, along the face where nearly all the men of the mines are at work. Entries other than those mentioned get sufficient air from leakages and opening of the doors to let the cars through.

One objection that this long-wall system has, in common with all long-wall systems with continuous faces, is, that in "opening up," it often takes a year or two to reach the full capacity of the hoisting and loading plant, and when that has been reached, the face keeps on getting larger and larger until at last some sections of the mine have to be closed. However, where the shaft is shallow, instead of temporarily closing a portion, it is usual to distribute the men more, having but one in each room; and, when a certain limited area has been worked, say 160 acres, it is considered cheaper to sink a new shaft and move the plant rather than to keep open a large number of entries, with the expectation of having to re-open those parts of the face which had temporarily to be shut down.

Hitherto most of the mining has been done in the eastern part of the field where the mines are all shallow, most of them under 100 feet in depth. But now, mining has begun in the north-western part where the seam is deeper and overlaid with wet drift. There, since shafts are expensive to sink, they must be made to work out large territories, which can be accomplished with mechanical haulage. At present, haulage is done entirely by mules, in all the "third vein" mines and perhaps more cheaply than could be done by mechanical means, as the roadways are many and distances short.

Payment to miners is made according to the tonnage of lump coal they mine and load out, which is about 80 per cent. of the gross weight of the coal. The price in the eastern part of the field is 87½ cents in summer and 90 in winter. In the western part it is 5 cents less for both seasons. This is a differential allowed the operators to offset the extra railroad haul to Chicago, which is the largest market for this field. The miner, for the price paid him for lump coal, loads out the fine coal, and must also carry 18 inches of brushing in the roadway, build the pack-walls, fill the gobs and load out the surplus rock. His items of expense, are shovels, picks, a small monthly smithing charge, and oil for his lamp. With steady work for both miner and mine, which is essential to the fullest success of the long-wall system, a good miner can get out four or five tons of lump per day. The average of good and bad would be three tons per man, which makes good wages.

The present difficulty, however, is over-production of coal. Too many mines have been opened for the market and as a consequence, the mines for several years have averaged little over half time, and the earnings of men and mines have been small.

Fig. 2

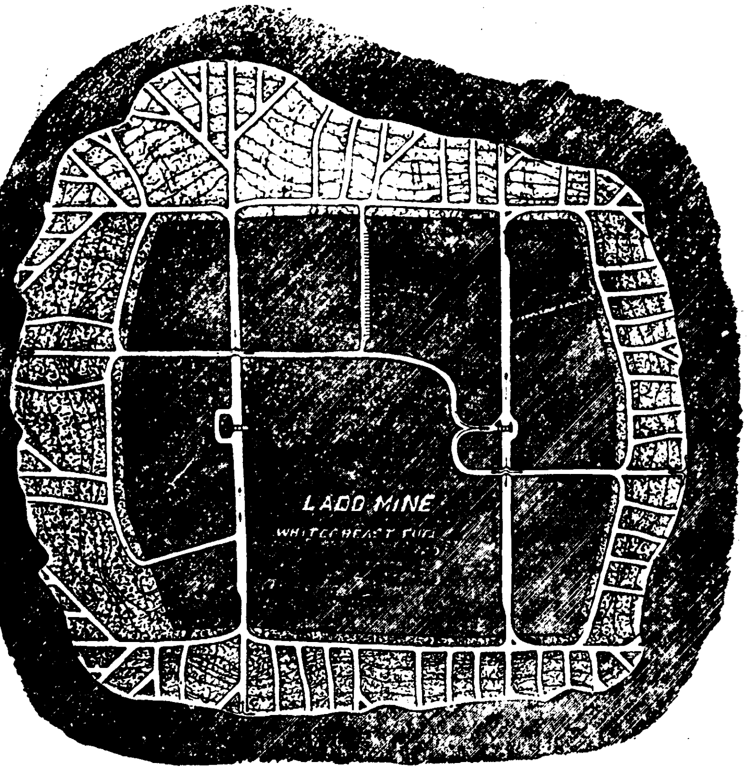
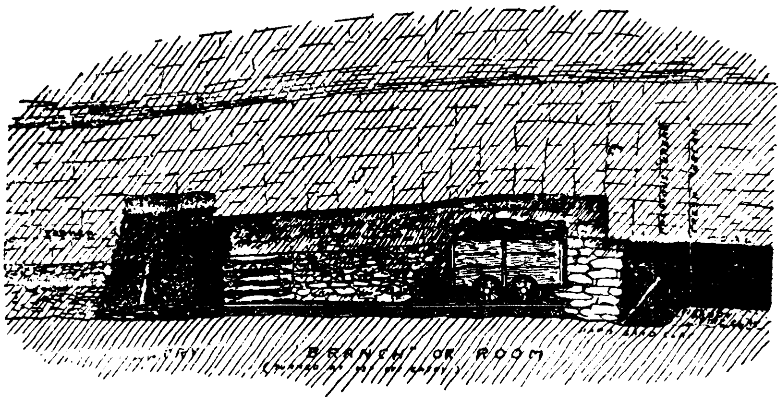


Fig. 3



One trouble that not working each day entails, is, that the careless miner does not load out all his fine coal, for on the days the mine does work, he wishes to load out only lump coal as that is all he is paid for. The fine coal if left in the gobs in any considerable quantity, may be ignited by the sulphur in the form of iron pyrites, which here and there is found in small streaks in the coal, and has not been sent out, as it should be, with the rock. A fire in the "gob" is an awkward thing at the best. It must be reached promptly by cutting a passage right to the heart of the fire, and loading out the burning stuff. If the fire should be neglected, it would soon be beyond control, would get into the roof, which contains enough bituminous matter and specks of the sulphur to fire, and the whole district would have to be abandoned. Double fire-walls of brick with sand between would then have to be erected in all the roadways round about.

In one of the mines of the field, such a fire has been smoldering for years through a considerable district of the mine.

Fig. 1 shows a typical mine of the district. The full lines show the working roads, the dotted lines the roads that have been cut off and therefore abandoned. In this particular mine the conditions were highly favorable, and it was noted for the exceptional rapidity of development, and working out of the coal in the tract assigned to it. The narrow-work around the shaft was completed in two months. The long-wall face was started with thirty rooms. During the first month the largest output in a day's run was 300 tons, but nine months later it had reached 1,038 tons. The highest record for a day's run of ten hours during the whole life of the mine was 1,900 tons gross weight, or 1,702 tons of lump. In one month with twenty-four working days there was hoisted and loaded 25,057 tons of lump coal. The life of the mine was comprised in 766 working days, during which about 175 acres of the coal seam were mined out, giving 688,619 tons of lump coal.

Fig. 2 shows a map of Ladd mine eight months after the narrow entries had reached the boundary of the pillar, and the several isolated long-wall faces had just started. At the end of four months a continuous long-wall face had been formed around the block. In the drawing, the lines shown circling around the pillar more or less parallel, are the faces of the long-wall on the first of each month. Those parts of the mine in which the fire-clay under the coal was soft enough to permit mining in it are readily observable, as the places where the face is farthest advanced. This mine is a double one, that is, it has two hoisting shafts. The roads are planned to serve either shaft, so when the output exceeds the capacity of one shaft the other can also be used. The average capacity of both shafts together should be not far from 3,000 tons of coal, gross weight. The pit-cars at this mine hold about one ton, gross weight. This is a somewhat larger capacity by 400 or 500 tons than the pit-cars have in the eastern part of the field. The engines hoist a car through the 500 feet to the top landing in ten seconds. Four cars per minute can be hoisted by the engine at either shaft. The ventilating is done by 24-foot forcing fan with straight paddles and spiral-expanding casing.

