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The Canadian Mining Review

Established 1882

Vol. X.—No. 10. 1891—OTTAWA, OCTOBER—1891. Vol. X.—No. 10.

PROVINCE OF NOVA SCOTIA.

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

—AND—

PRECIOUS STONES.

TITLES GIVEN DIRECT FROM THE CROWN, ROYALTIES AND RENTALS MODERATE.

GOLD AND SILVER.

Under the provisions of chap. 7, Revised Statutes of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of six months, which can be extended by renewal for another six months. Mines of ld and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. Up to ten areas the cost is 50 cts. per area, for every area in addition in same application 25 cents. Cost of renewal one half the original fees. Leases of any number of areas are granted for a term of 21 years at $2-00 per area. These leases are fo feitable 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 in smelted gold valued at $18.00 an ounce.

Applications for Licenses or Leases are receivable at the office of the Commissioner of public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of 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 s:arch for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which one square mile 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 free of charge, and provision is made for lessees and licensees whereby they can acquire promptly either by arrangement with the owner or by arbitration all land required for their mining works.

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

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

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

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

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

THE HON. C. E. CHURCH,

Commissioner Public Works and Mines,

HALIFAX, NOVA SCOTIA.

Ontario Mining Laws.

The following is a summary of the chief provisions of the amendments to the Mining Laws of Ontario, passed during the Session of 1891:

1. In Algoma, Thunder Bay, Rainy River and that part of Nipissing north of Lake Nipissing and the French and Mattawa Rivers, the price per acre of mining lands sold after the 4th day of May, 1891, is $4.50 in a surveyed township, and $4 in an unsurveyed territory, if within 12 miles of a railway, and if beyond that limit $3.50 in surveyed and $3 in unsurveyed territory. Elsewhere the price is $3 in a surveyed township any part of which lies within 12 miles of a railway, and $2 if at a greater distance.

2. Instead of by grant in fee simple, mining land may be obtained under a ten years' lease at a per acre rental, unless otherwise fixed by regulation, of $1 for the first year and 25 cents yearly thereafter if north of Lake Nipissing and the French and Mattawa Rivers, or of 60 cents for the first year and 15 cents yearly thereafter, if situated elsewhere, with right of renewal at the expiration for an additional ten years at the same rentals, and with a right of renewal thereafter every twenty years, subject to payment of the yearly rent charge in advance and to such conditions as may be provided by regulation. But the lessee may at any time purchase the land so held, in which case the first year's rent shall be treated as part of the purchase money.

3. The owner or lessee of mining land sold or leased by the Crown after the 4th day of May, 1891, is required during the first seven years to expend in actual mining operations $4 per acre if the location exceeds 160 acres, and $5 per acre if it is 160 acres or less.

4. After the 4th day of May, 1891, all ores or minerals of silver, nickel, or nickel and copper, taken from lands sold or leased by the Crown, are subject to a royalty of 3 per cent., and all other ores or minerals to such royalties as shall from time to time be fixed by Order-in-Council, not exceeding in the case of iron 2 per cent., and as to any other ores or minerals not exceeding 3 per cent.; and such royalties shall be calculated upon the value of the ores at the pit's mouth. But royalties shall not be imposed or collected upon any ores until after seven years from date of the patent or lease, except as to mines known to be rich in nickel, and as to these not until after four years.

5. Hereafter in all lands sold under the Public Lands Act, or for agricultural purposes, all minerals and mining rights are reserved to the Crown, unless otherwise provided in the patent or grant.

6. In the case of mining lands for which bona fide application was made in writing to the Department prior to the 24th April, 1891, grants may be made where the application is received within three months from the 4th day of May, 1891, and otherwise at the price and upon the conditions heretofore applicable in accordance with the terms of section 1, sub-section 5, of the Act of 1891.

ARCHIBALD BLUE.
Director.

OFFICE OF THE BUREAU OF MINES,
Toronto, May 21, 1891.

This advertisement will not be paid for if published without authority.

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Notes on Some Alloys.

The relations of aluminum with manganese are important. Their combining equivalents are as 1 : 2. Their sesquioxides are isomorphous; that of manganese forms, with potash, sulphate or ammonia, octahedral crystals having the constitution of common alum. In some deposits of earthy hematite the manganese content is remarkably variable, ranging from 2 to 10 per cent. and attended with some variation in the percentage of iron. The genesis of this material has another interesting fact to account for in the immense covering of manganese nodules spread over the ocean floor, according to the revelations of the submarine depths given to us by the "Challenger" expedition. Diaspore in the chrysoberyl series, of the composition H_2O, Al_2O_3, may be put alongside of manganite in the same series, of the composition H_2O, Mn_2O_3. The efficiency of manganese in the blast furnace and Bessemer converter is in part due to its specific heat 0·1217, while that of iron is 0·1138. Aluminum in the foundry cupola behaves differently from manganese towards combined carbon, setting free a portion of it when the metal begins to cool, to pass into the graphitic form. Manganese is said to enable cast metal to hold more carbon in solution, and thus favors chill and extreme hardness. This hardening property of manganese may be contrasted with the toughening quality of aluminum. The latter seems to be due to its effect upon the grain, producing fineness of texture. Manganese is claimed to harden steel to withstand abrasion, as for the grinding parts of rock mills, to an extraordinary degree; and special parts of machines are now supplied carrying different percentages of manganese alloyed with steel.

Aluminum has recently entered into two new partnerships for definite purposes. As an alloy with the composition known as aluminum bronze, it has so greatly improved the old firm as to raise its credit as high as German silver. It is claimed to be less corrodible than even nickel-silver. Its composition is, manganese 18%, aluminum 1.20%, silver 5%, zinc 13%, copper 67.5%. The other alloy has been but recently announced. It is a combination of aluminum and that strange metal, titanium, and of which nothing is as yet made known, but just such a character as might have been expected—that it is extremely hard while retaining some of that character for lightness which aluminum has.

Other alloys have lately been pointed to by Prof. Roberts-Austen, which should have some consideration from Canadian experimenters. Molybdenum he says, should be produced as cheaply as tin, and as it exists in the form of molybdenite in considerable quantity in this country, it will no doubt repay the investigation of its alloying combinations. The mineral is said to be extensively disseminated among rocks in the vicinity of Jones' Falls on the Rideau Canal, and in other sections of the Province of Ontario. Zirconium attracts attention as a metalloid which (in so small a combination as one-fifth of one per cent.) imparts great strength to gold. Zircon crystals have been found in considerable quantity in the township of Sebastopol, County of Renfrew. The subject of these and other alloys demands attention in our mining schools, for the purpose of leading the minds of students to the unexplored fields where research and ingenuity may reap rich rewards by giving to industrial processes new materials for further attainments in the arts.

The newly announced alloy of aluminum and titanium discovered by Prof. J. W. Langley, is of little greater specific gravity than pure aluminum, the amount of titanium used being very small. The alloy has a resilience and spring which will make it of use for many purposes, and it is claimed that when rolled or otherwise worked it shows a greater degree of hardness than in the cast form.

EN PASSANT.

Our next issue will contain a very full and graphic description of the "Mineral Resources of New Brunswick," from the pen of Prof. L. W. Bailey, Fredericton, a valued worker on the staff of the Geological Survey of Canada, who has given special attention to the examination and investigation of this interesting field.

From the Geological and Natural History Survey of Canada we have to acknowledge the Annual Report for 1888-9. It consists of ten separate reports, with maps and illustrations, relating to the geology, mineralogy and natural history of various sections of the Dominion. The present volume includes: "An Exploration in the Yukon and Mackenzie Basins," by R. G. McConnell; "An Exploration of the Glacial Lake Agassiz in Manitoba," by Warren Upham; "On the Mineral Resources of the Province of Quebec," by Dr. R. W. Ells; "The Surface Geology of Southern New Brunswick," by R. Chalmers; "Chemical Contributions from the Laboratory of the Survey," by G. C. Hoffman; "Mining and Mineral Statistics," by E. D. Ingall and H. P. Brummell; "Annotated List of the Minerals occuring in Canada," by G. C. Hoffman; and a very valuable report "On a Portion of the West Kootenai District, B.C.," which we reproduce elsewhere. The whole volume may be obtained for two dollars, while any of the reports enumerated may be had for from twenty to thirty cents each. We heartily commend the new volume to the attention of all our readers.

In the course of a fortnight we are promised a work of great interest on the subject of "The Phosphates of the World," from the pen of Dr. Frances Wyatt, New York. We hope to be able to fully review this comprehensive and valuable treatise in our next issue.

Wilder's patent for an aluminum alloy, composed of zinc, tin and aluminum, has been acquired by a company operating on an extensive scale at Hampton, Ia. Being free from iron this alloy is incorrodible, and it is said that it will cost less than first quality tin-plate, will be supplied in larger sizes, and will thus cost less for soldering.

From a recent report of the United States Consul in New Caledonia, it appears that in an area of 2,000,000 square kilomètres the nickel-producing area is about 800,000; that of this 80,000 kilomètres have been granted to mining companies and that about 20,000 kilomètres are being actually worked. The composition of the nickel ore is hydrated silicate of nickel and magnesia, without any trace of arsenic. It contains from 8 to 10 per cent. of metal, some samples containing as much as 16 per cent. The value of the poorer ore at ports of shipment is now £4 per ton. The mines are said to be inexhaustible. The exports of ore last year from New Caledonia were: Nickel ore, 5,000 tons; chromate of iron, 1,500; cobalt, 700; gold quartz, 210; and small quantities of nickel, silver, lead and copper. These exports, however, will increase, as orders have been received for large quantities, the Creusot works alone ordering 100,000 tons of nickel ore. Foundries and furnaces are being erected near Noumea for the treatment of the ore.

A recent United States Census Bulletin on graphite gives the production of this mineral in the United States, for the year 1889, at 7,000 short tons, of which one half was got in New York State. The crude ore is valued about $12 a ton and the cost of mining in New York stated at $5.30 and in Pennsylvania at $6 a ton. The yearly production of refined graphite is an apparently steady average of 400,000 lbs. valued at 8¼ cents a pound. The importation over five years was little in excess of the home production, being 7,240 long tons, yearly average, valued at $45 a ton. Besides the well known uses for pencils, crucibles and stove polish, a large use of graphite is now made for lubricating the bearings of heavy machinery. Grooved bushings in the boxes are filled with a composition of 75 per cent. graphite. As a substitute for red lead in packing joints it has the advantage that it does not harden and makes a tight joint that opens easily under the pipe tongs. It also makes a durable paint for smoke-stacks, boilers, tin roofs and other metal surfaces. It is probable that the value of the graphitic schist mined for the Dixon Crucible Company in New York State and the cost of mining are correctly given, but it may be doubted if the quantity of refined graphite manufactured in the United States is correctly reported.

The first volume of the *Journal* of the Iron and Steel Institute for the present year is just to hand, and as usual contains a vast amount of information of value to the iron and steel trades and their affiliated industries, compiled by its energetic editor, Mr. Jeans. Besides the Presidential address of Sir Frederick Abel, the *Journal* contains papers on "Tests for Steel used in the Manufacture of Artillery," by W. Anderson, D. C. L.; "Automatic Methods of Observation in the use of the Le Chatelier Pyrometer," by Prof. Roberts-Austen, C.B.; "Notes on the Micro-Structure of Steel," by F Osmond; "On the changes in Iron produced by Thermal Treatment, II," by E. J. Ball, Ph. D.· "Economical Puddling and Puddling Guides," by Thos. Turner, A.R.S.M.; "A Graphic Method for Calculating Blast Furnace Charges or Burdens," by H. C. Jenkins, Assoc. M. Inst., C.E.: and "Recent Progress in the manufacture of War Material in the United States," by W. H. Jaques. The Council announces that a special number will be issued at an early date, specially describing and recording the "Proceedings and Excursions held in the United States and Canada this time last year. This valuable work will take the form of a memorial volume, embracing not only accounts of the numerous mines, works and other places of interest visited in this country, but also special descriptive and critical papers by experts, the whole constituting an interesting souvenir of a very memorable occasion.

The paper on "Magnetic Concentrates in the Blast Furnace," of which a synopsis is elsewhere given, was the subject of some discussion at the Glen Summit meeting of the American Institute of Mining Engineers. Dr. Raymond said magnetic concentrates could in general only be profitably prepared from waste dumps. He was willing to stand by the statement he had made, that there is no American mine where it will pay to mine and concentrate lean magnetic ore. He would admit he was wrong when the Croton mines have been run long enough to furnish regular working figures, and not the results of a few months only. The low cost of mining at Croton was exceptional and by no means represented American mines in general. In the paper read no account was taken of royalty on ore or increase in future mining expenses. The small profit made proves how hard the whole thing is going to be unless everything is in its favor, and magnetic concentration will probably result profitably at only a few mines. He distinguished between the use of fine ore and dust concentrates in the furnace. If such as the 60 per cent. stuff from Edison's plant at Ogden were used, there would be great loss in flue dust. The chief use of concentrates will be in the form of briquettes for the open hearth furnace. Mr. Moffatt said the Lackawanna company had used 8,000 tons of concentrates from 60 mesh to ¼ mesh fineness; they commonly formed from one-twelfth to one-third of the furnace charge, and even fifty per cent. had been used. The flue dust had been of small amount, but it was found advantageous to moisten the ore when very fine. The experience of Mr. Langdon in the use of concentrates, at Witherbles, Sherman & Co.'s furnaces, Port Henry, N.Y., was given in a paper read at the meeting, the summary of which is, that with proper management there is no difficulty in using in the blast furnace at least 80 per cent of high grade magnetic concentrate, and there is an economy of fuel with the use of a large percentage of concentrate beyond what may be due to an increase of iron content in the mixture, and this economy may be attributed to the comminution of the ore.

It is said that when the formation of a Mining Bureau, as an adjunct to the Geological Survey, with the function of conducting an experimental plant for purposes of instruction, was mooted to the late Sir John Macdonald, he replied at once, "Your plan is an educational scheme, and would bring us in conflict with the provincial governments." This is mentioned merely to show that the great architect of Confederation was a typical Canadian politician, quick to see the political, rather than the practical side of a proposition. By its Experimental Farm at Ottawa, and its College of Military Science and Engineering at Kingston, the Dominion Government is in the educational field for the benefit of farmers and soldiers. If the Geological Survey cannot be made of educational value to the mining interests of the country its chief end is unfulfilled. Much might be said for the utilization of the great water power at Ottawa for an electric furnace, for electrolytic operations on low grade ores, for driving a model concentration mill, and for hydraulic appliances in a small complete furnace plant for all metallurgical processess. But though supported by the highest scientific testimony in the world as to the great value of such an institution, it may be doubted if a proposal for it would be seriously entertained.

The excellence of the electrical outfit of the Science Department of McGill University, received merited commendation during the late electrical exhibition at Montreal. It is satisfactory to know that this branch of engineering science can be fully taught at McGill, and that the equipment for demonstration and experiment is second to that of no educational institution in the world.

The presidential address of Prof. Roberts-Austen to the chemical section of the British Science Association at the late meeting at Cardiff, touched upon a wide range of subjects interesting to metallurgists, the characteristic note struck being an appeal for further research into the causes of phenomena brought near to us by the wonderful discoveries of Bessemer, Siemens, Gilchrist, Osmond and others. He concluded by "earnestly pleading for the more extended teaching of metallurgy throughout the country and for better laboratories arranged on the model of engineering laboratories in which the teaching is conducted with the aid of complete though small 'plant.' The necessity for affording public instruction in mining and metallurgy with a view to the full development of the mineral wealth of a nation is well known. The issues at stake are so vast that in this country, it was considered desirable to provide a centre of instruction in which the teaching of mining and metallurgy should not be left to private enterprise or even entrusted to a corporation, but should be under the direct control of the Government. With this end in view, the Royal School of Mines was founded in 1851, and has supplied a body of well trained men who have done excellent service for the country and her colonies."