Fig. 3 shows a profile sketch of the head of a roadway in the mine, illustrating the method of propping and undercutting the coal face, and the settlement of the roof further back.

The settling of the roof is appreciable at the surface even when the seam is at a depth of 400 or 500 feet; but so gradual is it, and without vibration, that the deep mines have caused no trouble in going under railroad tracks, and even under brick buildings, as has been done at La Salle.

Mining Explosives.

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By Prof. Vivian B. Lewis, Greenwich, Eng.

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(Paper before Fed. Institute of Mining Engineers.)

Last winter the writer had the honor of delivering a course of Cantor lectures before the Society of Arts on the subject of "Explosives and their modern Development," and in the last lecture of that course dealt with mining explosives, and showed, to his own satisfaction at any rate, that all explosives which give rise to carbon monoxide as a product of their combustion, ought to be strictly tabooed for use in mines, not only because of the risk of injury to health and life from the poisonous nature of the gas, but also because even small traces of carbon monoxide render mixtures of coal dust and air highly explosive, a point which has, he thinks, been entirely overlooked in all experiments upon this most important subject. In reviewing the properties of the various mining explosives now in use, it will be convenient to classify them according to the way in which they produce the gas which gives the explosive effect. Class I.: Explosion due to simple combustion, as in the case of blasting gunpowder. Class II.: Explosion due to detonation of the whole of the explosive, as in nitro-glycerine, nitro-cotton, and some Sprengel explosives. Class III.: Explosion due to detonation of part of the explosive and combustion of the remainder, as in carbonite, westphalite, &c. This may at first sight seem to be an awkward and unreasonable method of classification, but inasmuch as the claims of any explosive for mining purposes must in the first place be based on its safety as regards the non-ignition of explosive mixtures in the workings of a mine, and as this in turn largely depends upon the way in which the explosive generates its force, the writer prefers to adopt it in view of the considerations he wishes to bring before the members.

The most characteristic types of the first class are ordinary black gunpowder and blasting powder, both mixtures of the combustibles carbon and sulphur with potassic nitrate as the oxidizing material, the great difference between the two being that whilst in ordinary gunpowder the proportions are so arranged as to give great heat energy to the explosion, in blasting powder a slight lowering of temperature is obtained by increasing the proportion of sulphur present, and reducing the oxidizing material, the result being that during explosion, the products of combustion although increased in volume, consist largely of imperfectly oxidized bodies which are themselves inflammable.

Composition of Powders.

	Gunpowder.	Blasting powder.		
		England.	France.	Italy.
Potassic nitrate......	75	65	62	70
Sulphur	10	20	20	18
Charcoal	15	15	18	12
	100	100	100	100

Products of Combustion.

	Gunpowder. Fine grain.	Mining powder.
Carbon dioxide....................	50·62	32·15
Carbon monoxide.....................	10·47	33·75
Nitrogen............................	33·20	19·03
Sulphuretted hydrogen...............	2·48	7·10
Marsh gas	0·19	2·75
Hydrogen....	2·96	5·24
Oxygen	0·08	0·00
	100·00	100·00

Gunpowder itself is practically never used, and the only word that can be said in favor of the blasting powder is that it is cheap. It is absolutely unfitted for use in coal mines, and its abolition would do away with more than three-quarters the number of deaths annually returned as being caused by mining explosives. The great danger attending its use, however, consists in the combustible nature of the products evolved during decomposition, a factor in coal mine explosions which I venture to think cannot be overrated. On firing a charge of 1¼ lb. of blasting powder, over 3 cubic feet of combustible gas, consisting chiefly of carbon monoxide, would be produced, and this when mixed with pure air, would give over 10 ft. of an explosive or at any rate rapidly-burning mixture, and experiments which have been made upon the effects of fire-damp and dust combined in causing colliery explosions show conclusively that even when firedamp is present in such minute quantities as to form a mixture very far removed from the point of explosion, it makes the mixture of coal dust and air highly explosive; and traces of carbon monoxide will do exactly the same thing when the air is laden with coaldust, whilst the temperature of ignition is lower than with methane, so that when the air of the mine is charged with coaldust, the probabilities are that a very large volume of explosive mixture is formed by the rapid escape of the products of combustion into the dust-laden air, and this being ignited either by the flame or by red-hot solid products driven out into it by a blown-out shot initiates a considerable area of explosion. As the explosion takes place, and as the carbon monoxide already produced is oxidized to carbon dioxide by the action upon it of water vapor present, and also by its direct combustion with oxygen, the hydrogen of the water vapor is set free, whilst the heated coaldust also yields certain inflammable products of distillation to the air, and partial combustion of the coal dust gives a considerable proportion of carbon monoxide once more, and this driven rapidly ahead of the explosion, forms, with more coaldust and air, a new explosive zone, and so, by waves and throbs, the explosion is carried through the dust-laden galleries of the mine. In this way any explosive which generates inflammable products of incomplete combustion is unsafe, and should never be used even in mines where firedamp is unknown, as such explosives are quite capable of setting up an explosion with coaldust alone. A still greater danger arises if any trace of firedamp exists in the mine, as this, together with dust, provides an already explosive atmosphere, whilst the products evolved by blasting powder are capable of playing the same part as sulphur on a match, and causing ignition of the explosive mixture. Firedamp, as has been shown by the numerous experiments made since Sir Humphry Davy's memorable researches, is not easily inflamed, and explosive mixtures containing it not only require a temperature of over 1,200 degs. Fahr., but require this temperature to be applied for several seconds, sometimes as much as ten, before ignition takes place. This phenomenon is due to the absolute ignition point of methane being extremely high, far higher than the temperature at which it decomposes into hydrogen and acetylene, and the result is that at temperature such as 1,200 degs. Fahr., decomposition of the methane molecules first takes place, and the liberated hydrogen then igniting raises the mass to the true ignition point of the methane. This dual action requires an appreciable time, and it is this alone which gives the comparative safety in mines where any trace of firedamp exists. If we take the temperature developed by the more prominent explosives, we find them to be far above the ignition point of explosive mixtures of methane and air for a steadily applied heat.

	Degs. Cent.	Degs. Fahr.
Blasting gelatine..........................	3,220	5,828
Nitro-glycerine............................	3,170	5,738
Dynamite	2,940	5,284
Guncotton..................................	2,650	4,802
Tonite.....	2,648	4,7984
Picric acid................................	2,600	4,712
Roburite	2,100	3,812

Whilst the ignition point of explosive mixtures of the various combustible gases which could be present in the working of the mine, either produced by the use of improper explosives, or liberated by the coal, are about:—

	Degs. Cent.	Degs. Fahr.
Hydrogen...................................	620	1,148
Methane....................................	660	1,220
Ethylene	580	1,076
Ethane	605	1,121
Butylene...................................	540	1,004
Carbon monoxide............................	640	1,184
Ordinary coal gas..........................	648	1,198·4

It is manifest, therefore, that if the products of explosion escaped into the mine at this temperature, any explosive mixture in the mine must be ignited. This temperature, however, only exists whilst the gases are under the pressure generated by the explosion, and directly they blow out into the workings, expansion instantly cools them below the temperature necessary to bring about the changes leading to the ignition of mixtures of methane and air, or methane, air and coal dust. It is important that it should be fully realized that the factor of safety entirely depends upon the retarding influence of the chemical changes necessary before the ignition takes place, and it is the absence of this with explosive mixtures of other gases that constitute a real source of danger. Fortunately the inflammable constituent of pit gas is practically only methane, and with the use of proper explosives, *i.e.*, explosives which can be completely detonated, and which give neither combustible products nor burning solids on explosion, a very fair degree of safety is attained. Directly, however, inflammable gases other than methane are introduced, the margin of safety disappears, and with explosive mixtures which contain carbon monoxide, hydrogen, or ordinary illuminating coal gas, the point of ignition being the true one, no time is given for the products of the explosion to cool themselves down below the ignition point, and the gaseous mixture is fired. It will always be noticed that in making trials with various explosives where pit gas is used for the mixture in which the explosive gas is fired, ignition is rare, whilst with mixtures of air and coal gas, ignition is the rule rather than the exception, and surely no one can believe that this depends upon the few degrees higher point of ignition which the methane is supposed to possess, and it is this obliteration of the factor of retarded ignition which makes it imperative to discard any explosives generating combustible products of incomplete combustion for use in fiery mines. It is also evident that the more rapid the explosion the safer will it be, and no explosive should be used which relies upon simple combustion either as the primary or secondary principle in its action. A still greater source of danger found in the explosion of blasting powder is the excess of sulphur which it contains, and which during explosion shows its presence by the evil odour of the escaping gases which contain over 7 per cent. of sulphuretted hydrogen, whilst under certain conditions traces of carbon bisulphide are alzo produced. As has been already pointed out, the ignition point of carbon monoxide is about the same as ordinary coal gas, and may be taken as being 1,134 degs. Fahr., but the vapour of carbon bisulphide has an extremely low point of ignition, and the admixture of only 3 per cent. of its vapour with carbon monoxide lowers the igniting point to below 400 degs. Fahr. Blasting powder and other explosives of the first class should unhesitatingly be discarded, not only as being unsafe in use, but also as deleterious to health, the products of incomplete combustion all having a distinct toxic effect on the system.

Taking now explosives of the second class, we come to nitro-glycerine, nitro-cotton, and some of the Sprengel explosives, and the distinctive characteristics of this division is that all the members of it are capable of complete detonation, provided always that the right sort of detonator is employed. Nitro-glyceriue, which first inaugurated the modern era of high explosives and commenced its career as blasting oil, stands apart from all other nitro compounds, owing to the fact that it contains more oxygen than is necessary to complete the oxidation of the carbon and hydrogen found in its molecule.

Nitro-glycerine. Carbon dioxide. Water. Nitric oxide. Nitrogen.

$$2\,[C_3\,H_5\,(NO_3)_3] = 6\,(CO_2) + 5\,(H_2O) + NO + N_5.$$

The result being that it evolves no combustible products, whilst its rapidity of detonation would make it the safest and best of all the blasting explosives were it not for the danger inseparable from its physical conditions and sensitiveness to shock. Some of the best of the nitro-glycerine class of explosives, such as blasting gelatine, are amongst the worst offenders as regards the evolution of combustible products of combustion, as the deficiency in oxygen of the nitro-cotton employed is not made up for by the excess present in the nitro-glycerine used. Nitro-cotton alone has from time to time been used for blasting work, but in this case we obtain the maximum amount of combustible products. Several explosives have been made on the principle of mixing nitro-cotton with oxidizing materials, but the only one of these still in the market is tonite, in which the generation of carbon monoxide is reduced by mixing the nitro-cotton with mineral nitrates. Such mixtures, however, give rise to a residue of fused salts, which, if blown out into an explosive atmosphere, would be extremely liable to ignite it, whilst although the combustible gases evolved are reduced in quantity they are not done away with. Besides nitro-glycerine and nitro-cotton, such of the Sprengel explosives as are capable of complete detonation come under this group. The Sprengel explosives have been largely used for blasting purposes, both abroad and in this country; those used here consist of mixtures of nitrated hydrocarbons and ammonium nitrate. Roburite, introduced by Dr. Carl Roth, is a simple mixture of nitrate of ammonium with chlorinated meta-di-nitrobenzol. The ammonium nitrate is first dried and ground, then heated in a closed steam-jacketed vessel to a temperature of 80 degs. Cent., and the melted organic compound is added, and the whole stirred until an intimate mixture is obtained. On cooling, the yellow powder is ready for use, and is stored in airtight canisters, or is made up into cartridges. Owing to the deliquescent nature of the ammonium nitrate, the finished explosive must be kept out of contact with the atmosphere, and for this reason the cartridges are waterproofed by dipping them in melted wax. This mixture is not exploded by ordinary percussion, firing, or electric sparks. If a layer of the explosive is struck a heavy blow with a hammer, the portion directly receiving the blow is decomposed, owing to the heat developed, but no detonation whatever takes place, nor are those portions of the substance around the spot in any way affected, whilst if roburite be mixed with gunpowder and the gunpowder be then ignited, the latter explodes and scatters the roburite without firing it. The roburite can only be exploded by a specially powerful detonator, and on decomposition the gases evolved contain no combustible constituents, but consist only of carbon dioxide, water and nitrogen, with a small trace of hydrochloric acid gas, which is at once condensed by the large volume of water vapor evolved, and gives rise to no inconvenience. Ammonite is another explosive of this class, which is manufactured from ammonium nitrate and dinitronapthalene, these substances being blended in the proportions to give as the products of combustion carbon dioxide, water vapor and nitrogen, but during the decomposition taking place, probably some more complex action occurs, as small traces of ammonia can generally be detected. Bellite consists of a mixture of dinitro-benzene with ammonium nitrate, the latter being kept rather in excess. Securite consists of ammonium nitrate and dinitro-benzene, but from the proportion of nitrate used it is probable that carbon monoxide is produced. These cartridges are coated with nitrated resin, in order to protect them from the action of the atmosphere. There is no doubt but that this group of explosives approach more nearly to real safety explosives than any which have yet been introduced. The low temperature of explosion secured by the use of ammonium nitrate, the absence of any combustible products of decomposition—except perhaps with securite—and the fact that both the oxidizing material and the combustible are capable of complete detonation with a sufficiently powerful fuse, give these explosives enormous advantages over any others to be obtained, whilst they are absolutely safe in handling. The safety of the Sprengel explosives in handling and use is to a large extent dependent upon the fact that when the mixture of ammonium nitrate and the nitrated organic body is ignited by ordinary flame, the ammonium nitrate requires a large amount of heat for its decomposition, in order to render the oxygen which it contains available for the combustion of the carbon and hydrogen in the organic body, and the temperature of the burning substance is not sufficiently high to propagate this action throughout the mass, the result being that to cause continued combustion you must have a continuous supply of heat, or the flame first started simply dies out. The effect of this is that in handling, such bodies are practically non-inflammable, and when they are made to explode by detonation, a more than usually powerful detonator has to be employed, so that although with nitro-glycerine mixtures a charge of 7 grains of mercuric fulminate is amply sufficient to produce detonation, such a body as roburite needs at least 15 grains. Moreover, when detonation has been produced, the amount of heat absorbed by the decomposition of the ammonium nitrate causes a very considerable lowering of the temperature of explosion. To the writer's mind it is an absolute *sine qua non* that in an explosive mixture for mining work, all the constituents should be capable of detonation, and the reason for this is that under these conditions the shock of the detonator resolves both the oxidizing and combustible bodies into their respective molecules, and that these then recombine into the gaseous forms which give the explosive force, the whole action being practically instantaneous, and causing the projection of the hot products with such velocity as to give no time for the decomposition of the methane in the pit gas, and the ignition of its constituents. In order to obtain the requisite rapidity of explosion to ensure safety as regards the ignition of gaseous mixtures in the pit, the reacting portions of the explosive must be in the condition of molecular division, and for blasting purposes this can only be obtained by complete detonation. It is impossible to obtain safety by any attempt at mechanical division. An excellent example of this failure of mechanical means is to be seen in westphalite, which is made by mixing 95 per cent. of ammonium nitrate with 5 per cent. of shellac or resin dissolved in alcohol; the alcohol is driven off by heat, and the mixture is ground and made up into cartridges. In this mixture the resin or shellac cannot be detonated, and the presence of the inert material necessitates the use of a No. 9 detonator, containing 2.5 to 3 grains of fulminate, to explode the mixture, and when detonated the ammonium nitrate only is decomposed, and the simple combustion of the resinous matter by the products follows as a secondary reaction, with the result that the period of explosion is very sensibly increased, and the risk of the ignition of the pit gases becomes much greater. The resinous material undergoing combustion is also a source of danger, as, instead of being in a molecular state of division, the smallness of the particles is governed by the degree of fineness to which it is ground, and a blown-out shot would be accompanied by a shower of sparks of the burning resin. The fine condition into which it must be ground must also increase the troubles due to the hygroscopic nature of the ammonium nitrate. In deciding as to the relative claims of the other members of the Sprengel group, ammonium nitrate being common to all, the best will be the one in which the nitrated combustible is the most susceptible to detonation, as this reduces the chance of mis-fires or partial detonation as well as increases the rapidity of explosion, and the writer should expect the chloro-dinitro-benzol used in roburite to answer best to this requirement.