Andrew Lang's saying, that "where as a matter of science we know nothing we can only utter the message of our temperature," quoted by Professor Roberts-Austen at the close of his address, may be used to account for the apathy of the governing bodies in the Canadian confederation towards efforts for the scientific investigation of our mineral resources and the development of metallurgical processes in the country. If with all her vast attainment in industrial arts and science, Great Britain requires for her students in metallurgy, laboratories in which teaching is conducted with the aid of a complete though small plant, much more is such equipment necessary in Ontario for example, where the metallurgy of iron and steel are utterly unknown, and many attempts to establish furnaces have resulted in failures, redeemed from ridicule only by the patience and earnestness put into the enterprises. The educational facilities so far provided in Toronto towards making mining engineers will result in sending graduates abroad for experiment, experience and expatriation,—a result the country complacently sees attained in the case of a considerable number of young men who yearly leave the Royal Military College at Kingston, with an education most expensively given by the country, for professional service in the United States. An experimental establishment in metallurgy has been brought before the consideration of the Ontario Government. Would that they might rise above the level of political temperature to the appreciation of the honest directness and pugnacity of the remark addressed to Pip in *Great Expectations*: "Well! somebody must keep the pot abilin', Pip, or the pot won't bile, don't you know?"

Steel powder for polishing stones, and which can advantageously replace emery, is obtained by lightly sprinkling over-heated steel with water. The metal is thus made friable and reducible to dust by stamps. It is cheaper than emery and gives a finer and more durable polish.

The total coal production of the United States in 1890 is reported to be 142,229,515 short tons. This shows an increase over 1880, ten years before, of 97.57 per cent. The total number of 296,974 employés shows that a population of nearly or quite 1,200,000 people is directly dependent on the operation of the collieries.

A work of considerable interest to all interested in the subject of "Stones for Building and Decoration," has just been published from the pen of George P. Merrill, Curator of Geology in the United States National Museum. The work opens with a brief sketch of the early history of stone-working in the United States, followed by chapters on the geographical distribution of the minerals, and the physical and chemical properties of such stones as are utilized for general construction and decorative purposes. A systematic description of the rocks, quarries and quarry regions is given. Each variety of stone is taken up in turn, its composition, origin, structure and general adaptability for any form of work discussed, and the resources of each State and Territory described in alphabetical order. A special portion of the work is given up to the methods of quarrying and working; the machines and implements used in stone-working; the weathering of building stone; the selection of stone for building purposes, and the methods employed for the protection and preservation of stone from the ravages of time. The work is illustrated with eleven full page plates, drawn in most cases from photographs taken by Mr. Merrill, and eighteen figures in the text. The volume is indeed a most exhaustive and comprehensive treatise well worthy of perusal by the student, the stone-dealer, the architect, and all interested in the subject.

The minimum cost of electric lighting and electric power is attained where the water fall is used for transmission over comparatively long distances. The dynamo can be placed close to the water wheel and wires run to cities and towns for miles around. A company in Maine operating electrical plant by hydraulic means, furnishes power at 50 per cent. less cost than the average company in New England.

The evaporation of metals under electric stress was the subject of a paper by W. Crookes read before the British Science Association at the late Cardiff meeting. Premising that it is well known that in a vacuum tube furnished with interval platinum electrodes, the glass near the negative pole becomes blackened by the deposition of metallic platinum, he described experiments upon the evaporation of different substances. Taking gold as the standard, the following is the order in which metals volatilize:

Palladium....	108.00	Platinum.....	44.00
Gold.....	100.00	Copper.....	40.24
Silver.....	82.68	Nickel.....	10.99
Lead.....	75.04	Iridium.....	10.49
Zinc.....	56.96	Iron	5.50

In 20 hours, nearly 3 grains of silver were volatilized, and the deposit was easily detached from the glass in the form of brilliant foil.

The volatility and atomic penetration of iron when soldered with nickel, have been the subject of experiments by Fleitmann. The metals adhered so intensely it was impossible to separate them by mechanical means, and chemical analysis proved a perfect assimilation although the soldering had been done at a temperature 500° to 600° below the fusing point. Other tests showed the volatility of iron when heated to cherry redness. Two plates of iron and nickel superposed were submitted to the same degree of heat; the iron passed into the nickel to a notable extent without soldering or adhesion of the surfaces resulting. On the sheet of nickel an alloy with the iron was formed which penetrated ·05 of the thickness of one milimetre sheets and contained an average 24 per cent. of iron. The nickel did not pass into the iron, the plate of which remained intact and preserved the sombre appearance it had received from the heating.

It will be remembered that at the last October meeting of the American Institute of Mining Engineers, the accuracy was questioned of carbon determinations of iron or steel made by dissolving the metal in double chloride of copper and ammonium. The subject was referred to a committee, for which Mr. J. W. Langley reports that they are able to say, that all of the double chlorides of copper and ammonium they have examined contain tarry matter, (probably pyridial compounds), held in solution in commercial ammonia. This substance is retained by the carbon sponge, and causes the apparent carbon in the steel to be reported too high. The remedy is to use potassium chloride instead of ammonium chloride and make the solution slightly acid. The metal should be dissolved in a solution of double chloride of copper and potassium, to which 5 per cent. of its volume of strong hydrochloric acid has been added. A neutral solution of double chloride gives too low results.

So numerous are electric launches on the Thames that boats containing dynamo plants move up and down the river for the purpose of supplying the fluid. They can charge the accumulators of 6 launches at once. Electric welding is applied to the repair of broken saw teeth, thus saving the cost and labor of resetting. A device has been invented for preventing electric cars that have stopped on an up grade from running down grade before the brakes are applied. A push switch for electric lamps has been invented. There are two buttons, the white one lighting the lamp, the black one putting it out. To avoid the hissing in the arc lamp a carbon pencil has been invented containing a percentage of alkali silicate, which under combustion forms a conducting vapor that is said to prevent the trouble.

At the Sault Ste. Marie Mining Convention, Mr. Hammond, of Fort William, struck the right note in declaring that the great need of the Algoma district is a mining school. This great territory has surely money-borrowing powers, and can, under the Mining School Act of last session, do something towards laying the foundation for such a school. A recent paper on the Sheffield Metallurgical School will be noticed in our next issue, and will doubtless set definitely before the mining interests of Algoma the outlines of the educational institution they require.

The sustenance of the men thrown out of employment by the long continued strike at the Wellington collieries, has been the subject of wonder and comment by their eastern brethren. From the report of the financial secretary of the Miners and Mine Laborers' Protective Association, of the Island of Vancouver, we learn that the colliers have been receiving $25 for single, $12 50 for half members or boys who were working in the pits, and $3.50 for each child. The strikers have not, it would thus appear, been doing so badly after all; at any rate they have been receiving at least as much as would keep body and soul together without suffering, and more than that, many of them possess farms or small holdings, at which they have been able to grow many things for their own consumption. Under these circumstances, it was not to be wondered at that from 70 to 100 able-bodied miners should have been prepared to hold the fort for this extended length of time. Then, too, Mr. Tully Boyce, the leader of the miner's movement, has, it is stated, been getting upwards of $100 a month in wages and union allowances, since, whether he worked in the pits or not, he has had his wages made up to that sum out of the union funds, while he has been allowed liberal travelling and other expenses for visiting San Francisco and other places on business connected with the Association. Other officials of the union have also, it is said, received moneys for services rendered.

The question is put by the *American Manufacturer*, touching the furnace results of operations with finely comminuted magnetic ores, "Why may not equally good results, that is, comparatively, be obtained by a comminution of ores that cannot be concentrated? Why will not the Oriskany (earthy-red hematite) ores of Virginia work better in the furnace by charging them fine, or a large proportion of them? The theory of the action in the case of concentrates is, of course, that the gases of the furnace have more ready access to the particles of ore and reduce them more readily, while the melting operation and the fluxing out of the earthy matter is also more quickly performed by the greater ease with which the heat and flux reach the particles of earthy matter when it is in a fine state. This reducing the ores to a fine condition might be accomplished, in part at least, by roasting, and the ore then be freed at the same time from a large part of its moisture." These questions have been submitted to British furnace-masters in a series of papers by Mr. S. J. May, which have appeared in recent issues of *Iron*. He has conducted experiments on the magnetization of some hematites, by roasting, and discussed, with some show of probability, the economy of concentrating these ores by the magnetic operation. The subject deserves careful investigation. The preparation of ores for the blast furnace is a subject becoming daily of increasing importance, especially in Alabama, Tennessee and the Atlantic States.

The demolition of rocks under water without explosives, has been successfully effected on the Suez Canal, where the interruption of navigation and the danger of injury to neighboring constructions from blasting operations, rendered some other method necessary. A paper in the *Scientific American Supplement* gives the leading details of the system contrived by Mr. Henry Lobintz, for shattering rock by the action of rams let fall from a convenient height and acting like an artillery projectile upon the wall of a fortress. In a preliminary experiment at Craigmillar quarry near Edinburgh, it was found that a ram of two tons weight, shot with a steel point, falling 18 feet, broke up more than one seventh of a cubic yard of hard rock at a blow. The application of this method under water, obviously modified the conditions of the experiment. At the eastern end of the canal, a conglomerate of gypsum, sandstone and shells, composing the bottom, was found of too great elasticity for the pointed battering rams, the blows making holes from 6 inches to 2 feet in depth, but leaving the rock intact between the holes. By operating the dredging buckets very near the rams and simultaneously, improved results were obtained, expressed in cost at 84 cents a cubic yard, not including charges for insurance, interest and depreciation of plant. Better results were obtained where the rock presented a face more easily disintegrated and permitted the operations of dredging and battering to be carried on separately, the working expense being thus reduced to 65 cents a cubic yard. The system offers some appreciable advantages for work in ports, rivers and canals, and even for rock cutting in the construction of railroads.

After an experience of some years' duration natural gas is about to disappear from the mills and manufactories of Pittsburg. As a fuel for manufacturing purposes, natural gas is almost ideal, but its supply seems likely to prove precarious, and the companies which purvey it prefer to deal with domestic consumers rather than with works and factories. This preference is quite natural when it is stated that private consumers pay 20c. per 1,000 cubic feet, as against the 10c. paid by manufacturers. To the latter class of consumers the price was raised on October 1, to 15c., which alteration is held to mark the end of the use of natural gas for manufacturing purposes, as supplied by the companies. Various concerns who have their own sources of supply will continue to use natural gas as long as they can get it, but according to the American journals, it is no secret that the supply is rapidly diminishing. If that is really the case, it is patent that the reign of natural gas will soon be over. Even in that event, however, there can be little doubt that the use of gas as fuel will be established, and manufacturers will resort to producer gas rather than return to coal and coke. The largest supplying company evidently anticipate that result, as they have plans all ready for the manufacture of fuel gas at Pittsburg directly the price of natural gas reaches a point equal to the cost of fuel gas. "For puddling and heating furnaces," says the *Ironmonger*, "gaseous fuel is fairly certain to be used, owing to its economy, efficiency and cleanliness, but it is doubtful whether gas can compete with coal for steam-raising purposes. Improved furnaces are aiding the use of coal very greatly, and lessening the difficulty in respect of smoke, hence on both sides of the Atlantic the broad results are likely to be very similar at no distant date."

The Readman-Parker process accomplishes the manufacture of phosphorus by disassociating the elements of mineral phosphates by means of the electric current. The dynamo used for producing the current gives 400 units of electrical energy, equivalent to 536 indicated horse power. The electrodes are bundles of 9 carbons, each 2½ inches diameter, attached by casting into a head of cast iron. The carbons weigh 20 lbs. each, and are 48 inches long. The furnaces are rectangular troughs of fire brick, 60 in. x 20 in. x 36 in deep. Into each end is built a cast iron tube, through which the electrodes enter the furnace. These are geared for advance into or withdrawal from the furnace. The raw materials such as phosphates of lime, magnesia and alumina, are introduced into the furnace and the furnace and the current turned on. Shortly afterwards indications of phosphorus appear. The vapors and gases pass through large copper condensers, the first filled with hot, the second with cold water. As the phosphorus forms it distils off from the mixture, and the residue forms a liquid slag at the bottom of the furnace. Fresh material is introduced, and the operation is a continuous one, and may be worked for days without intermission. The crude phosphorous obtained is nearly pure, and is readily refined in the usual way. Each furnace yields about 1½ cwt. phosphorus per day. The phosphorus in the slag seldom exceeds 1 per cent.

Search for oil in Colorado is prosecuted with diligence and success. At a depth of 1,400 feet oil has been struck on Plain Creek, five miles south of Littleton. Developments are eagerly looked for at Denver, because of the proximity of the wells, and the altitude being 500 feet higher than the city, the product could be piped at minimum cost. Discoveries of petroleum are reported from Alabama.

A vast heap of abandoned machinery, such as pulleys, sprocket wheels, conveyors and screens, which had been thrown out of the mill, caught the attention of a representative of the *Engineering and Mining Journal* on a recent visit to Edison's Concentration Works at Ogden, N.Y. "The abrasive action of the fine grains of magnetite and rock and the friction of the bearings had not been properly provided for, and the machinery failed by wearing itself out in a very short time." The writer of this note having visited these works would also mention the costly wear of immense belts used as horizontal conveyors, the expense of which could have been much diminished by the use of shallow metal trays carried on narrow belts or wire rope. "The machinery is now undergoing reconstruction and is not at present in operation." Dr. Raymond's all too general criticism of magnetic concentration of iron ores may be justified in view of the history of the Ogden mill, but there are now in operation a sufficient number of such works to enable the engineer to determine the character of the appliances to be used in the presence of a particular ore, and the economics of the results to be kept in mind in order to win profit. The eminent quality of Dr. Raymond's criticism of any process is well known; nevertheless there seems to be sufficient ground for the belief that the process of magnetic concentration has a wide field of successful work before it.

The water jet has been long in use by the well-borer for assisting the descent of the drill and carrying off the spoil. In what is called the hydraulic process the drillings are pumped up through the drill rods: in the jetting process the water is forced down the drill rods and washes the drillings up and out of the outside casings. It would seem an easy step to the use of this method for helping the pile-driver. On the Manchester ship canal now under construction some 13,000 piles, 14 inches square and 35 feet long, have been driven through sand by the use of the water jet principle. Four steam pumps delivered the water at a pressure of 30 lbs. through 2-inch rubber hose to the pile, where it was attached to a 1½-inch iron pipe, which was put down under water pressure alongside the pile. With this assistance the steam pile engines quickly drove the pile, which, without the disturbance caused in the sand by the water-jets, could not be driven. At Atlantic City, N.J., the water jet has been applied to the driving of piles for a board walk. Water was brought from the city works in a 2-inch pipe, to the end of which, as the work progressed, was attached a 30-foot length of hose, ending in a common brass nozzle, 4 feet long, with an opening of 1¼ inches. The piles were swung into place by a light tripod, with block and fall, and steadied by the foreman, while one of the men held the nozzle of the hose vertically and close to the foot of the pile. Under the action of the jet the pile was lowered almost as fast as the men could pay out the rope, the nozzle following it down. The instant this was withdrawn the sand packed around the pile, holding it apparently at least as firmly as if driven by a ram in the usual way.