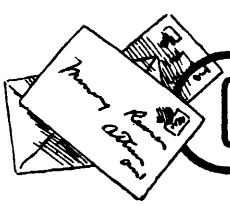
The third group of explosives consists of mixtures of the first and second groups, in which a body susceptible to detonation, and generally of an oxidizing character, is exploded and the products made to act upon a combustible. Westphalite is an admirable example of this group, but the most important member is carbonite, which consists of a mixture of about twenty-five parts of nitro-glycerine, thirty parts of nitrate of pottassium, four parts of nitrate of barium, forty parts of wood meal, and one of carbonate of sodium. On detonation the nitro-glycerine is decomposed and combustion of the wood meal at the expense of some of the oxygen of the nitro-glycerine and the metallic nitrates takes place. There is no doubt that the admixture of so large a proportion of carbonaceous material reduces the temperature of the explosion, but it also makes it one of the worst offenders as regards the generation of combustible products, and if carbonite be exploded in an experimental bomb, the escaping gases can be ignited and will burn with a characteristic carbon monoxide flame, over 40 per cent. of the products of its combustion consisting of this gas. So far carbonite has come out in trials and in practice in a very satisfactory manner, but a blown-out shot in a dusty mine would be quite likely to lead to an explosion, whilst the fumes must be very injurious to health.

For the reasons which the writer has brought before the members, he thinks the selection of a safety explosive should be based upon the following points:—(1) The explosion must be due to detonation and not to simple combustion; (2) if the explosive be a mixture, both the combustible and oxidizing material must be susceptible of detonation; (3) the products of explosion must be non-inflammable and non-poisonous; (4) the explosive must be safe in handling as well as in action, and compounds of an unstable character which are liable to change should be avoided; (5) the temperature of explosion should be as low as is compatible with rapidity of action. The following table gives an idea of how far the explosives most in use comply with these requirements, and it will be seen that the Sprengel explosives occupy the foremost place:—

Mining Explosives.

Name.	How exploded.	Products of explosion.	
		Combustible.	Non-combustible.
Gunpowder	Combustion	14	86
Blasting powder	"	42	58
Nitro-glycerine	Detonation	*nil*	100
Nitro-cotton	"	61	39
Gelignite	" and combustion.	7	93
Carbonite	" " "	41	59
Roburite	"	*nil*	100
Ammonite	"	*nil*	100
Bellite	"	*nil*	100
Securite	"	trace	100
Blasting gelatine	"	46	54
Tonite	" and combustion.	8	92
Westphalite	" " "	trace	100

Given an explosive which answers to these requirements, and using electric firing, with detonators containing sufficient fulminate unmixed with chlorate of potash, to ensure complete detonation, ought to reduce accidents from explosives to a minimum.



CORRESPONDENCE

The Slocan District, B.C.

The Editor:

SIR,—The district especially under consideration is that portion of the British Columbian Selkirks which lies between the Kootenay and Slocan lakes. Of this district, the mountains drained by the creeks flowing into the east side of Slocan Lake have, so far, been found to be the best mineralized. In the formations which surround the Carpenter Creek and its three branches, the great majority of the producing silver mines are situated. These are usually galena, silver bearing, within a calciferous slate formation, or in the near neighborhood of such rock. Some few mines carry dry ores of silver, but these are more often found in the granites or the crystalline rocks which make up the massive formation of this district. When so found, the silver occurs as native silver, ruby silver, sulphide of silver, grey copper carrying silver, and other combinations less readily determined.

In 1891 the first movement was made into this country, and this being before the last fall or "slump" in silver, caused some considerable excitement and progress. Since that time prospecting and development have gone steadily on, as there are here bodies of ore so rich that it still pays well to mine them.

This summer a large amount of work is being done towards increasing the ease of getting out the ore, whereby mines which formerly had to pack in supplies and pack out ore several miles, will now be able to construct tramways down to the railroads, or, at least, short waggon roads, thus making their mines more profitable, and producers all the year round, which was not the case before, for but little ore was shipped after the snow season of the winter.

Dealing more particularly with the ore-producing mines, the galena-silver properties take the lead, chiefly because they are of greater body and extent, giving more encouragement to mining companies to work permanently, but besides this, until the prospecting of the present season, the richer leads carrying dry silver ores and gold, had not been discovered.

Concerning the producing mines of the Slocan, tributary to the Nakusp and Slocan railway, the following is a quotation from the New Denver *Ledge*:—

"From the initial shipment of September 13th, till January 1st, 1895, the Slocan mines sent out over the Nakusp and Slocan railway:—

	Tons.	Valued at.
Alpha mine	771¼	$ 77,125
Mountain Chief	91¼	9,125
Slocan Star	1031½	103,150
Fisher Maiden	47¾	4,775
Noble Five	87	8,750
Minnesota Silver Co	15	1,500
Reco	42¼	4,225
Idaho	60	6,000
Last Chance	15	1,500

This does not include the heaviest shipments made by the Concentrator Co., of Three Forks, who handled some 6,000 odd tons during the winter.