At an altitude of 12,500 feet the Virginius mine in Colorado is lighted and the concentrator, saw mill, pumps, hoisting and other machinery operated by electricity, and a great saving of costly fuel effected.

The great dam under construction across the Colorado River at Austin, Texas, will be 1,150 feet long, 60 feet high and 18 feet wide at top. The dam, hydraulic canal, gate house and other works will cost $800,000. The water power will be used for electric light for the city, for operating the street railway system and pumping the city's water supply, and it is expected there will be an available surplus of 13,000 horse-power for driving factories.

Mr. W. A. Carlyle, a graduate of McGill, and a few years ago a member of the staff of our Geological Survey, has been appointed to the chair of Mining Engineering at McGill. Mr. Carlyle has, since he left the Survey, been employed in mining work in the Western States.

The production of pig-iron in Great Britain and the United States for the first half years of 1890 and 1891 compare as follows:

	1st half 1890.	1st half 1891.	Decrease.
Great Britain, tons .	4,168,464	3,812,787	355,677
United States, " ..	5,109,775	3,776,556	1,333,219

In the first half of the current year Britain had actually reached an increase of output of 106,121 tons of pig-iron over the last half of 1890. There has been an increase of 25,136 tons of open hearth steel, and a decrease in Bessemer steel of 132,275 tons at British furnaces during the first half of this compared with the same period of last year.

Carnegie's Homestead Steel Works, on 1st Oct., cast a 25 tons nickel-steel ingot without a flaw. It will be rolled into a single plate for a United States war vessel. Another ingot, 50 tons weight, has since been cast and rolled into plate 13 inches thick for the same vessel. This establishment is said to be far more successful in its operations with the famous nickel steel alloy than similar works in France.

Railway building has fallen off in such a marked degree in the United States, and locomotive and car building work is so dull in the face of bountiful crops, that our neighbors are seeking for "radical reasons" for this state of things. Some think that the railroads cannot hold out much longer, but must soon enter the market with demands requiring large quantities of iron and steel, and that within a few weeks the iron trade will be pushed into a degree of activity bordering on a boom.

The literature of tin enterprises has for years been an interesting feature in the columns of American trade papers. The Pittsburgh *Dispatch* produces figures to show that the Welsh tin plate manufacturers have been making from 33 to 45 per cent. per annum. The industrious tinners of South Wales would give a good commission for the production of such vast profits in their business or for information as to how they can be attained. Virginia, fruitful in booming cities, basic steel works and other new enterprises, will not let Chicago walk at the head of the race for the name of home-made tin-plate manufactured from the great Horney Peak tin ores, and therefore no one need be surprised to learn that at Savernake, Va., there is a million dollar organization to build steel and tin-plate works, composed of "leading American and English" (of course) "business men." It cannot be denied that it is all that is claimed for it, —"An enterprise of great magnitude and of immense value, not only to Savernake but to the whole South." Nevertheless, there are enterprises more likely to be profitable in the development of the vast resources of the grand Old Dominion than the manufacture of tin-plate.

From the *Critic* we learn that Mr. Lucius Boyd, a mining engineer "from Dublin," is now in Nova Scotia, and that his advent is regarded as "likely to lead to most beneficial results." The same great authority says, "Mr. Boyd has been very extensively engaged in lead mining in Spain and his descriptions of the old Roman workings found there and modern mining are most interesting." This will be good reading in the Eastern Townships, where Mr. Boyd has undeniably a great reputation as a story-teller. Many will doubtless be curious to learn if the genial Lucius included in his "yarns" any reference to that paragon of "*modern mining*," the White's Asbestos Company? The *Critic* might kindly inform us on this point.

Although American mining engineers have dealt successfully with many great problems, it may be doubted if this country can show a mine in which such advanced ideas have been introduced as are in use at the Lumpsey iron ore mine of Bell Brothers, in the Cleveland district of England. The mine was recently visited by one of the English engineering societies, and the workings were fully described by the *Engineer*. The shaft is 564 feet deep, about 250 hands are employed in the mine and 1,000 tons of ore are raised in a day of eight hours. The hoisting engine has two cylinders forty-two inches in diameter and seventy-two inches stroke; the hoisting drum is a cone of seventeen feet diameter at one end and twenty-one feet at the other, and a gross load of eight tons and twelve hundredweight is raised in thirty seconds. Steel girders weighing fifty pounds to the yard are used in place of timber for supports in all the main galleries, the increased first cost being 35 per cent. All the hauling in the mine is done with an endless steel cable. All the drilling is done by mechanical means, hydraulic power being chiefly used. In sinking the shaft the inflow of water caused considerable trouble, but the springs are now utilized in driving the drills. A series of six inch pipes take the water about 260 feet above the bottom of the pit, which gives a pressure of about 215 pounds per square inch at the bottom of the shaft. From that point the water is distributed through the mine to the drilling machines. One of these machines will drill seventy holes 1¾ inches in diameter and 56 inches deep in a shift of eight hours. Drilling machines driven by petroleum engines have also been introduced, doing about the same work as the hydraulic machines. The ore vein is nine feet thick, but the ore yields only 30 per cent. metallic iron.

By a method invented by Mr. Oncken, casks are now made from one piece of wood, or to be accurate, the whole of the body, with the exception of top and bottom, is manufactured from one piece of timber. The stem of the tree is first cut into logs of the length of the barrel required, and is then boiled for two or three hours in a closed vessel, to soften the wood, a current of electricity being passed through the water the whole time. From the boiler the log of wood is taken to the machine, and as it is revolved against the blade a continuous sheet of wood is produced of any thickness. The wood is drawn out flat from the rear of the machine by hand, on to a table. The sheet thus obtained is cut transversely into pieces of the desired length for a barrel. The pieces are then passed through a machine, which cuts the groove in which the head is eventually fitted. Another machine cuts narrow V-shaped pieces at intervals out of the edges of the pieces of wood, which are then easily bent round into a cylinder and firmly hooped, the V-shaped slots enabling it to assume the necessary conical form at each end. There is thus only one joint in the body of the barrel.

Do shadows of the Land League and of boycotting secret societies rest irrevocably on Irish mining enterprise? and if not, how else can the result of the auction sale of the Slicourdagh collieries and the Knockmahon and Ardmore (? copper) mines on the 17th September, ult., be accounted for? The collieries are said to be of great extent in Tipperary, and "to contain a comparatively unlimited quantity of anthracite coal, and culm of excellent quality, free from sulphur. A great portion of the country over which the company's rights extend has so far been unworked for minerals. A large number of cottages stand on the property. The coal beds are near the surface and easily worked, and the collieries are still in working order." The Knockmahon mines in Waterford County are said to have been worked to advantage and to afford opportunity for further exploration. The collieries were knocked down to Mr. Richard Dodd, an English buyer, for £1,010, and the Knockmahon and Ardmore mines to Mr. Edward Spays, M.E., for £50 sterling.

The Witwatersrandt, South Africa, gold mines produced last August 59,070 oz., the largest monthly output yet reached. The district has turned out in three years and eight months 1,577,534, oz. or roughly, $27,500,000.

Gold reefs have been discovered in Errisbeg Mountain, Connemara, Ireland. The reefs are "from 1½ feet to 6 feet wide, showing gold free and in a pyritous matrix," yielding from 4 dwts. to 8 dwts. a ton. Experiments are in progress to see if this yield will pay expenses.

Prof. John Nicolson, B. Sc. (Edinburgh), has been called to fill the Workman chair of Mechanical Engineering at McGill University, Montreal, vacated through the transfer of Prof. C. A. C. Wilson to the W. C. McDonald chair of Mechanical Engineering.

The Norwegian government has prepared a plan for expending during a series of years £5,500,000 in railway construction. The imports of the country, which have increased nearly three millions sterling in three years, amounted last year to £11,594,117, and the exports to £7,284,129. The Swedish iron trade is in a healthy condition, and it is expected the year's make of Lancashire iron will be disposed of without reduction in price. In fact there has been a recent advance in hammered iron of 2s. 6d. a ton.

CORRESPONDENCE.

Mining Notes From New Brunswick.

Without preamble let me say that mining in New Brunswick is comparatively of small dimensions, but there is hope for the future. The mining resources of the province have long lain dormant for want of a full and complete mining law. Last session this was remedied to a great extent, and a Mining Act passed similar in all respects to the Nova Scotia mining act—the only observable difference being in the royalty on gold, which is placed at 2½%, whereas in Nova Scotia it is only 2%. Much dissatisfaction is expressed by many land owners at the new Act, as by old statutes enacted some years ago, all minerals on private lands were vested in the owner. The fact of it being so, however, never seems to have stimulated the mining industry in the province, hence the repeal of the same, and a general Act empowering the Government to issue rights of search, prospecting licenses, and leases on all lands, both private as well as Crown lands.

It is said the Act will be, in many respects, amended during the coming winter. What is done will be fully reported to you at the time.

Since the passage of the Act, many persons have availed themselves of its requirements, and numerous applications for areas have been filed in the Surveyor General's department, over which a number of disputes have arisen already and which are being fully considered.

Many persons in the province itself, are unaware of the existence of the mineral deposits of New Brunswick, but within its borders may be found most positive traces of gold, galena, copper, manganese, iron, coal, (both hard and soft), gypsum, baryta, antimony, iron pyrites, plumbago, nickel; and traces of tin and asbestos have been met with from time to time. In addition to this there is strong indication of petroleum, natural gas, salt beds of importance, brine springs, from which the best salt in Canada can be manufactured, mineral springs in abundance, and granite and freestone quarries of the greatest value, and limestone in almost inexhaustible abundance.

But of all these, few have been developed to any important extent. The chief development having been in manganese, gypsum, and the granite and freestone quarries in the province.

The famous Albertite coal of Albert County, at one time was the most extensive mining operation ever conducted in the province, from which thousands of tons of the precious Albertite was extracted, and its stockholders became very wealthy from its operation. The supply of the mineral, however, gave out; the mines were abandoned and all the costly machinery in due time removed and sold. Indications of this mineral are still to be met with in Albert, Westmoreland and King's County, and much time and money has been spent in prospecting for it for years past. There are many who believe it will be found again in sufficiently large quantity to pay for working.

In various parts of the province work of exploration is going on quietly for different minerals.

At Woodstock, in Carleton County, a local company has spent considerable money in developing a galena deposit, which gives good evidence of being productive. They have gone down about 150 feet and are diligently continuing operations to prove the value of the mine.

In Charlotte County, at St. Stephen, much activity is being displayed in the development of an iron pyrite body which, to say the least, is attracting considerable attention from home and American capitalists. The ore, which seems to be a combination yielding copper, silver, with occasionally some gold, and a fair percentage of nickel, is of very large extent, being quite near to shipment, and in one case on what is known as the Hall farm, has shown a width of about 250 feet, and can be distinctly traced for some distance. Numerous assays have shown from 1% to 2½% at times of nickel, and considerable work of development has been and is now being done. A number of properties it is said, have been bonded to American capitalists. What the final outcome may be it is hard to state, but many are confident that a body of ore, rivalling to a certain extent the famous nickel beds of Sudbury, are in this locality. One thing can be stated with accuracy, and that is that the ore from the Sudbury district and the St. Stephen ore are exact counterparts of each other so far as looks and appearances go.

In King's County, near Sussex, manganese exists in abundance.

The Markhamville mines, which have been worked almost continuously for the past thirty years, are at present not showing up very well. It is said by many the ore is exhausted, while others scoff at such an idea. In other sections large bodies of manganese exist and only await the advance of the capitalist, and a market demand which, while frequently fluctuating, seems very quiet at present. This mineral also exists in good quantities in Albert County and some portions of St. John County.

In Gloucester County exist splendid beds or belts of magnetic iron, and also every appearance of large and good paying galena belts, some of which are being quietly tested, so it is stated, by American capitalists. On one of these veins or belts, assays of the ore have shown a yield of from 10 to 60 ounces of silver, and from 12 to 15 dwts. to as high as 2 oz. and more of gold in combination.

Below St. John, for many years past, considerable money has been spent in the search for anthracite, and those interested firmly believe their efforts will be crowned with success.

In York County, it is beyond doubt that valuable deposits of antimony exist. In past years mining operations were conducted there, but the matter assumed more of a stock gambling operation than that of legitimate mining, and together with reckless and extravagant modes of mining, the enterprise got a "black eye" so to speak, and that coupled with the holding out for fancy and extravagant prices by the owners, killed all efforts in this direction.

In other parts of the province explorations are being made for gold, and it is confidently believed the day is not far distant when it will be discovered and mined with paying results. The regions of the Upper St. John River, the Tobique and the Nashwaak and upper branches of the South West Mirimichi rivers are considered favorable grounds for prospecting, and there will be considerable time and money spent in these sections in the near future.

The gypsum deposits of the province are being worked to quite a large extent, particularly those of Albert County, near Hillsboro, and at the Plaster Rock, so called, on the Upper St. John, to which a railway is now being constructed.

Taken as a whole, the mining outlook for New Brunswick is fairly good, and it is to be hoped that when a chance for capital does offer those owning or controlling mineral deposits, will not frighten capitalists away by asking fancy or extravagant prices or refusing bona fide offers of development which would result favorably all round. This course has, in the past, greatly retarded the development of many claims that might prove remunerative, and when mine owners can get themselves down to a common sense basis on undeveloped properties, they may realize that it is the best course for all concerned.

Hoping I have not occupied too much of your valuable space, and with the promise that you shall hear from me again if my notes meet with your approval,

I am,

Yours, etc.,

CRYSTAL.

FREDERICTON, N.B., 21st. Oct., 1891.

P.S.—I shall be glad to answer such inquiries as readers of your journal may be pleased to make through your columns at any time.

C.

Mining at Illecillewaet, B.C.

West Kootenai District has been well to the front lately owing to the two magnificent displays of exhibits of the ores of the district at the Toronto Exhibition, and also at Westminster, B.C., and Victoria, B.C., The Illecillewaet District was well to the fore in the display of high grade galena ores, and though some forty or more claims were represented from Illecillewaet, it is not a fifth part of the number of known mineral-bearing claims that could have been shown if more time had been taken to collect specimens. It was an excellent indication of what an enormous value to the Province of British Columbia is the apparently inexhaustible wealth of her mines. That so much should have been done at a short notice conveys an excellent idea of what could be done in making a grand display if needed, for there was no attempt made to collect specimens for an exhibit until about three weeks before the exhibition opened. Great credit is due to the energy shown by all parties in promoting the success of the exhibition. The Hon. J. Robson, Premier of British Columbia, takes a deep interest in the development of the mining industries of the province, and most cordially supported the idea of an exhibit, and made a special grant of some $350 to pay the expenses of collecting the specimens. The sinews of war being thus supplied, the work was at once taken in hand and competent men told off to the different districts to collect and bring the specimens to Illecillewaet, which was the centre of the district. Here, under the able and intelligent superintendence of Mr. J. M. Kellie, M.P.P. for West Kootenai, himself a practical miner, the specimens were duly certified, labelled and packed for the two exhibitions, the C. P. R. generously carrying the specimens to both places free, in a special car. The weight of the samples sent to Toronto was 2,040 lbs., and to Westminster, 2,010 lbs. The samples, on arrival, were officially assayed. I quote a few of them: Oak Leaf, Illecillewaet (Messrs. Jowett & Haig), 40 oz. to 400 oz. silver; Maple Leaf, Illecillewaet (J. MacKinnon), 60 oz. to 90 oz. silver—60% lead; the Gladstone, Illecillewaet (Messrs. Kennedy & McCarty), 60 oz. to 1,100 oz. silver and 60% lead; Crystal, Illecillewaet (Messrs. Corbin & Kennedy), 60 oz. to 80 oz. silver, and 60% lead; Homestake, Illecillewaet (Mr. C. Taylor), 100 oz. silver—40% lead; the Ottawa, Illecillewaet (Mr. Walter Scott), 150 oz. silver and 70% lead; Dunvegan, Illecillewaet (Messrs. Boyd, Bain & Co), 70 oz. to 115 oz. silver—60% lead; Spanish Fly, Illecillewaet (Messrs. Gallop, Jowett & Haig), 20 oz. silver and $10 gold; the Sanquhar, Illecillewaet (Mr. Walter Scott), 70 oz. to 110 oz. silver—65% lead; the Maple, Illecillewaet (Mr. D. Walsby), 60 oz. silver and 40% lead; the Elizabeth, Illecillewaet, Fish Creek (Mrs. Walter Scott), 139 oz. to 175 oz. silver, and 71% lead; the Gold Queen, Illecillewaet (Messrs. Stark & Taylor), 20 oz. to 286 oz. silver, and $10 in gold; Blue Bell, Illecillewaet (Messrs. Gallop & Green), 70 oz. silver; Goat Cave, Illecillewaet (Messrs. Scott & Chisholm), 60 oz. to 80 oz. silver, and 40% lead; the Jumbo, Illecillewaet (Messrs. Corbin & Kennedy), 60 oz. to 1,300 oz. silver, and 40% lead; the Sprague, Illecillewaet (Selkirk Mining Co.), 150 oz. to 170 oz. silver, and 45% lead; the Whale, Illecillewaet (Messrs. Boyd & McKinnon), 70 oz. to 1,000 oz. silver—30% lead; and many others, but I think that these will show that there are some excellent prospects in this district, or this part of it. There was also a splendid show from Ainsworth, Hot Springs, Toad Mountain, and the exhibit from the famous Silver King Mine was quite a feature of the exhibition. Last year this district received a medal of merit at Toronto for the best exhibit of mineral ores, and it will not be far behind this time. All who have seen and examined these splendid specimens echo the sentiment expressed by one of the leading smelter men of the State of Washington, that the West Kootenai District is the most promising mining district on the American Continent. The great drawback to the prosperity and development of these claims is the want of means of communication by trails and roads. This is being gradually overcome, the B. C. Government voting as much money as it can for this purpose, and work is slowly but surely progressing in this direction. It is a most important work and should receive special grants, for there is nothing that would sooner repay the outlay than free communication between the various mining camps. Let that once be fully established and then development work will begin in earnest; population will come in and every branch of trade and business will receive a grand impetus. Mr. S. S. Ryckman, M.P., of Hamilton, Ont., has favored us with a visit, having heard of the great value of our silver deposits, and thought that he would like to see for himself that the facts warranted the favorable reports that he had heard. Mr. Ryckman is most favorably impressed, both with the extent as well as the value of the mines in the Illecillewaet District, and no doubt when satisfied, will become an important shareholder in some of the leading mines, thus giving an impetus to the development of the district and setting an example that it would be both well and wise for others to follow, as there are no "wildcat" ventures here: every prospect shown has a substantial backing of galena-bearing ore. A little time and these mines are bound, from their extent—being true fissure leads, the high grade of the ores and the facility for transportation given by the C. P. R. when the ore is once at the foot of the mountains—to be the centre and scene of busy, bustling, active life, for nothing can retard for any length of time the introduction of capital for the development of the mines. There is this important, and may-be neglected, fact to be considered when looking toward British Columbia as a field for mining investment, and that is, that this country was almost unknown, except to an occasional hunter or trapper, and really only dates as a known and determined locality, for about five years. So that it is rather early to cry out because not many people come here. The reason is not far to seek: they are entirely ignorant on the matter, and it requires a little time to instruct the public mind and convey the knowledge that there *is* such a place and that *there* are located mines of exceptional richness and value, which offer every inducement to the large or small investor, with the certainty of a remunerative return for money invested. At the new locality of Fish Creek there are now twenty-two claims located and recorded. This is bound to be a big district when developed. I will send you a detailed description shortly of what will be a place of note in mining circles in the near future. The new trail is being carried towards the arm of Trout Lake, and is now down over twenty miles from Flat Creek, where the old trail comes in. Two substantial bridges have been built, and next year the communication with the Lardeaux district, and thence to Kootenai Lake, Toad Moontain, etc., will be opened to parties on foot or horseback. A most interesting discovery has just been made some eighteen miles down the trail in Fish Creek, and that is of a geyser, which throws an enormous body of cold water into the air to the height of about 60 feet—a natural curiosity well worth a visit. In fact the whole of this district is most interesting, and when once known will draw tourists from all parts to see the wonders and beauties of the Almighty's works. There is good sport also, for cariboo and bears are numerous, and a determined and fearless sportsman could have fine sport, especially this time of year. We can appreciate caribou, but the bears are a dangerous nuisance that we try to exterminate wherever we meet or see them. By the way, some of these gentry paid a visit last week to Albert canyon and appropriated two fine, fat pigs belonging to one of the section men and which he had been fattening for his winter supply of pork. Mr. Bruin came and the result is, the bear is so much fatter and the section man so much poorer. There had been a heavy snowfall on the mountains that had driven the bears down into the valleys. I had a narrow escape myself from a big cinnamon bear last week. It is not safe to go out here without a good rifle.—Quite a chapter on bears.

The Selkirk Mining Company's claim, the "Lanark," is now on a rich body of ore, and is the very best evidence we have that our mines only need developing. The Selkirk Co. has spent some $250,000 on this property, and will soon be getting some valuable returns for the outlay. They have two tunnels driven in from the side of the mountain to the lead—one, 300 feet below the surface prospect, and the other, some 300 feet below that. A shaft sunk from the surface, in the ore, is some 600 feet in depth, and they have now a body of ore in sight 30 feet wide 300 yards long, and some 600 feet in depth. The average for this claim is from 60 oz. to 80 oz. silver—60% lead. This is the only proved and developed mine here yet, and the result is most encouraging to all mine owners. The mine has been working for about three years—for the last two years under the able superintendence of Captain Eva, a gentleman well known in the States of Utah, California and other western States, as one of the most capable and skilful mine managers on the American Con-

tinent. A Cornishman by birth, he has been working amongst mines and mining of all kinds of mineral from the time he was ten years old—that is some fifty years, as he is now some sixty years of age. An aerial tramway is to be erected to bring the ore from the hillside down to the C. P. R. track, and next year will find this mine delivering ore at the rate of 60 to 100 tons per day.

The "Jumbo," owned by Messrs. Corbin & Kennedy, has been placed in the hands of an English syndicate for the sum of $200,000, and this mine has had some $25,000 expended on it. Taken altogether, the prospects of Illecillewaet are very healthy, and all point to a full springtide of prosperity, wealth, and stirring business in a very short time.

There is no chance here for doctors, as no one ever dies—country too healthy. E. A. WATSON.

ILLECILLEWAET, B ., Oct. 7th, 1891.

Florida Phosphate.

SIR,—The September number of the *Review* has just reached me.

The phosphate items are of particular interest.

The position as regards Florida is becoming particularly interesting. The general demoralization existing among consumers in Europe, produced by the exaggerated and "booming" reports so assiduously spread by the Floridians, is perhaps less intense than it was, but there is still room for great improvement. The Floridians themselves are now beginning to realize the injury they have wrought, and a general closing down of mines seems imminent. How very absurd the exaggerated statement of "shipments of 300,000 tons from the Hard Rock field during 1891," made by a prominent phosphate land operator early this year, is best shown by the annexed statistics, which are absolutely correct.

Present indications favor a somewhat better market, but notwithstanding this, some of the Florida companies continue to offer the article down. As novices in the export trade they fail to see that a price of 11¼d, with freight at 29s. (actual rate paid), is materially less than 10½d., with freight of 17s. 6d., which was about the average rate during 1890 from Fernandina.

I consider that I am perfectly correct when I say that there are to-day not 15,000 tons of ⅔ rock overground in the state of Florida; and further, that the entire output of such material for the year 1891, including what has been shipped thus far, will not aggregate 60,000 tons from all sources.

Shipments of phosphate rock from Fernandina, Florida, mined in Citrus and Marion Counties of ⅔ test:

1890		1891	
May.....	3,510 tons.	January	1,771 tons
August.....	983 "	February.....	1,680 "
September...	1,452 "	March.	3,851 "
November...	1,472 "	April.....	4,616 "
December ...	2,331 "	May.....	3,632 "
		June.....	4,275 "
Total....	9,748 "	July.....	4,265 "
		August..	3,050 "
		Sept. (to 17th)	4,325 "
		Total....	31,465 "

Yours, etc.,

NEW YORK, Oct. 9th, 1891. LOUP.

Cooling the Air of Mines.—The effectual cooling of mines is a subject which has long occupied the minds of engineers. An invention of some moment has been introduced to the managers of the Cornish mines by Captain Williams, and is one very likely to become adopted by colliery managers also. The machine is a simple one, and the moving parts are enclosed in a large upright box, and may be made in different sizes to suit the requirements of particular mines. Within the box is a cup-shaped cylinder which swims in water, whilst the motion of the piston-rod, actuated by steam-power, produces a strong current of air at both its upward and downward strokes. It can be placed at any required depth in the mine or colliery, and receives its full supply of air from the surface. No grease or oil being used, the air is, of course, preserved in the same condition as supplied. The under portion of the machine always contains about 6 ft. of water, and the up-stroke of the cup-piston going to the top of the machine, with the water running down the sides, keeps the inner part of the machine deluged with water, by which means the air is cooled before it is delivered into the mine; even to a temperate heat in the hottest summer. The inventor claims that the machine will force some 5,598,720 cubic inches of cool air into the interior of the mine, each minute, or that it will only require an engine of some two-horse power to deliver from 7,000 to 8,000 cubic feet of air into any part of the mine or colliery per minute. The machine will be thoroughly tested during the next few months.

Preservation of Mine Timber.—Experiments made at the Altenwald Colliery, Saarbrücken, of coating mine timber with lime, coal tar, wood tar and carbolineum, proved that lime was the worst and carbolineum the best preventative against dry rot. The cost of a double coating of carbolineum to a prop of 8¼ feet in length and 10 inches in diameter was 6d. for the carbolineum and 1¾d. for labor. At various mines in Saxony not only are the supports wetted occasionally to prevent dry-rot, but the wood is first impregnated with a solution of ferrous sulphate before being put into use. This method of treatment has been adopted for some time and has been found to give very good results.

Nova Scotia Gold Fields.

[Interesting Address By Mr. ALFRED WOODHOUSE, F.G.S., at the October meeting of the Gold Miners' Association.]

During the past month there have not been wanting evidences that the gold industry of Nova Scotia was about to be boomed.

Several foreign engineers and promoters have visited the Province, and have been practically unanimous in their favorable opinions of the chances for gold mining. At the October meeting of the Gold Miners' Association an invitation was extended to Mr. Alfred Woodhouse, F.G.S., of London, Eng., to address the Association on the subject of their industry, which invitation was accepted, and we have secured a copy of his remarks which we herewith present to our readers. It must be borne in mind that Mr. Woodhouse's experience largely relates to South Africa, and that that is a country of large veins; nevertheless, the truth which Mr. Woodhouse so clearly reiterates cannot be too often impressed upon mine owners and managers.

Mr. Alfred Woodhouse said that it was with some diffidence he ventured to give his impressions of what he had seen in Nova Scotia, considering how short his visit had been. He would, however, begin by stating that so far as he had gone he was decidedly favorably impressed with the future prospects of the gold mining industry of this Province. The formation here was decidedly favorable, and the output of gold in the past conclusively proved that the province had an industry that deserved even more attention than had been given it up to the present time. There was every justification for outside capitalists to invest their capital in developing these gold mines.

He warned them against offering to outside capitalists the worst of the mines, as if this was done, capitalists would very quickly be disgusted. The first principle which should guide those interested in securing the co-operation of outside capitalists should be to give them something with which they would be so satisfied that they would come again and want more.

So far as he had seen, comparing the lodes in Nova Scotia with those in other countries, he had every reason to believe that the leads in this Province would continue to great depths. He would not go so far as to say that they are fissure veins, but at the same time it did not necessarily follow that because they were not fissure veins they would not continue down to great and unworkable depths. Compared with other gold fields the veins here were a little thin. At the same time the lodes were very close together. But the mines must be worked on a commercial basis. Twenty dollars' worth of gold must be produced for something less than twenty dollars, otherwise commercial failure was bound to ensue. He was sorry to say that he could not agree with the present system of working the mines. The system in vogue here might properly be called the preliminary state of gold mining. For instance—a prospector starts and finds a vein with some gold in it, and naturally follows on that gold until water or some other little difficulty prevents him from continuing, when he leaves that vein and goes to some other. This may be a very good practice so far as developing the district is concerned, but it is not gold mining. Any one going to a gold mining section of the country here is struck with the enormous number of these small pits which have been sunk on the surface of the veins, and as soon as they have gone down a few feet they leave it and go to some other spot, which is following out nothing more than the old primitive method of two or three thousand years ago. He thought that, with some few exceptions, the system might be summed up in the word "Fossicking." However, the work that had been carried out by these prospectors was of some value. They have proved that there is valuable gold existing in these localities, and that with proper system of working there is every prospect of permanent value attaching to these mines. After the prospector comes forward the small capitalist, who mines down to a certain point—about 200 or 300 feet—beyond which point he is a little nervous about going. This is simply because he has not that amount of confidence in the mines that the surface workings or the work above the 300-feet level should have given.

The gold in Nova Scotia, so far as he had seen, ran in streaks or gold chutes. He did not think that sufficient attention was paid to these streaks. Every piece of work that was carried out on a mine should be accurately planned. As the ore is removed it should be accurately marked on the plan, and not only marked on the plan, but the various yields of gold at the different points should be indicated on the plan, so that after a few months' work the line of that particular gold streak should be accurately known. He wished particularly to mention what he assumed was the same in this country as in other countries—that a streak of gold will pinch and make in the same way as the leads of the country will pinch up and widen out, and therefore when gold miners, in working, gradually ran to a point where the gold was pinched to a few feet in length, they should not be disheartened. It would be an extraordinary thing if the streak of gold did not again widen out as the workmen proceeded deeper. In a country like Nova Scotia, where, in the gold mining localities, there were so many leads close together, the system of working was wrong. He admitted that it was easier to find fault than to propose corrections and improvements, but he felt it his duty to distinctly express his opinion that the system of working the mines in Nova Scotia was unsound. The proper system of working where there were so many leads occurring together, was by means of vertical shafts, from which cross-cuts should be made to tap the various leads. From this main shaft drifts should be started on the various leads with a slight gradient up-hill, so that not only all the water drained to the main shaft, but with this slight gradient the loaded trucks could be run down easily to the main shaft, and the same truck raised and delivered at the mill so that there would not be a second handling of the ore. Instead of adopting that system here the present existing plan was that of inclined shafts. The objection to this is that if inclined shafts are sunk, the miner cannot tell what variations in dip the lode may take. It may start at an angle of sixty degrees and go to sixty-five and then come back even to fifty-five degrees. Was it not clear that the wear, tear and friction of the hauling gear would be very much greater by this system than by the other?

It would be a great advantage to the mines in Nova Scotia if more money was spent under ground, and not so much on the surface until it had been practically demonstrated what was actually below. After all it should be remembered that it was the mine and not the machinery that gave the dividend. He stated this with some diffidence, for they must not forget that gold-miners were perhaps the most obstinate and assertative people on the face of the globe, and "knew all about it," and if they did not nobody else did. (Laughter).