Also, it will be seen that the values given above are simply nominal, being the customs valuations upon these ores which are shipped mainly to the Omaha smelters.

Besides these mines many small shipments were made from properties worked in a small way by the original locaters. Their output being heavily handicapped by the high rates for pack animals and feed.

Since May active work has been going forward in the opening up of this district by the extension and improvement of roads already built, and by the construction of the Kaslo and Slocan railway, a narrow guage line which taps the Slocan Star and Cody Creek group, and gives the ore an outlet by way of Kootenay Lake at Kaslo, twenty-five miles eastward. The C. P. R. also is now engaged in building an electric tramway from Three Forks to Sandon, to draw ore from the same rich mines.

The Concentrating Co., a Duluth syndicate, owning the Idaho and Alma groups, have this summer constructed a three-rail tramway some 7,000 feet long, by which to supply their concentrator, which has a capacity of 100 tons a day.

The now famous Slocan Star will also have a tramway and concentrator put up before winter, and in time most of the principal mines will find it necessary to concentrate some of their ore, which is of too low grade to pay under the present expensive shipment, and is thrown on the dumps.

Under the influence of the improved shipping facilities it is expected that this winter's output will be much increased, as the ores can be shipped and treated at the Tacoma smelters for $24 a ton, leaving a large margin for the expenses of getting it out, when it runs, as it usually does, from $100 to $200 a ton in silver with from 50% to 75% lead. These ores carry very little zinc and silica. They are usually hand-picked and shipped in small sacks carrying between one and two hundred pounds. A sack sample being made and assayed in order to check the smelter's returns.

During the last three months much prospecting has been done along the creeks flowing into the Slocan Lake from the east.

This country is composed chiefly of granite with bands of other igneous rocks, and some masses of a quartzitic nature impregnated with iron. There is an absence of the limy slates characteristic of the galena-silver basins.

This formation carries dry ores such as contain native silver, silver sulphide, argentiferous grey copper, and other mineral combinations of silver not so readily determined. With these is usually a fair showing of gold and in some the gold is free and visible, but more usually it appears to be in combination with various sulphides.

The L. H. is a property which is highly mineralized with arsenical iron. This carries gold. Along the foot wall of this band of rock there occur pockets of arsenic; these contain silver up to 1,000 oz. a ton.

Upon Springer Creek and Ten Mile Creek, which flow into the lake near its southern end, are several very rich properties which carry native silver and sulphides to the value of over 1,000 ozs. to the ton, and over $100 in gold. These, however, have been found but lately, and it is for the future to show whether their early promise is carried out when actual mining begins. As far as can be seen at present they are true fissure veins, and being in the granite are likely to hold their size with some regularity.

These favorable locations have caused considerable excitement in the district but have failed so far to direct the attention of capitalists who steadily pour into the Rossland county.

Under the present mining laws the acquisition of claims is made very simple and easy. Any man holding a miner's certificate, (which costs $5), can locate as many properties as he desires, provided they are not, any two of them, upon the same ledge. Each location being 1,500 feet square. By this means many claims are recorded which will not justify the expense of their development, and such are termed "wild cats." Their value being nil until the expected boom comes along, when anything showing mineral appears to sell quite readily, as the present summer's experience around Rossland seems to show. These claims being held for one year under a light assessment of development work, excuse the speculation.

Nevertheless, out of the prospectors' assays made this summer at New Denver, of which there have been some 350 since June 1st, nearly 50% of those made for silver have carried over 100 ozs. in silver, some have shown nothing at all owing to the ignorance of the locator as to what constitutes ledge matter, and many have carried gold in quantities ranging from a trace to $150 a ton. These prospectors, as usual, are rarely able to bear the expense of the development of their claims, and yet hold them at somewhat high figures considering their undeveloped character. They are more readily dealt with by means of bonding the property, or selling an interest for cash, which latter means enables them to take out some ore, for which they can get the smelter returns and at the same time determine the character of the mine and its dividend-paying possibilities.

J. C. GWILLAM.

New Denver, B.C., 20th August, 1895.

NOVA SCOTIA NOTES.

It is with the deepest feelings of regret that we have to record the death of Mr. J. M. Reid, late manager of the Oxford gold mine, at East Chezzetcook. Mr. Reid developed symptoms of consumption last year in consequence of which he had to give up the management of the Oxford mine. He then travelled to Colorado, California, and North Carolina, where he died. Mr. Reid was 31 years of age, and was manager of the Oxford mines for 10 years, during which time he made many friends.

A company is being promoted by Messrs. C. E. Willis and G. J. Partington to take over the Oxford gold mines. Mr. Partington is the resident manager and has started work already.

All previous records were beaten at the Mines office by Mr. F. W. Christie, who has taken up 860 gold mining areas in the neighborhood of Brookfield, Colchester Co. It is reported that these areas have been taken up for London people, who are interested in a cyanide process for extracting gold. No one is more anxious than ourselves to see a good strong English company operating in Nova Scotia, but we would like to see them in a good district or not at all, and we cannot say that we hail the venture with delight. Nova Scotia, through no fault of its own, has a bad enough name on the other side of the Atlantic. We do not think the investment of British capital in gold areas in the neighborhood of Brookfield, Colchester County, will be likely to improve it.

Mr. W. R. Thomas has relinquished the management of the Nova Scotian Gold Mines, at Montague, to take over the management of a copper mine at Pulcilo, in Portugal, for an English company. We congratulate Mr. Thomas, and feel sure he will be more in his right sphere now he has returned to copper mining.

Mr. George W. Maynard, M.E., of New York, has been in the province for some time investigating gold and iron properties. He is making a series of mill tests of the barrel quartz lead at Waverley, and is also examining iron properties at Middleton.

Mr. J. E. Hardman has resigned the management of the Tudor Gold Mining Co. at Waverley.

Mr. W. F. Libby still continues his success at the Brookfield (Queens Co.) mine. 648 oz. in three months is a very good record.

The Mining Society of Nova Scotia have taken a large room under the Queen Hotel, 107 Hollis Street. The room has been prettily fitted up and members appreciate the change.

Mr. A. A. Hayward has taken up 150 areas adjoining the Golden Lode mine in South Uniacke.

The Halifax *Herald* of Aug. 22nd is responsible for the following:—"From a correspondent in Port Morien the *Trades Journal* received a short account of a fatal accident which occurred on the Dominion Coal Co.'s railway at that place last Tuesday. Mr. Evans, the superintendent of the mine, was in the habit, so it is stated, of running the locomotive occasionally. On Tuesday, while handling the locomotive, something went wrong, and in some way Hector McLean, the brakeman, was killed. An inquest was held and the jury returned a verdict of manslaughter, and, as a consequence the superintendent was sent to jail."

It is proposed to organize a company to start a mill for the purpose of grinding the gypsum at Gay's River.

A suit for a large sum of money, nearly $700,000, has just been started in the Supreme Court by the American Trust and Loan Co. against the Eastern Development Co., who own the Coxheath copper mine near Sydney, C.B.