And now, another point that is frequently lost sight of. As ore is removed a certain amount of development should take place, so that when a hundred tons of rock are raised two hundred tons more would practically be put in sight, and in that way the reserves are always increasing. The cost of this extra development should be included in the cost of working the mine.

As regards amalgamation, the first principle is to check the forward flow of pulp as often as possible, the more you check, the more gold you will save. A matter hitherto neglected was the question of concentration. The concentration of ores was a most important matter. He saw by the statistics published that only some 60 per cent. of the gold was saved.* Now, by a little practical knowledge and experience, competent men were able to save an additional percentage of gold, and while the cost of saving such percentage was very small, the beneficial result to a company was very considerable in the course of a year. He suggested that the question of concentration should receive more attention than had been hitherto given to it. He might mention that during the night shifts, when everybody was asleep, the stone is fed into the battery, and is passed over plates to take its chance, and that is what some call amalgamation! Any ignorant man could do that. Put a "nigger" to work and tell him to feed the quartz into the mill and set the stamps going so many drops a minute, let the crushed ore run over a certain surface of amalgamated plates, and that is termed amalgamation! That is not amalgamation. Amalgamation is a science and must be understood and pursued as a science.

Another matter which has escaped general notice in this country, and which should receive immediate attention, was the question of the alluvial deposits. As we see the country to-day, we notice that the contour of the surface is undulating or flat, but in former ages as one can see from the character of the drift, there must have been very high ground. Now these leads continued to much greater height, as amongst the drift, large masses of quartz are found. The drift here in this Province is perhaps unusually thick; but very little attention has been paid to it. During his visit, he had given particular attention to this matter, and he had found that in every district where he had been, there was always the same state of affairs. They do not know anything about cradles, sluice boxes, etc. They pan the gravel and obtain a certain amount of gold and some quartz. This quartz they break and only retain what shows visible gold. At Waverley, recently, he witnessed a man panning from the shores of a lake. His takes for the morning amounted to a few grains of gold and several small pieces of quartz showing visible gold. He asked permission to examine the results and ascertained that the yield was in value about $1.50 from the morning's work. That was obtained by the aid of a washing basin which was not more than nine inches in diameter. If a working man with such methods could achieve that result in a morning, what would a judicious outlay of a little capital effect?

It must not be forgotten that the gold in Nova Scotia was unusually coarse. He had been informed that a piece of gold had been taken out of a mine here, in weight 27 ounces. He had never seen a piece of gold coming out of a vein and weighing anything like 27 ounces. If such were the case and one such piece was found, there could be no doubt that there were plenty more. He stated that in his opinion, there was very good alluvial gold to be found in Nova Scotia, but it required looking for, and as soon as the Province could attract a desirable population by the discovery of rich alluvial in one place and another, a very important advance would be made in the position of the gold mining industry in Nova Scotia.

He thought Captain McDuff would bear him out when he stated that the great point to ascertain in connection with this is to learn where are the beds of the old rivers? Although rivers run north and south now that might not have been the case formerly. Where they ran north and south before they might now run east and west. He believed that if properly looked for, good alluvial fields would be eventually discovered in Nova Scotia.

[* Mr Woodhouse gives no authority for these statistics, and hence we do not know to what country they apply, but in Nova Scotia the sulphurets, as a rule, run low and the percentage saved is nearer 75 than 60.—EDITOR.]

In conclusion he would state that they were too eager to handle the dividend and would not form any reserve fund and thus be ready for the rainy day, *which always arrives in gold mining*—and many mines are to-day closed down for want of forethought.

Capital was essential. He thought that a stage in the mining industry in Nova Scotia had been reached where deep sinking and permanent works must be carried forward, and in his opinion, the only way to obtain most satisfactory results was, as a rule, by sinking vertical shafts and working these mines as mines are being worked in other countries.

Gold mining operations, when of a permanent character, are generally beyond the compass of private individuals. In some of the mines of this Province, a working capital of not less than $100,000 was highly desirable.

He suggested that the Gold Miner's Association should petition the Government, urging the necessity of proving the quartz with the aid of diamond drills and thus afford encouragement to those who, by their enterprise, are swelling the Province's finances.

It had been practically proved that gold in large quantities existed in the mines of Nova Scotia, and all that was now necessary for the prosperity of the gold mining industry was to induce foreign capitalists to come forward and carry on the work that had been so well begun.

At the conclusion of Mr. Woodhouse's address, remarks were made by several other gentlemen, amongst them Mr. B. C. Wilson, of Waverley, and Mr. Ross, of Montreal. Mr. Ross, among other things, said:—

There were other products in Nova Scotia which were more directly in his line than the important product just treated upon so eloquently by Mr. Woodhouse. He cordially agreed with that gentleman's observations about the cross-cutting. There seemed to be a peculiar aversion among the miners of this country to cross-cutting, and though they may have good reason to believe that there is another lode within perhaps ten feet, they will not pursue the proper course and cross cut to it, but would rather dig a little trench, when perhaps they already may have the depth secured, and it may only be a question of a few feet before their efforts would be rewarded. Some outside capitalists had come to this Province and done well. Others who had secured good mines let them slip through their hands by not working them properly. Other mines again, have been taken up and enormous amounts of machinery put on the ground before the owners really knew what they had to treat. They have been managed for the most part from thousands of miles away and not on the spot. Such a course would not do justice to any mine.

He had been pretty well over the whole Province in connection with other minerals of Nova Scotia. There were in this Province immense fields of coal and immense deposits of iron. There were also large quantities of manganese and antimony in some localities. These mines if properly operated would all pay and prove of great benefit to the country, but they could not be worked without capital. The people in Nova Scotia appeared to have a special preference for gold mines as compared with other mines, but there were other mines as well in this Province of great value. Capitalists, before investing any money in mines in a particular region, naturally ask what other mines are being worked there and what profits have they paid. There is no use to state that any particular mine would have paid had it been properly worked. The question is,—Have they paid? The wonderful mineral resources of Nova Scotia were not sufficiently known abroad. There were thousands of business men in London who may have heard of Nova Scotia, but know absolutely nothing of its mineral resources.

We import an enormous amount of iron from Europe for our own consumption, and he considered that the people here were capable of developing an industry which would be a benefit not only to Nova Scotia, but to the whole of Canada, and thus this Province could in that branch compete with the United States and Europe.

He had heard a great deal about other minerals and had received samples. Some were sent to him as asbestos which, he was sorry to say, were not asbestos; and also samples of tin, which, he was sorry to say, were not tin. (Laughter.)

There were comparatively large quantities of molybdenum found in this Province, but as yet no practical use could be made of it in the arts on a large scale.

There was one point concerning which he should like to see some definite stand taken. An official analyst and assayer should be employed in this Province. (Applause.) Nova Scotia derives a large part of her revenue from the mines, and he thought it was unfair that the Province which benefitted so largely from the operation of the mines should not expend a few hundred dollars in the employment of a public analyst to report on all sorts and descriptions of minerals sent him, and who might be the means of increasing the revenue of the Province by thus assisting in the discovery of valuable mineral deposits. Some of the greatest mines in the world had been brought before public notice by the discovery of valuable specimens by ignorant countrymen.

If such people could send their little findings to a public analyst, from whom they could get a straight report as to their value, a great amount of good might be done to the Province.

In this connection it would be desirable to have a museum where specimens could be sent for reference and a geological chart prepared, and thus the localities where the various minerals are situated could be more exactly designated than by the present system. (Applause.)

Mining in West Kootenai, B.C.*—Graphic Description of the Mining Districts and Mining Claims in this Promising new Field.

DR. G. M. DAWSON, GEOLOGICAL SURVEY OF CANADA.

The first mining claims were taken up at this place in 1883 by Thomas Hammill, afterwards murdered at Hendrys. These claims were situated near the shore of the lake, and were named the "Lu-Lu" and "Spring." Later in the same year claims known as the "Surprise," "Morning Star" and "Evening Star" were staked further back from the lake, and nearly on the line of what is now known as the Spokane vein. The ores discovered at this time were, however, rather low in content of silver, and it was not till the find of rich ores in Toad Mountain became known in the spring of 1887 that an impetus was again given to prospecting and high grade ores were discovered in this vicinity.

Nearly all the principal deposits since found here, some of which have been developed to a considerable extent, are included in an area extending from south to north between Coffee Creek to Woodberry Creek, a length of about six miles; from east to west from the lake shore to the vicinity of the "Sky Line" claim, a width of little over two miles. The number of actual discoveries of considerable bodies of good ore already made in this comparatively limited area is remarkable, and new finds are still occurring from time to time.

From the edge of the lake the country rises to the west in a long irregular slope, which, as seen from a distance, presents a series of step-like ascents, produced doubtless by the irregular denudation of a series of beds of unequal hardness. This step-like appearance, though also observed to the northward along the same side of the lake, is here much more marked than elsewhere. The region has originally been densely wooded, and in some of the hollows excellent cedar and white pine timber is still to be found, but since the occupation of the camp, most of the original forest has been burnt off, either accidentally or with the object of facilitating prospecting. A fairly good trail has been made from the lake shore to the "Number One" mine, a distance of about two miles in a straight line in a west-north-west bearing, the height above the lake attained at this point being about 2,520 feet. The course of the trail is, however, exceedingly sinuous, and besides the numerous sharp zig-zags necessary to overcome the steeper parts of the ascent, it makes a long sweep to the southward, and another to the northward before reaching the "Number One." Smaller trails and tracks branch off in various directions to other claims, and by one of these the ascent of the main slope may be continued in a south-westerly direction from the "Number One" mine to the "Sky Line" at an approximate height above the lake of 3,460 feet. No attempt has yet been made towards the construction of a waggon road, and such ore as has been sent out has been carried down to the lake shore on horses or mules. The best general section of the rocks of the vicinity was obtained along the main trail, measurements being made by pacing, but as there are considerable intervals in which no rock exposures occur, this still leaves much to be desired. The general strike of the rocks, which is preserved with considerable regularity, is nearly due north and south, but about half-a-mile below the "Number One" mine it turns gradually to a nearly north west bearing, a change which, however, is probably local in character. The dip of the rocks is, almost without exception, to the westward, at an average angle of perhaps 45°. The inclination is, however, considerably less near the shore of the lake and probably also in the vicinity of the "Number One" mine, while further up near the "Sky Line," and in the vicinity of the edge of a granite mass to the west, the beds are much disturbed and crumpled, and often nearly vertical.

On the shores of the lake the rocks are coarsely crystalline, glittering mica-schists, often garnetiferous and in thin flaggy beds, dipping S. 77° W. < 20°†. Rocks of the same character and referable to the Schuswap series of the general section, are seen in a few places, and appear to be continuous for a distance of a little more than a quarter of a mile back from the lake, measured at right angles to the strike. A belt of green schists is then crossed, with a width of about 700 feet, and with westward dips at angles of 45° to 50°. A trail going southward toward the "Little Donald" claim branches off a short distance before the west edge of the green schist is reached and between this trail and the west edge of these schists the beds have irregular and sometimes very high dips. To the west of this belt of green schists the rocks appear for the most part again to consist of rather coarse mica-schists, to the vicinity of the "Spokane" mine, a further distance of 1,300 feet measured as before, directly across the strike. The "Spokane" mine is situated near the brow of a steep, step-like ascent of about 200 feet, at the foot of which runs a strong body of "barren quartz" and silicified rock, together with a wide dyke of augite andlesite, with large porphyritic crystals of black pyroxene and glassy felspar. It appears probable that some faulting may occur near this line, and that the strata so far described in ascending from the lake may form a single synclinal fold, overthrown to the eastward, of which the belt of green schists marks the axis.

Beyond the "Spokane" mine considerable intervals occur in which no rock exposures are seen near the trail, but the rocks appear to consist almost entirely, for a width of 2,800 feet across the strike, of greenish schists, which, though fine-grained, are often distinctly hornblendic in character. The angles of dip observed are nearly uniform, and it is probable that the thickness of these schistose beds is here about 2,350 feet. One bed of hard grey, somewhat schistose and slightly micaceous quartzite, of forty or fifty feet in thickness, was noticed in this schist series not far west of the "Spokane" mine. Another rock of peculiar character was found near the upper part of this series of schists, possibly forming its upward termination and immediately underlying the limestones next above. This is a grey, rather fine-grained schistose conglomerate, of which the schistose surfaces are often highly micaceous, and in which numerous small garnets occur. This entire series of schists, though not distinctly separable into greenish and greyish members, and though more highly altered and much less in thickness than those of the Adams Lake series in its typical locality, is supposed to represent that series.

Overlying these generally green schists is an important bed of limestone, the upper and western line of which is found on the trail at Cooper's cabin. It occupies a width, measured across the strike, of 600 feet, and has a possible thickness of 530 feet, though from its massive character and the crumpled appearance in some small exposures where bedding can be seen, this is very uncertain. It is chiefly grey and fine-grained, though occasionally marble-like. This limestone, together with the rocks overlying it, and forming the whole upper part of the Hot Springs section, are supposed to represent series No. 5 of the Adams Lake section, though the considerable volume of greyish schists found between the limestone and that at the "Number One" is not precisely parallel on Adam's Lake.

The section between Cooper's cabin and the "Number One" mine is very imperfectly exposed, but the rocks met with are chiefly greyish schists, often rather micaceous (though quite different in appearance from the mica-schists of the lake shore), with one or more rather important belts of black glossy argillites. Micaceous quartzite-schist occurs among the grey schists in places.

The width occupied by these rocks, measured across the strike from the line of Cooper's cabin to that of the "Number One" mine, is about 2,900 feet, and the thickness of rocks represented may be about 2,600 feet.

In the vicinity of the "Number One" mine, limestone is again found, and is supposed to represent a second and higher zone of this rock. It is conjectured that this may occupy the centre of a synclinal fold, the eastern side of which is regular and rather wide. The disturbed and often vertical black argillite-schist near the "Sky Line" in the vicinity of the edge of the bordering granite to the west, may represent the return on the west side of the synclinal of the similar rocks alluded to in the foregoing paragraph. It would, however, require much detailed examination to fully work out the structure of this section.

That a considerable amount of importance attaches to the arrangement of the various rocks comprised in the section at Hot Springs, is evident from the observed dependence in character of the ore deposits on that of the country-rock. The general direction of the veins is nearly north and south, being nearly or in some cases exactly parallel with the strike of the rocks. Some of these, like the "Spokane," appear to dip also at the same angle with the enclosing beds, but in other cases, to the west of this, the metalliferous veins cut across the bedding of the rocks to a greater or less extent, and may be expected to change in character when followed in depth into country-rock of another kind. The number of well defined veins which occur has not been yet ascertained. Some of the lodes are said to have been followed for several miles, but while it is evident that belts producing similar ore and exhibiting veins of like character and appearance have thus been traced out, it is not yet certain that any single vein runs continuously for such distance. This cannot, in fact, be certainly ascertained till much further work has been done. The lowest tier of deposits, included in the mica-schists of the Schuswap series, may be stated to yield ore averaging from 20 to 40 ounces of silver to the ton, while further up, selected ore in lots of several tons, has yielded from 85 to 300 ounces to the ton, the richest deposits being those associated with the limestone and black argillites.