MISCELLANEA

The Safety of the Miner's Calling.—The disastous effects of occasional colliery explosions is apt to lead to the belief that the miner's calling is more dangerous than any other occupation. Official statistics, however, clearly prove the error of this assumption. On turning to the collieries, which are usually regarded as the most dangerous mines, it will be found that the amelioration of the lot of the collier in recent years, owing to the lessening of the number of accidents, is most gratifying. In the 10 years from 1833 to 1842 the average number of lives lost by accidents amounted to 4.1 per thousand colliers employed. In 1853 to 1862 this proportion sank to 3.4, in 1863 to 1872 to 2.0, and in 1883 to 1892 to 1.8, whilst in 1893 to 1894 the proportion did not exceed 0.9 per thousand. In other words, since 1833 fatal accidents have decreased 75 per cent. In metal mines the mortality from accidents has remained nearly stationary, and amounts to 1.3 per thousand. Thus the collieries with their fire-damp and other noxious gases, their dust explosions, and their mine fires, present greater safety than metal mines. This apparnet anomaly is explained by the fact that in the small metal mines improvements are more slowly introduced and carelessness is more prevalent than in the larger well-managed collieries where there is constant supervision day and night.

It is still more remarkable to find that coal mining is less dangerous than many other avocations. The German official statistics show that the milling trade is just as dangerous as coal mining, for the lives lost by accidents averaged 0.9 per thousand millers employed. On railways and in breweries the deaths average 1.3 per thousand, while carters and warehouse men have a still higher average—1.5 per thousand. Coachmen are subjected to greater dangers, the accidental deaths being 2.0 per thousand whilst with men engaged on river barges the average is 2.1, and in sea-going vessels 2.2 per thousand. These figures, it must be noted, do not include fishermen, whose work is the most dangerous of all. The English statistics for 1883 to 1892 show that the deaths of sailors caused by accidents on steamers were 4.8 per thousand, and those of mariners and fishermen were 7.7 per thousand. Thus the collier working underground is eight times safer than his fellow worker on the sea.

Coal mining is a calling that brings little sickness in its train. Dr. Ogle, the eminent authority on mortality statistics, brings forward evidence to show that, if accidents are excluded, the mortality of coal miners only slightly exceeds that of the most healthy class of men, the agricultural laborers. Taking the years of age between twenty-five and forty-five, he gives the following comparative figures as the mean annual death rates per thousand living:—All males, 10.16; coal miners, 7.64; ironstone miners, 8.05; tin miners, 14.77; butchers, 12.16; plumbers and painters, 11.07; tailors, 10.73; shoemakers, 9.31; and agricultural laborers, 7.13.

As would naturally be expected, breathing bad air or working in constrained positions are frequent causes of disease among miners, and Dr. Snell contends that the disease of the eyes known as nystagmus is prevalent among colliers who have to work lying on their sides. It is curious to note that as regards tendency to insanity, miners favorably contrast with persons engaged in other callings. The recently published report of the commissioners on lunacy, show that for every 10,000 miners given by the census the annual average of admissions to asylums in 1889-93, did not exceed 4.4. In the case of costermongers and peddlars, who head the list, it amounted to 20.1; flannel merchants and cotton warehousemen come second, the proportion being 18.2; then follow physicians and surgeons with 15.8; chemists and druggists with 14.1; lawyers with 13.5 and architects, surveyors and builders with 5.9; whilst in the case of navvies and railway laborers the proportion sinks to 4.8. These figures are very curious, and the position occupied by miners on the list is most remarkable. The statistics are certainly encouraging, for they show that the coal miner's calling is a healthy one physically and mentally.—*Colliery Guardian.*

Silver Smelting in British Columbia.—By the decision of the Consolidated Kansas City Smelting and Refining Company to put in a large smelting plant at Nakusp, West Kootenay, the smelting industry may be considered as soon to be put upon a satisfactory basis in British Columbia. The Company referred to is one of the most important in the United States, and would not have decided upon taking such a step unless is was perfectly satisfied that the position of things fully justified it. The inducement offered by the Dominion Government in the shape of a bonus on every ton of ore smelted in the Province, has undoubtedly had a beneficial influence in the matter. It is also a proof that the Company is satisfied both as to the supply of dry ores, obtainable in the district, being ample for its requirements, and also that it can find a market for the lead produced at prices that will be remunerative.

The smelter at Pilot Bay appears to be overcoming the difficulty which was first encountered of getting a sufficient supply of dry ores and, therefore, that may be considered as an enterprise firmly established. With the third smelter which the Hall Mines Company has decided to erect at Nelson, principally for the treatment of the ore from the Silver King mine, there will be three smelting works in operation in West Kootenay, and we may, therefore, now consider that the smelting industry will, in a short time, be a most important factor in the development of the wealth of one of the most important mineral sections of this Province.—*Statistic News Advertiser.*

Mineral Shipments from Trail Creek, B.C.—From statistics furnished by the local Customs officials the following is the estimated amount and value of the shipments of gold, silver and copper ores shipped from the Trail Creek district for the fiscal year ending June 30th, 1895. Although for twelve months, yet almost the whole of the shipments have been made during the last five months:

Gold	20,510 ounces	$400,200.00
Silver................	29,804 "	21,802.30
Copper	925,693 pounds	46,372.65
Total value............		$468,374.95

A New Coal Calorimeter.—In a paper presented to the American Society of Mechanical Engineers at Detroit recently, Mr. R. C. Carpenter describes an instrument for determining the heating value of coals. In principle it is a large thermometer, the combustion taking place in the bulb and the heat being absorbed by the liquid in the bulb, the heat causing the liquid to rise in a glass tube extending upward outside. The fuel is placed in a dish in the bottom of the combustion chamber, and is fired by an electric current through a platinum wire, and oxygen is supplied through a tube. The discharge gases pass through a long coil of copper pipe.

The Down-Draught Furnace for Steam Boilers.—At the meeting of the American Society of Mechanical Engineers, Mr. W. H. Bryan, St. Louis, described the down-draught boiler furnace invented by M. C. Hawley, of St. Louis, which is said to have done more than any other mechanical device towards the solution of the smoke problem. In this furnace the fire burns downward, instead of upward, the coals being sustained upon grates which are water tubes connected with the water circulation of the boiler. The air enters the furnace above the fire, and passes down through it. Some of the coals drop down through the grate, and are burned upon a grate below with an upward draught, the gases from both the fires passing onward together to impart their heat to the boiler. It is said that 90 per cent. of the furnace work is usually done by the upper fire with the down draught.

Welding Nickel Steel.—H. P. McIntosh, the secretary of the Canadian Copper Company of Cleveland, has this to say regarding some trials the company has made recently in welding nickel steel: In each trial two pieces, each one inch square by six inches, were welded together with a lap weld, with the following results:—No. 1.—Samples containing nickel 2.05 per cent. and carbon 0.22 per cent. cut like soft steel, welded perfectly, with no sign of weld showing; bent twice at right angles at the weld when hot, weld did not open nor was any crack noted; bent at right angles when cold, failed to show any crack at weld. No. 2.—Samples containing nickel 3.25 per cent. and carbon 0.16 per cent. worked exactly like No. 1, same tests, no crack seen; welded perfectly. No. 3.—Samples containing nickel 3.40 per cent. and carbon 0.31 per cent. cut a trifle harder, also hammered like a harder steel, welded perfectly, bent hot and cold like No. 1, showed no crack, weld cannot be seen. No. 4.—Samples containing nickel 2.62 per cent. and carbon 0.19 per cent. worked exactly like Nos. 1 and 2, same tests did not show any weakness at weld. No. 5.—Samples containing nickel 3.20 per cent. and carbon 0.54 per cent. worked a little harder, but gave perfect, solid weld; no cracks on bending hot and cold. No. 6.—Samples containing nickel 3.10 per cent. and carbon 0.96 per cent. worked harder, *i.e.*, like a tool steel, welded perfectly, no cracks on bending hot and cold. No. 7.—Samples containing nickel 4.95 per cent. and carbon 0.51 per cent. worked like No. 5, not so hard as No. 6, perfect weld, no cracks on bending. In general, the percentage of nickel does not affect the welding power at all. The steel must be treated like any other steel, using more care with the higher carbon.