The ore is principally argentiferous galena, which, in the lower veins contained in the harder rocks, has usually become decomposed to a very limited depth only from the surface; but in the limestones the decomposition has often extended to a considerable depth, and has resulted in the production of soft, rusty "carbonate ores;" filiform native silver or "wire silver," together with tetrahedrite are also found in some of these richer deposits. The veins which, like the "Spokane," follow the bedding of the mica-schists, are the most regular, while, as might be anticipated, those contained in the limestones are not nearly so uniform in size, and tend apparently to assume the character of mineral-impregnated belts of rock in which occasional large masses or "chimneys" occur. This is apparent in claims such as the "Sunshine" and "Number One." In the latter, where most work has been done, there is comparatively little true gangue associated with the ore, but zones of the limestone itself have become shattered and more or less highly charged with ore throughout. The ore even penetrates the limestone itself in the vicinity of the main deposits, and thin plates of native silver are found in joints, particularly in those parts of the rock which immediately overlie the larger masses of rich ore.

* Report of Progress Geological Survey.

† The bearings given in this and following pages are magnetic, it being supposed that such compass bearings may prove more serviceable to the miners and prospectors than true bearings. The magnetic declination here is about 24° E.

The importance of the Hot Springs vicinity as a producer of silver and lead may, I believe, be stated to be assured by the number of deposits already known, and by the richness in silver of the ores from many of these which have been partially developed. Should only a small proportion of the numerous claims prove eventually to be as valuable as many of them now appear to be, the output of ore cannot fail to become very considerable within a few years.

The following notes relate to such of the claims as I was able to inspect personally last June. While those include several of the best known and most promising properties, numerous others are not mentioned, as it was impossible to visit all in the time at my disposal. The notes here given may, however, serve to afford some information as to the general mode of occurrence of the ores. The claims first described are those met with on or near the main trail, in order of ascent from the lake, and ending with the "Sky Line." After these, some claims to the south of the main trail are noted. A considerable group of claims situated some distance to the north of the main trail, including the Gallagher and others, was not visited by me.

Jeff Davis' Claim.—Height above lake, 690 ft.* Very little work has been done upon this deposit, which, at the surface appears to consist of an irregular shattered belt of rock, silicified and charged with ore, rather than a well-defined vein. Veins running through this contain galena in considerable quantity, in some places with a width of six inches of nearly pure ore. The ore is considerably decomposed at the surface, but is occasionally found to include a little copper-pyrites. This claim was first taken up in 1883 and has since been re-located several times. Several other claims, supposed to cover extensions of the same deposit, have been staked to the north and to the south.

Spokane Mine.—Height above lake, 1120 feet. This is situated on a very well defined vein, which runs between the beds of a medium-grained grey, silvery mica-schist. The course of the vein is the same as the strike of the beds, or N. 43° W. It dips to the south-westward at an angle of about 60°. The vein, as seen on the surface, is from one to two feet in thickness and is largely composed of galena, associated with a little iron-pyrites and quartzose gangue. A shaft has been sunk to a limited depth on the vein, following its dip, and a good deal of exploratory work has been carried on. The shipments during 1889 amounted to 44 tons, which yielded at the rate of 35 ounces of silver to the ton. The following claims are supposed to be upon the continuation of the "Spokane" lode, and there is little doubt in this case, from the remarkable regularity of the deposit, that most of them are actually situated on the same lode. Claims to the southward: "Maestro," "Little Phil," "Black Diamond," "Little Donald," "Paymaster," and one or more in addition, of which the names were not ascertained. Claims to the northward: "Trinket," "Maple Leaf" and others beyond Cedar Creek, which, owing to the amount of cover in the valley of the creek, cannot be certainly traced into connection with the "Spokane."

Sunrise Claim.—Height above lake, 1,920 feet. The country rock is here limestone, forming the lower part of the important limestone belt already described. The ore deposit, so far as it has been exposed by surface work, appears to be rather irregular in character, the ore reticulating through the limestone for a width of 20 feet or more, where best exposed. The direction of the general run of the ore at this place appears to be from N. 20° W. to N. 30° W., or nearly transverse to the strike of the rocks, which, however, turns more to the westward a short distance further north. A considerable body of ore is seen on the "Sunrise," most of it rusty and decomposed, forming the so-called "carbonate ore." This, however, contains numerous irregular masses of unaltered coarse-grained galena, which holds also a little iron-pyrites. To the southward along the strike of the rocks, the "Coronation" and "Black Chief" claims, with several others, have been taken up. To the north are the "Ohio," "Sweden" and a number of other claims.

Sweden Claim.—This is situated about 1,200 feet northward from the last-described, the "Ohio" claim intervening. A shaft has been sunk here to a depth of 40 feet, in which the width of the vein is stated to average 3 feet. The upper part of the deposit is completely decomposed, forming a soft, rusty mass of carbonate ore. From the shaft unaltered ore consists of galena, with zinc-blende and some iron-pyrites. The gangue is calcite, with a little quartz.

Tiger Claim.—Height above lake, 1,790 feet. This lies still further to the northward, on the edge of the wide valley of Cedar Creek. It is spoken of as being on the continuation of the last deposit, but the connection is not definitely traced. The vein here follows the bedding of the rock, running N. 65° W., with a southerly dip of 60°. The vein is overlain by rather fine-grained, grey, micaceous schists, and underlain by limestone, and appears to be about 3 feet wide. The ore is considerably decomposed and resembles that of the "Sweden," consisting of coarse crystalline galena, with some iron- and copper-pyrites.

Number One Mine.—Height above lake (at shaft), 2,510 feet. More development work has been carried out on this claim than on any other at Hot Springs. During the past year (1889) it is stated that 130 tons of selected ore has been shipped, the return in silver being at the rate of 85 ounces to the ton. Several substantial houses have been erected and other improvements made. A shaft had been sunk on the ore to a certain depth, at the time of my visit, and an adit run in for the purpose of intersecting the shaft, but I am unable to state what progress has been made in these workings up to date. The ore occurs in grey limestone, which is often rather shaly, and just above the shaft glossy black argillites are seen in the hill. The deposit appears to be somewhat irregular and "pockety" in character, as is usually the case in limestone country-rock. Its general run is supposed to be about N. 15° W., and ore, presumably epresenting a continuation of the same deposit, has been uncovered at several places, extending for a length of about 400 feet. At the surface the ore is completely decomposed, forming a soft, rusty mass, which is excavated by pick and shovel. In depth it is found to consist of galena and blende, with a little iron- and copper-pyrites. Native (wire) silver is not infrequent, and it is probable that some tetrahedrite or ruby-silver ore also occurs minutely disseminated. The metalliferous constituents of the ore are usually disseminated in small crystalline aggregations, the gangue consisting of more or less altered and silicified limestone and sometimes of quartz. Many little cavities lined with quartz crystals are found in the mass, and in some instances the metalliferous minerals penetrate the limestone irregularly for considerable distances. The mode of occurrence of the ore at this place and elsewhere in the limestone country, is such as to suggest that systematic exploration with the diamond drill will in future prove to be of essential service in tracing out and exploring for the more important deposits. Claims upon which ore has been found and which are supposed to cover portions of the northern continuation of the "Number One" deposit are, the "Columbia." "G. B. Wright," "Black Bear," "Della" and "Kate."

Della Claim.—This is the only one of the claims just enumerated which was visited. It is situated at a distance of nearly a mile in a north-westward direction from the "Number One," at an elevation of 2,490 feet above the lake. From the "Della" sixteen tons of ore is stated to have been shipped during the past season, yielding about 105 ounces of silver to the ton. An opening about fourteen feet in depth had been made on the out-crop at the time of my visit, but the vicinity is so much covered by soil and undergrowth that little could be seen of the relations of the ore. Black, glossy argillites, however, out-crop on the up-hill side of the ore, which is evidently in considerable body, though its width could not be ascertained. Where excavated it is almost completely decomposed, and resembles the upper part of the "Number One" deposit, but contains more galena in proportion. Some iron-pyrites was also seen.

Sky Line.—This claim is situated nearly a mile from the "Number One," in a direction about S. 30° W., and at a considerably greater elevation, being approximately 3,460 feet above the lake. It was discovered just about the time I reached Hot Springs, and it so happened that I was unable to find the point at which it had been uncovered. Specimens of the ore obtained at the surface consisted of rather fine-grained, grey siliceous rock, which had become porous from the weathering-out of its metalliferous constituents, but had no rusty appearance. In an unaltered state the ore might probably resemble some of the more siliceous portions of the "Number One." Under date January 24, 1890, Mr. J. Anderson informs me that a shaft has been sunk on this deposit to a depth of 100 feet where the ore appears to be unaffected by surface action, and shows more galena. It also occasionally holds native silver, and some copper pyrites with a sulphuret of silver or tetrahedrite. This claim is situated close to the eastern edge of the granite, which bounds the mining field to the west. An experimental shipment of 12 tons of ore has yielded about 300 ounces of silver to the ton. The ore is said to occur at the junction of argillite and limestone, the argillite forming the hanging wall.

The following claims, situated to the south of the main trail, were visited.

Little Donald.—Height above lake, 1,120 feet. This has already been alluded to as being on the southern extension of the "Spokane" vein. It is distant about a mile from the "Spokane" mine. The country-rock is mica-schist, dipping S. 70° W. $< 45°$. The vein here dips at an angle of about 40° and an incline had been run down on it for about 50 feet, with a drift to the north of about 40 feet at the date of my visit. The shaft was full of water at the time, but was afterwards cleared and carried down to 75 or 100 feet, when the quantity of water coming in led to the temporary suspension of operations. The vein is reputed to average from 6 to 9 feet in thickness. The ore consists chiefly of galena in coarsely crystallized form, and is not decomposed far from the surface. The gangue is chiefly calcite and dolomite, and the fact that very high assays are occasionally obtained indicates that some of the richer silver ores, such as tetrahedrite or argentite, are present in places. During the summer of 1889, 66 tons were shipped, yielding 95 ounces of silver to the ton.

Krao Claim.—Height above lake, 1,390 feet. Some shipments were here first made of ore obtained from cavities in limestone, which constitutes the country-rock. These were said to run high in silver. After going down about 40 feet at this place, a second opening was begun at about 150 feet from the first, where the vein was better defined. A shaft was begun near the vein and was down about 20 feet last June. It has since, I believe, been carried to a depth of 75 feet. The vein appeared near the surface to be from 6 to 8 feet wide, but with rather irregular walls The limestone has the appearance here of a greyish or bluish marble, and dips S. 6° W. $< 80°$, which the vein also appears to follow. The ore consists chiefly of rather massive, coarsely-crystalline galena, more or less decomposed, but occasionally finds of native silver are reported. During the season eleven tons of ore was shipped, yielding at the rate of 90 ounces to the ton. Several claims supposed to cover the southern continuation of the same lode as far as Coffee Creek, or for a distance estimated at 7,500 feet, are said to show well in ore. These are the "Crow Fledgling," "Now Then," "Crescent" and "Eden."

United Claim.—Height above lake, 1,500 feet; situated about 1,500 feet to the north-west of the "Krao." This was a new discovery at the time of my visit, and had been uncovered for about 50 feet only. The foot wall which was exposed consists of greenish schist, dipping south-westward at an angle of about 40°, and the vein appeared to be parallel to its bedding. Its thickness, as uncovered, was from 3 to 5 feet. Part of the ore consists of coarsely-crystallized galena, part of very fine-grained galena.

Arkansas Claim.—An opening known by this name has been made in this vicinity on what appears to be a considerable deposit. There is a good showing of galena and rusty vein matter.

Black Chief.—Height above lake, 1,690 feet. Small prospect holes only had been opened upon this deposit, showing galena and rusty vein matter with much quartz. The dip of the vein is about S. 78° W. $< 20°$. Pure galena is said to assay 46 ounces of silver to the ton,

As previously stated, a great many claims upon which more or less ore has actually been found were not visited by me. Of these, one of the most important is that known as the "Gallagher," to the north of Cedar Creek, from which during the past summer, thirteen tons of ore was shipped, which is reported as yielding 126 ounces of silver to the ton. This is one of a considerable group of claims in the same vicinity. The notes given above, while incomplete, may serve to give some idea of this new district. The various claims in the present incipient stages of the work, change more or less in relative importance and appearance every month, as the work of development goes on, and thus render very minute description or enumeration of little practical importance.

Hendryx Mining Camp.

The peninsula on the east side of Kootenai Lake, nearly opposite Hot Springs, has become known as Hendryx, from the name of the very energetic manager of the Kootenai Milling and Smelting Co., by which company most of the work so far done here has been carried out. The rocks here met with have already been described as belonging to the lower part of the mica-schist series, or Shuswap group of the general section. The ore is comparatively low grade as regards silver, and will probably require the erection of smelting works on the spot before it can be profitably utilized. Its profitable shipment under the present conditions is quite out of the question.

The deposits of galena at this place are said to have been discovered by the botanist Douglas, as long ago as 1825. In later years they have been taken up and abandoned several times, the country being too remote for their utilization or development.

The ore deposit, though, as above stated, low in content of silver—assays giving from 15 to 40 ounces to the ton only—is very large and striking in appearance. It seems to run in a general north and south direction through the entire length of the little peninsula, and is covered by three claims, known from south to north as the "Kootenai Chief," "Blue-bell" and "Comfort." The lode is shown at intervals, partly in natural exposures and in part in strippings, through all three claims, or for a total length of about 4,000 feet. Though varying much in appearance from place to place, and also in the upper and lower parts of the deposit, as seen in single exposures its general character is very similar in all. The ore consists of a mixture of iron and copper pyrites, galena and blende, contained in a quartzose gangue, which is often more or less cavernous and crystalline. Portions of considerable thickness occur throughout, which are almost pure galena, while in others iron pyrites preponderates, and these two minerals are usually associated in a finely or coarsely granular mass.

Though, generally speaking, very constant in its direction, the thickness of the lode appears to vary considerably. Thus on the southern point of the peninsular ("Kootenai Chief" claim) the main ore-mass has an average thickness, so far as can be seen, of about twelve feet; in a cross-cut made on the "Blue-bell" claim, the ore is reported to be about eighty-six feet thick, and from the material on the dump, must here consist chiefly of galena. In a general way, the lode closely follows the strike of the containing rocks, which consist of mica-schists, marble and quartzites. That the lode is not, however, always in strict parallelism to the bedding, is shown by the fact that the bed above it is in some places marble, in others mica-schist; also by the circumstance that parallel zones of ore occur at some distance from the main mass. It should be added, that while the general run of the ore appears to be persistent and continuous, as above stated, there are evidences of small displacements by faulting, while masses of marble or limestone also occur in it, and irregular spurs of ore were observed to run off, as though at times the ore had replaced parts of the adjacent marble.

At the south point of the peninsula, the ore and containing rocks dip S. 80° W. $< 60°$; at the "Blue-bell" openings, S. 73°, W. $< 45°$; and near the north end of the "Comfort" claim, S. 80°, West. $< 20°$. A considerable amount of prospecting and development work has been done on the "Blue-bell" claim, and an adit is now being run in from the vicinity of the lake shore with the

*The heights assigned to this and other claims were barometrically determined with approximate accuracy.

object of tapping the vein at a considerable depth and affording a satisfactory beginning for regular work. This, at latest advices, had reached a length of over 300 feet. The work done in the "Kootenai Chief" and "Comfort" claims has been confined to stripping and surface trenching.

Toad Mountain and Vicinity.

The greater number of the discoveries of metalliferous deposits made on Toad Mountain and in its vicinity, are included within the limits of an apparently isolated area of stratified rocks. This area runs nearly east and west, extending from the head of Cottonwood-Smith Creek, westward to the vicinity of the lower fall of the Kootenai River at Ward's Ferry. Its length, in the direction above indicated, is about eleven miles, while its average breadth may be about two miles. While, however, its northern boundary may be considered as being shown with approximate accuracy by the line on the map, its southern edge was not examined by me, but depends on statements received from others. The rocks surrounding this area are everywhere, so far as observed, grey granites.

The stratified rocks here met with differ considerably in appearance from those found in the vicinity of Hot Springs, but, as already mentioned it is supposed that they represent, for the most part, the greenish and grey schists of the Adams Lake series. The differences found between these rocks and their supposed representatives at Hot Springs is paralleled elsewhere in the province, and appear to depend chiefly on the greater amount of pressure and consequent crushing to which the rocks of the last-named locality have been subjected. It is principally to action of this kind that the markedly schistose character of the rocks of Hot Springs is attributed. The outlier constituting the stratified area of Toad Mountain, has apparently been more affected by heat and hydrothermal action consequent on the extrusion of the granite, and while schists resembling those of the grey and green series at Hot Springs are not wanting here, they are subordinate in importance. Connected with this difference in the mode of alteration of the rocks, rather than with any original diversity in the mineralogical composition of the country-rock, is no doubt the well-marked difference in the ores of the two places.

The rocks characteristic of this outlier, though presenting many varieties which will eventually be found worthy of more minute investigation, may be described as consisting for the most part of stratified volcanic materials of palæozoic age. These are generally of greenish or grey colour, and appear for the most part to be diabase in lithological composition. Diabase-porphyrite is not uncommon, and notwithstanding the considerable degree of metamorphism which the strata have suffered, some distinctly amygdaloidal diabases are still to be found. Hornblende-schists and rather massive pyroxmite-like rocks with some hornblende, also occur, especially in the immediate vicinity of the granite. When the rocks assume a distinctly schistose character, as in certain belts near the "Cottonwood" and "Silver King" mines, it is sometimes clearly apparent that the schistose structure does not entirely correspond with the original bedding, but crosses it at an angle. Near the western extremity of the stratified area, where the rocks are more closely surrounded by the granite than elsewhere, they are found to have suffered more than the usual amount of change. They consist of fine-grained gneissic, hornblendic and micaceous schists, often greenish in colour, owing to the development of epidote. Here also a thin bed of limestone converted to a coarsely crystalline marble was observed. In addition to the rocks of volcanic origin, beds of blackish argillite, more or less pure, were found in some places, but these hold a subordinate position in the series. The general direction of the strike of the rocks in this area is nearly parallel to the longer axis of the area itself, while the majority of the dips are in southward direction, usually at high angles or nearly vertical, though toward the west end decreasing to 40° or even to 20°.

Much altered fragments of the stratified rocks are frequently found enclosed in the mass of the granite near the line of junction. The granite near this line is also generally much jointed, and often greenish from the development of epidote, which is specially abundant along the jointage planes. The occurrence of this isolated area of stratified rocks, together with that of the smaller but similar mass on the east side of the Cottonwood-Smith Creek, renders it probable that additional similar areas yet remain to be found elsewhere in the great granite region. Should such be discovered, they may prove to afford further deposits of ores like those of Toad Mountain. The following notes refer to the claims visited by me on Toad Mountain and in its vicinity last June. These comprise the principal properties upon which more or less work has been done:

Silver King Mine.—Height above lake (at houses), 4,310 feet. This property, sometimes known as the "Hall Brothers' Mine," is the most important so far known, and its discovery led directly to the recent interest and developments in this region. It was accidentally found late in the autumn of 1886, but nothing was done toward opening it up until the next spring. Toad Mountain, previously one among many undesignated summits, received its somewhat peculiar name at the same time. The mine is now reached by a fairly good, though often steep trail, the distance from Nelson being about five miles in a straight line. The property consists of three claims, each 1,500 feet in length. Of these, two, named the "Silver King" and "Kootanie Bonanza," are laid out along the run of the principal vein, the third, known as the "American Flag," lies alongside to the north, and is supposed to cover a second parallel vein.

In ascending the mountain by the trail, granite continues for some distance from Nelson, but is replaced by stratified rocks, previously described, probably near the point at which Give-out Creek is crossed by a bridge. Greenish diabases, both massive and schistose, are characteristic, but about quarter of a mile southward from the houses at the mine, these are followed by a grey decomposed quartz-porphyry, which, from its appearance and mode of fracture along jointage-planes, simulates granite when seen from a distance. The rocks in the immediate neighborhood of the openings made on the ore, are generally massive, though also in places schistose. They are here frequently more or less completely silicified and blotched by little segregations of quartz. On the slopes of the summit situated about a mile to the westward from the houses at the mine, some blackish argillite-like beds occur, and on this summit one of the distinctly amygdaloidal rocks previously alluded to was found. Lithologically this rock is a diabase-porphyrite.

The rocks are generally highly inclined or vertical, and their strike is nearly parallel to that of the schistose lamination, so that it is difficult to determine whether the schistose zones have differed originally in composition, or whether they merely represent lines along which the rocks have yielded to crushing. The general run of the metalliferous veins is also here nearly, though probably not exactly, parallel to the strike of the rocks.

The greater part of the work accomplished has been carried out on the "Silver King" claim, for an opportunity to examine the openings on which and other facilities I was indebted to Mr. J. Macdonald and Mr. Hall.

The lode, or ore-body, has been traced more or less continuously through the "Silver King" and "Kootanie Bonanza" claims, with a general direction nearly east and west magnetic. While, however, the general continuity of the ore-bearing zone has thus been proved, it appeared to me probable, on comparing the positions of the various openings, that its run is not throughout perfectly straight. On the "Silver King" claim houses have been built, and two drifts have been run in at different levels on the lode. From the end of the upper drift, the ore had been followed down by a winze to a depth of thirty feet at the time of my visit. This is stated since to have been continued to fifty feet, at which depth it is reported to be in a large body of rich ore.

The best opportunity of examining into the character of the deposit occurs in these workings. The lode is found to possess no distinct walls, but to occur as a zone of variable, and sometimes apparently of indefinite width, of shattered and mineralized rock, throughout which veins of pure and richly argentiferous ore occur in a somewhat irregular manner. Where gangue appears it is principally quartz, but there is on the whole a rather notable absence of gangue, or crystallized vein material, the ore apparently filling irregular crevices, and running in shoots and spurs into the rock, so as to form here and there considerable masses. The metalliferous minerals comprise bornite and tetrehedrite, with some iron and copper pyrites, but only occasional traces of galena. The two first mentioned minerals, when nearly pure, contain the largest percentage of silver, while the pyrites is comparatively poor. In surface exposures the material of the lode is almost completely oxidised, producing a brown or blackish gossany material with some green and blue carbonates of copper.

The excavations so far made are of a very irregular character, the ore having been followed wherever it appeared, and in some cases a considerable quantity of barren rock has been dealt with in pursuing this method of work, which can be justified only because of the great richness of the ore and the want of sufficient capital for more systematic operations. All the circumstances appeared to me to warrant the expenditure of a large sum of money, if necessary, in order to define and open out this remarkable deposit in a proper manner, and till work of this kind has been done, it will be impossible to ensure any large or continuous output of ore. The richer portions of the ore are at present selected by cobbing and and hand-picking, and packed in sacks for shipment; but a considerable portion of the whole is thrown to one side, pending the erection of machinery for fine concentration. According to the Report of the Minister of Mines of British Columbia for 1889, the cost of conveying the rich ore on pack mules from the mine to Nelson, was $10 per ton, and from Nelson to Butte, Montana (a distance of 700 miles), including the charge for smelting, cost a further sum of about $47.

The character of the ore obtained is shown by the following analyses by Messrs. Johnson & Matthy, London, for which I am indebted to Mr. R. D. Atkins, who collected the three specimens referred to:

	I.	II.	III.
Copper	47·000	24·900	40·100
Silver	2.360	·232	1·292
Iron	7·300	12·200	1·800
Zinc	1·300	2·400	5·700
Manganese	1·200	5·100	·400
Antimony	1·400	3·400	15·600
Cobalt and Nickel	traces.	traces.	traces.
Lead	·100	traces.	1·700
Arsenic	3·100	2·100	4·500
Carbonic Acid	nil.	6·000	nil.
Lime	nil.	5·200	nil.
Magnesia	·700	traces.	nil.
Alumina	nil.	·200	nil.
Sulphur	22·900	22·000	27·200
Phosphorus	nil.	traces.	nil.
Siliceous insoluble matter	9·200	8·800	1·000
Traces of gold, oxygen, water and loss	3·440	7·468	·708

to the ton of 2,240 lbs., specimen No. 1 contains 771 ounces of silver; No. 2, 75 ounces 16 dwt; No. 3, 422 ounces. Traces of gold were found in all, and in two shipments made to smelter, of which details have been obtained, the value of the gold recovered per ton of 2,000 lbs., amounted to $2.16 and $1.44 respectively.

The ore where exposed on the "Kootanie Bonanza, to the east of the "Silver King," and at a height of about 200 feet above the level of the lower drift on that claim, is similar in appearance to that of the "Silver King," but more or less superficially decomposed. What is known as the "Grizzly" claim, lies parallel to the "Kootanie Bonanza," adjoining it to the north. This is not a part of the Hall Brothers' property. An opening made to a small depth in one place, again shows similar ore in a shattered zone of country-rock. The "American Flag" claim was not visited.

A small opening made at the side of the main trail a short distance below the houses on the "Silver King" and at the west end of that claim, deserves some notice. This, according to Mr. Macdonald, is precisely on the line of the main lode, and is considered to represent its continuation at a lower level. The lode is here much more regular in character than where it has been worked, being enclosed by schistose rocks, the strike of which it follows. It is from three to four feet in width, and contains a considerable proportion of galena, approaching in character and appearance the deposits found on the "Iroquois" and "Dandy" claims, subsequently noticed. On the assumption that this actually represents the continuation of the "Silver King" lode, it is evident that that deposit must change in its character to the westward or in depth, and it seems probable that such change occurs together with that in the nature of the country-rock, the hard, massive, irregularly shattered rocks found in the drifts appearing to yield the richest ore. The shipments from the "Silver King" during the past season are reported to have aggregated sixty tons, averaging about 300 ounces of silver to the ton.

Dandy Claim.—Height above lake (at entrance to drift), 3,980 feet, or about 300 feet below the houses of the "Silver King." This claim lies to the west of the "Silver King" claim, adjoining it, and there can be little doubt that it is located on the continuation of the same lode, which has been exposed at various places throughout the length of the claim. Comparatively little work beyond this tracing of the lode had been done at the time of my visit. The lode runs nearly east and west magnetic, showing, where a drift had been begun, a dip at an angle of about 80° to the southward and a width of three feet. The ore consists principally of galena, with copper pyrites and occasionally some blende. It shows besides occasional stringers of tetrahedrite, which are reported to yield very high assays. The gangue consists of quartz, which is present in larger quantities than in the "Silver King" ore. The wall rocks are composed of green slates or schistose diabases, the strike of which the vein follows exactly. It holds its width well where exposed, and appears to be fairly regular in direction and character. No ore rich enough to ship under present circumstances has yet been obtained from this property, which nevertheless promises well, and appears capable of yielding, with fine concentration, a large proportion of rich ore.

Iroquois Claim.—Height above lake (at entrance to drift), 4,190 feet. This claim lies to the south of the run of the "Silver King" lode, and is supposed to cover a distinct deposit. The vein here runs about S. 80° E. and has been traced by trenching at intervals through the whole length of the claim, or for a distance of about 1,500 feet. The country-rock is a grey, rusty or green-grey schist, probably a diabase schist, but so much decomposed in some places that it is difficult to characterize it. A drift about sixty feet in length had been run in along the lode at the time of my visit. The lode is practically vertical, with a width in some places of twelve feet of ore or mineralized rock. It is stated to be not less than six feet in width in any place where it has been exposed. The ore somewhat resembles that of "Silver King," but contains more galena, and is more diffused through the gangue and the country-rock where exposed in the working. It also contains copper and iron pyrites, together with some tetrahedrite, the last mentioned mineral being the richest in silver. Crystalline quartz, which often occurs in nearly pure masses of some size, is much more abundant than in the "Silver King" workings. This is another very promising deposit, but like the "Dandy," yields no ore rich enough for present shipment.

The group of claims to which the above description refers, including those of the Hall Brothers, are contiguous, and are comprised in a comparatively small area on and near the sources of Give-out Creek. Here the discoveries and work already accomplished are such as to ensure a large output of rich, or rich and medium grade, silver ores, and the combination of the interests thus included within a length of less than a mile from east to west, would appear to justify the immediate initiation of some more efficient system of transport to the shore of the lake than that afforded by the present trail. While a waggon road with moderate grades might, I believe, be constructed from Nelson, the cost would be great, and the late date at which snow lies at the considerable altitude of these claims, as compared with that at which it entirely disappears from the lower levels, would be a drawback. The transport of ore down the steep grades of the upper part of the mountain might be arranged for, however, by

a tramway to a point lower in the valley of Give-out Creek, or an aerial wire tramway might without difficulty be constructed. Some such means of conveying the ores, together with the capital necessary for the systematic opening up of the deposits and the introduction of machinery for the fine concentration of the second quality of ore, are the most pressing needs of this locality. No very important further developments need be expected till some such facilities are available, except, indeed, in the case of the richer portions of the "Silver King" lode, which may continue for some time to yield sufficient high grade ore to pay for its working on the present comparatively ineffective system.

Cottonwood Mine.—Height above lake, 2,835 feet. This is situated at the extreme east end of Toad Mountain, on the summit of a spur which lies between the source of Cottonwood-Smith Creek and a small western feeder of that stream. A good trail has been constructed from Nelson to this property, which consists of three claims placed end to end on the length of the deposit, and a fourth claim lying alongside. The deposit consists essentially of a belt of pyritized schists holding gold. The rocks of the stratified series seen a short distance to the north of the deposit, and near their junction with the granite, are diabases and diabase-schists of the usual kind, and include diabase porphyrite precisely like that previously described. In the immediate vicinity of the metalliferous belt, the rocks are chiefly schistose diabase, and the belt itself consists of similar rocks, which here and there include lenticular areas of massive diabase, together with some almost nacreous pale-grey and whitish schists. In what I have spoken of as the metalliferous belt, all these rocks are more or less completely though irregularly silicified, and charged with granular iron-pyrites, with here and there a little copper-pyrites and specks of galena. These pyritized schists are further seamed in all directions by little veins and stringers of quartz, holding the same minerals, but chiefly iron-pyrites. The entire superficial portion of this metalliferous belt of rock has been more or less completely oxidized to a depth varying from a couple of feet to ten, twenty or more feet. The decomposition of the rock is usually so complete that it may be removed easily with the pick and shovel. Some portions of the little quartz veins traversing the rocks, present in the decomposed mass an almost scoriaceous appearance, due to the removal of the iron-pyrites, and occasionally the whole of the iron-oxide produced in this process, has subsequently been leached out, leaving porous masses of white quartz. The iron oxide thus removed has elsewhere been deposited in fissures and hollows in the form of bog-iron ore.

The metalliferous belt is said to be continuously traceable throughout the length of the three claims above alluded to, and in the vicinity of the present workings must have a width of at least 300 feet. The average dip of the schists at this place is about S. 12° E. < 80°, and this is probably followed by the metalliferous zone. The assay value of the metalliferous material appears to vary considerably, and I am not in possession of such information as to be able to state what might be taken as a fair average. For the purpose of working the superficially decomposed portions of the deposit, two Huntington mills, with a capacity of 12½ tons, have been erected, and the necessary houses, ore-shoots, etc., constructed. But a small quantity of the material has, however, as yet been milled. Should the results prove satisfactory, the quantity of pyritized material which may eventually be treated by concentration and chlorination appears to be practically unlimited, and in consequence of the facility with which it may be handled and worked, a comparatively small average yield in gold would be sufficient to justify work on a large scale.