The Great Water Wheels at Niagara.—The three wheels now set and completed for the Niagara Falls Power Company were designed by Faesch and Piccard, of Geneva, Switzerland, and were built under contract with the I. P. Morris Company, of Philadelphia. They consist of two Fourneyron turbines, one being set inverted and vertically over the other, so as to neutralize weight on the step or bearing. Each of these twin wheels is, moreover, made three stories high or deep, and the speed gate consists of a cylindrical rim, moving up and down on the outside of each wheel. To further neutralize weight on the upper bearing of the shaft, the water from the supply tube is allowed to pass through the disc of the upper guide wheels, and to act vertically upward upon the disc of the upper turbine wheel. The disc of the lower guide wheel is, on the other hand, solid, and the weight of water upon it is supported by three inclined rods passing through it and the wheel casing. These wheels will discharge 430 cubic feet per second, and, acting under 136 ft. of fall from the surface of the upper water to the centre between the upper and lower wheels, will make 250 revolutions per minute; at 75 per cent. efficiency they will give 5,000-horse power. The turbine wheels are made of bronze, the rim and buckets forming a single casting. The shaft is a steel tube 38 in. diameter, except at points where it passes the journal bearings or guides, at which it is 11 in. in diameter and solid. A heavy flywheel was originally designed to be mounted on this shaft, to enable the governor the better to control the speed of the wheel, but has been replaced by the revolving field of the dynamo.—*Cassier's Magazine.*

Limitation of Explosives.—Mr. Frank Clowes, Professor of Chemistry in the University College, Nottingham, read, before a recent meeeting of the Institution of Mining Engineers, an interesting paper on "The limtiing explosive mixtures of various combustable gases with air," and gave as the conclusions of his experiments—1. When mixed with atmospheric air at ordinary atmospheric pressures different combustible gases show different limiting explosive proportions. 2. The range between the lower and upper explosive mixtures is least in the case of methane or fire-damp. The range is widest in the case of hydrogen, but carbonic oxide shows an almost equally wide range. The limits in the case of water gas are widely separated; with coal gas the range of explosibility is less. 3. The tendency to explode is greater when the mixture is fired from below than when it is fired from above. Hence the lower-limit mixture contains less gas, and the upper-limit contains more gas, when the mixture is fired below than when it is fired above. 4. Since the risk of explosion occurring when a gas is mixed in unknown proportion with air is diminished as the limits of explosibility approach one another, the gases which were employed in these experiments may be placed in the following order of increasing danger:—Marsh gas, ethylene, coal gas, water gas, carbonic oxide, hydrogen. 5. In every case the danger of an explosion resulting from a naked flame being brought into contact with a mixture of unknown composition is greatest when the flame is applied to the bottom of the mixture than when it is applied to the top.

This paper was followed by another from Mr. Clowes, on "The change of Composition Produced in Air by Flames and by Respiration." As the result of experiments, he stated that the proportion of oxygen left in the residual air corresponded to that contained in the artificially produced athmosphere which had previously been found to extinguish each flame. Further, that the composition of the extinctive atmospheres left by the common wick-fed flames was very similar, and closely corresponded with the composition of expired air. A coal-gas flame, however, was able to reduce the proportion of oxygen in the air to a considerably greater extent than ordinary, wick-fed flames; while the hydrogen flame diminished the oxygen in the air to about one-third the amount left by these flames, and to one-half that left by the coal-gas flame. The combustion of fire-damp (marsh gas) produced an effect on the composition of the air which was very similar to that of the wick-fed flames. The results obtained by Dr. Haldane on the respirability of atmospheres of various composition prove that the air in which the wick-fed flames or the flames of fire-damp had burnt until they became extinguished was respirable not only with safety, but even without inconvenience. This was also true of air which has been once breathed, and which extinguishes ordinary wick-fed flames. Dr. Haldane further maintains that no permanent injury to health would result from breathing such atomspheres for some time. It follows that the extinction of the flame of a candle or a safety-lamp in air did not prove such air to be unfit for respiration, and that accorded with the experience of many practical miners.

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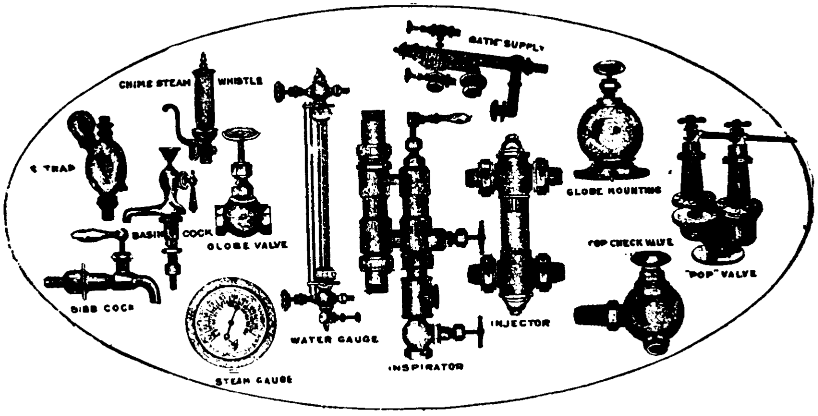

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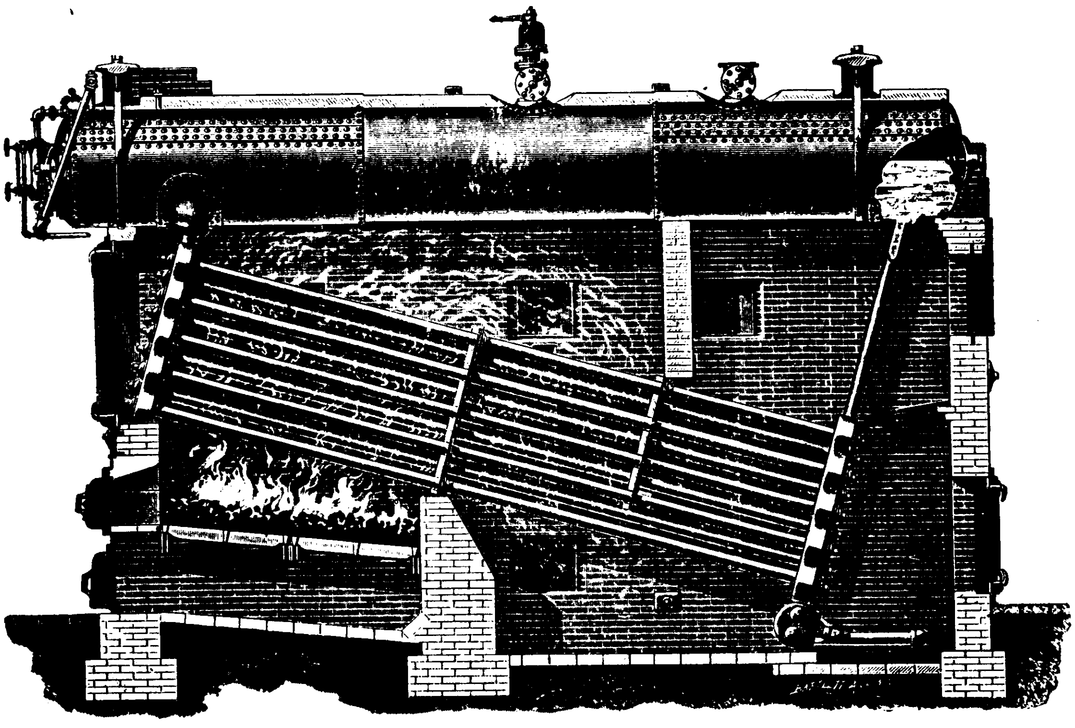

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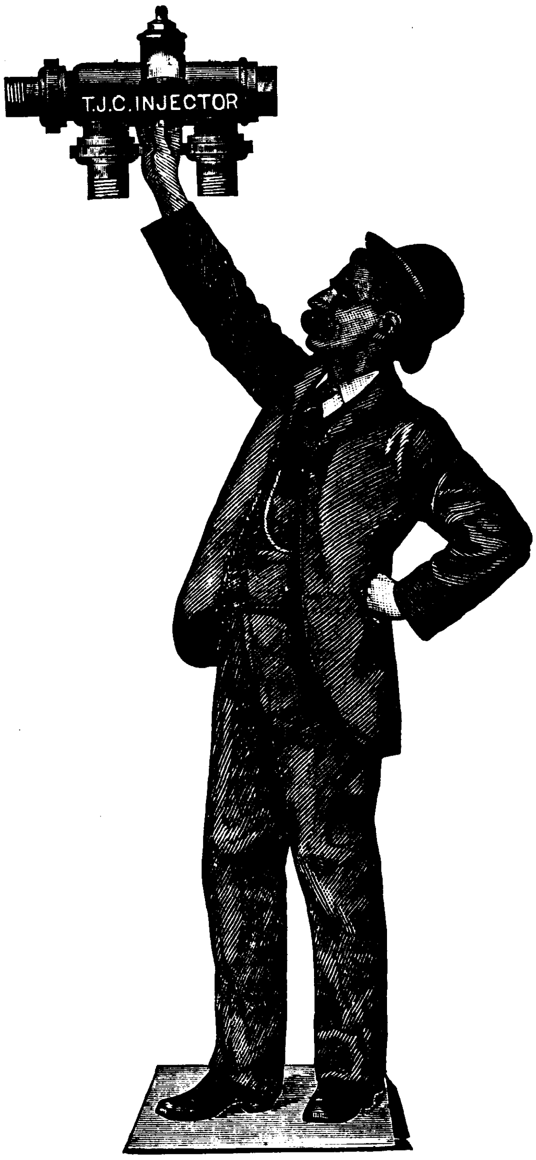

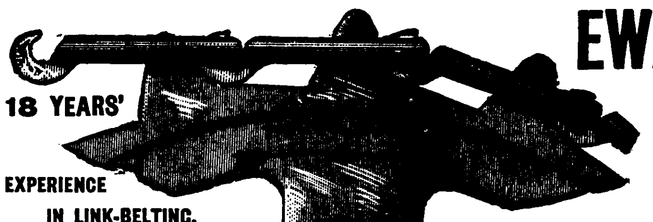

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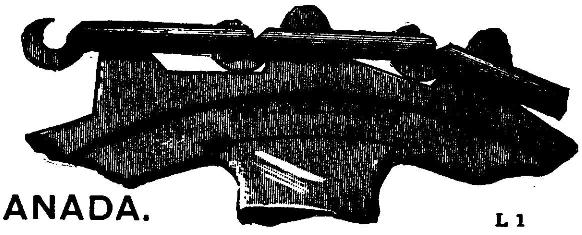

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   - (B) Analytical Chemistry and Assaying.
2. *Four Years' Courses for a Degree in*
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   - (B) Chemistry and Mineralogy (B. Sc.)
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3. *Post-Graduate Courses for the Degree of*

   Doctor of Science (D. Sc.)
   For further information see the calendar of Queen's University for 1894-95, p. 117.
4. *Prospector's Course.*

   The School offers to Mine Foremen, Assayers, Prospectors and Mining Men generally, Special Courses of Instruction beginning January 8th, 1896, and continuing eight weeks.
5. *Extramural Classes for Prospectors and Mining Men.*

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The School is provided with well equipped Laboratories for the study of Chemical Analysis, Assaying, Blowpiping, Mineralogy, Petrography and Drawing. In the Mining Laboratory recently built the operations of Crushing, Amalgamating, Concentrating, etc., can be studied on a large scale.

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PRECIOUS STONES.

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GOLD AND SILVER.

Under the provisions of chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents annually for each area contained in the lease it becomes non-forfeitable if the labor be not performed.

Licenses are issued to owners of quartz crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted gold valued at $18 an ounce.

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

MINES OTHER THAN GOLD AND SILVER.

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

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

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

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

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones; five per cent.; Coal, 10 cents on every ton sold.

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

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

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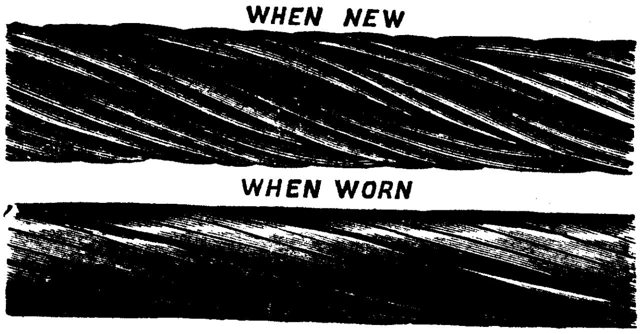

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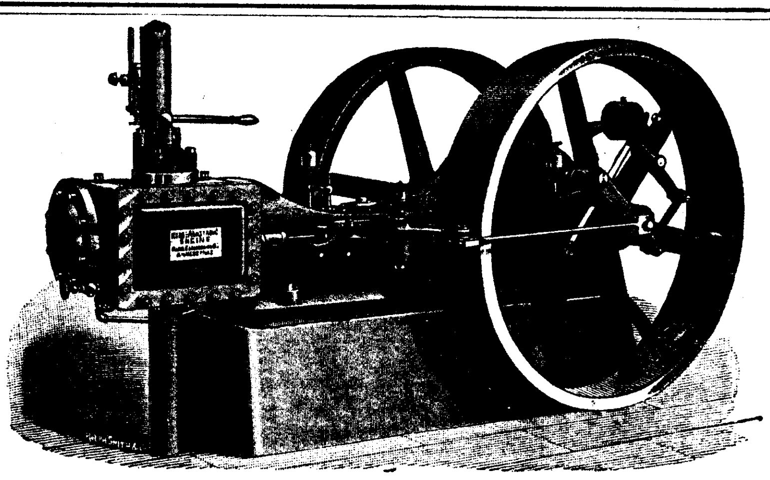

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