Umatilla and Uncle Sam Claims. Height above lake (at cabin), 1,280 feet. These claims are situated on the east side of Cottonwood-Smith Creek, about two miles and a half from Nelson. Together with a third claim called "The Apex," these are generally known as the "Labeau Mines." They occur in an outlier of the diabase series, the extent of which to the eastward was not ascertained. The vein opened on the two first-mentioned claims, is stated to be continuously traceable for a considerable distance, and to average about two feet in width. Where I saw this vein, at a point at which a small shaft ha. been sunk on it, it runs N. 20° W., and is nearly vertical, or dipping at an angle of about 80° to the eastward. The eastern or hanging wall is here formed by a dyke of grey granite five or more feet in width. The foot wall is not well defined, the ore blending irregularly with the diabase rock on that side. The vein covered by the "Apex" claim is stated to run nearly east and west.

The character of the ore obtained from this group of claims differs considerably from that elsewhere seen in the district. The quartz gangue is hard and vitreous and more or less charged with green chloritic minerals. The metalliferous constituents are fine-grained, and consist chiefly of galena and an intimate mixture of galena and blende. Tetrahedrite, or some such richly argentiferous mineral, probably also occurs in small quantity, irregularly disseminated.

Tough Nut Mine.—This is situated on the northern slope of Toad Mountain, at the head of Sandy Creek, and about two miles in a north-westward direction from the "Silver King." The vein here opened appears well defined. It runs S. 70° E., and is nearly vertical, the width of the ore-bearing part of the vein being, where seen, about four feet and a-half. The vein has been exposed at intervals throughout the length of the claim of 1,500 feet, and is seen on the summit of the ridge to the eastward on an adjoining claim known as the "Evening Tide." The ore contains galena, with iron- and copper-pyrites, zinc-blende and tetrahedrite, the last-named mineral being, as usual, the richest in silver. Crystalline quartz is moderately abundant, but a considerable part of the gangue is made up of dolomite and shattered and mineralized rock matter. The adjacent country-rock consists of green schists of the usual character. The vein is well situated for working by means of drifts, as the hillside up which it runs is very steep and over 900 feet in height. The work done at the time of my visit, besides surface stripping, included a drift about 100 feet in length on the vein, and a shaft 30 feet deep, at a distance of 440 feet from the mouth of the drift, and about 160 feet higher on the hill. Several other claims have been taken up in this vicinity, but with the exception of the "Tough Nut," little or nothing has been done toward their development.

Poorman Mine.—This is one of several claims belonging to the Eagle Creek Gold Mining Company, but on this only has any considerable work of development been accomplished. These claims, with several others in different hands, are situated about four miles west of Nelson, and the point at which most work has been done is about half a mile south of the main trail from Nelson to Sproat's Landing, on the east side of Eagle Creek. The deposits of this locality differ from all those previously described, in being situated beyond the area of the stratified rocks, the country-rock here being a dark grey, mica-syenite of granitic appearance, and referable to the granites of the second period of irruption, as already noted. This, as already mentioned, is an interesting point, as showing that the granitoid rocks may, under certain circumstances, also prove to be metalliferous.

The lode opened up on the "Poorman Claim" runs about S. 60° E., with a northerly dip at an angle of 50° to 60°. It averages about 18 inches in width, and seems regular and fairly constant in this respect. The gangue consists of glassy or milky quartz, and contains copper- and iron-pyrites, distributed throughout in stringers and small bunches. The gold is contained in these sulphurets, and the average value in gold, per ton of the ore, is stated at $30. At the date of my visit an adit had been run in to the vein, intersecting it at a depth of about 95 feet from the out-crop, and since that time further work has been done, and a ten-stamp mill, with concentrators and other machinery, has been placed on the ground ready for erection in the spring.

Other Metalliferous Deposits.

Though scarcely recognized as belonging to the Toad Mountain region proper, the deposits on Eagle Creek are really on the northern slope of the mountain-mass thus named. A few outlying localities in this vicinity and elsewhere in the district, in which minerals of economic value are known to occur, may now be alluded to.

Copper Queen.—This name is applied to a discovery situated on the north side of the Kootanie River, about a mile above the mouth of Forty-nine Creek. I was unable to visit this claim, which is described as an irregular deposit of great size. Specimens received from it, however, show the ore to consist chiefly of massive copper-pyrites. Though reported to contain a considerable proportion of silver, specimens of this ore subjected to examination in the laboratory of the Survey proved to contain only 1·4 ounce of silver to the ton, with traces of gold.

Iron Ore near the Lower Fall.—About half a mile below the lower fall of the Kootanie River, on the north bank, and near the water's edge, is a remarkable occurrence of magnetic iron ore. The ore is found in large, loose masses, weighing several tons, but owing to the want of good exposures its actual relations to the rocks adjacent could not be ascertained. The place of its occurrence is near, if not on, the line of junction of the granites with the here highly altered rocks of the stratified series. It appears to be associated with a dyke about 40 feet in width, of green-grey augite-porphyrite of somewhat peculiar appearance, which crumbles down easily under the action of the weather. It seems probable that the iron ore, when in situ may form large, irregular masses along the borders of this dyke. The ore is finely granular in texture and generally free from rock matter or other impurities, but in some places contains silicious kernels, with epidote and brown garnet. A fragment of the ore comprising one of these kernels, and rusty in appearance, was examined for gold and silver, but proved to contain neither.

On the north-east arm of Upper Arrow Lake, ten mining claims have been taken up, according to the report of the Minister of Mines for British Columbia. Good specimens of argentiferous galena ores have been brought from these claims, which, however, were not visited by me, and on which little work has yet been done.

Specimens from a quartz vein traversing the argillite-schists a short distance north of the mouth of Koos-Kanax Creek, on Upper Arrow Lake, proved, on assay in the laboratory of the Survey, to contain neither gold nor silver.

Some specimens of a peculiar vitreous quartz traversing the gneissic and mica-schist series at the north-west corner of Kootanie Lake, though showing a little galena, also proved to contain neither gold nor silver on assay.

The occurrence of tourmaline with some peculiarities in the appearance of the granites, already referred to as being characteristic in the vicinity of Fry River, on Kootanie Lake, led me to collect some of the heavier materials by washing the gravel of the river in a gold-pan, for the purpose of ascertaining whether any trace of tin could be found, but this also proved to be quite barren on analysis.

Petroleum Engines in Mines.

Mr. A. A. Atkinson, in the Journal of the British Society of Mining Students, describes the five horse power petroleum engine at the New Brancepeth colliery. It is placed at a distance of 2,400 yards from the shaft, and at a point 165 vertical feet to the dip. It is placed on a masonry pillar, which also carries the tank and other details. A heavy fly wheel is used, and the explosion takes place at every second stroke. The cylinder is cooled by water supplied by a ¾ inch pipe. The ignition spark is supplied by a single bichromate cell. The engine runs at 140 to 160 revolutions, and works a pump at 20 to 23 strokes per minute. A 6 inch double-acting pump with a stroke of 18 inches is used, and forces the water for 1,320 yards to a height of 72 feet above the suction end. Fifty gallons per minute are delivered when the engine runs at 170 revolutions. The exhaust from the engine is taken a distance of 33 yards from the engine, and issues at a temperature of 70° F. The most complete combustion takes place at higher speeds; when the speed is low the exhaust contains a large percentage of carbonic-oxide. This, however, is largely diluted by a good current of air which passes through the engine house. The cost for 10 hours is 10s. 8d., whilst the cost of working the pump from the tail rope of the haulage system is calculated at £1 14s. In this time 10 gallons of petroleum are used, or about 1⅞ pint per horse power per hour. Regulations are given for controlling the working of the engine and the carriage and storing of petroleum.

Mr. H. B. Budgell also gives some notes on the working of two petroleum engines underground. One was situated near the bottom of the pit, where it had plenty of air, and gave satisfaction. The other was at the bottom of a long dip, where the air supply was imperfect and the water sometimes gained on the pump, so that it was working under considerable disadvantages. The exhaust from this latter had acted badly on the roof in the return airways. The first of these pumps deals with 100 gallons per minute for 10 hoars, and delivers it to a height of 100 feet through 250 yards of piping. The author then goes into the question of the work done and the cost, and shows that the work for the cost is about the same in both instances.

Coal Separating and Washing Plant.

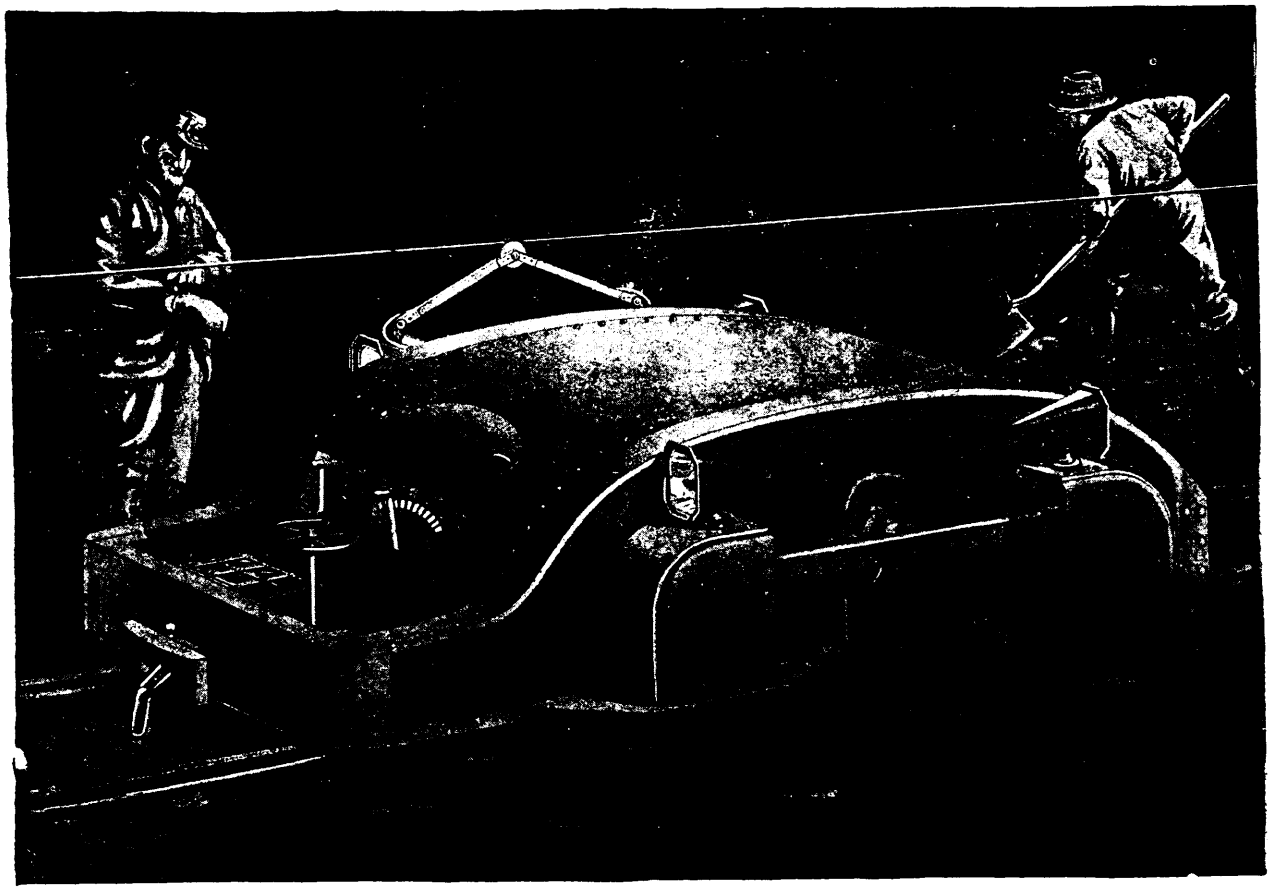
Detailed illustrations are given in *Engineering* of a Luhrig coal-separating and washing plant. The plant treats 1,500 tons per day, the output of three pits, and consists of a dry separation or coal-washing plant proper, with means for dispensing with settling ponds by treating the water. Elevations, plans and sections of the plant are given. It consists of (1) a screening plant; (2) the coal-washing plant proper; (3) plant for handling automatically the finest material contained in the water used for the washing, to obviate the necessity for settling ponds; and (4) the loading plant. The whole process is designed to avoid breakage by rough handling of the coal, and to make the action as nearly as possible, automatic. The coal is brought in hutches by wire ropes, and is discharged by tumblers on to vibrating screens with 2 inch round holes. The lump coal passes on to the travelling belts, which are made of spaced round rods instead of plates. The dross from these picking belts and from the screens, is taken by an elevator to the washery.

The machinery in the dry separator house is driven by a separate engine, so that loading can go on continuously. The dross from the screens and belts is passed through revolving trommels, and all sizes above ⅝ inch pass to the jigs. The intermediate quality from these jigs is crushed and re treated. The fine coal under ⅛ inch in size, is treated in pyramidal separating boxes and felspar jigs. The dirty water is passed down along a trough against a slowly travelling creeper, which collects and removes the dirt as it settles.

Economy of an Electric Mining Plant.—After briefly describing the Hercules mining machine Mr. C. F. Scott, in a paper read before the Engineers' Society of Western Pennsylvania, draws a comparison between hand labor and machine labor for coal mining. In machine mining the stalls can be made much wider, because of the great rapidity of mining, so that the roof will stand a shorter time with fewer pillars. The immediate effect of the introduction of coal-cutting machinery is to reduce the cost of undercutting from 20d. to 5d. per ton of 1½ inch coal in the Pennsylvania district. Taking into account the other expenses, there is saving of 25%. Another advantage of machine mining is that perfect pillars are left and can be recovered, as there is no temptation to rot them. The reduction of the number of stalls for the same output, due to machinery, also causes a great saving in the timber, the number of roads and the tramways that have to be kept up. The saving of coal due to the introduction of machinery, is also very great; this arises from the small amount of slack and the larger coal produced by the smaller height and greater depth of undercutting, and also from the pillars not being crushed. An estimate is given of the saving in expense by using a plant of seven machines, run ten hours a day, and cutting 233 tons. The cost is £29 11s. 3d., made up as follows: fuel, 9s. 7d.; wages, £2 10s.; deterioration of boiler, engine, electrical apparatus and wire, £1 6s.; cost of repairs, £1 8d.; cost of working, £4 17s.; loading and blasting, £19 8s. The indirect saving is estimated at £2 19s. The cost of hand mining is £38 6s. 8d. The saving by the use of machines is therefore considerable in all directions.

Electrical Mining Machinery.—The Exhibits at the recent Montreal Electrical Exhibition.

The Fourteenth Convention of the National Electric Light Association, held in Montreal last month, marks the beginning of a new era in electrical progress in the Dominion. Canada has fallen far to the rear of other countries in the application of electricity to mechanics, and though dynamos are now being installed almost daily, still their number is very far from what it should be. But the Convention has presented to Canadians a better idea of the great adaptability and economy of this factor than could have been obtained by years of theoretical teaching, and the consequence should be an immediate and greatly increased installation of electrical plants. The Victoria Rink, where the exhibition was held, was completely filled with all descriptions of machinery, arc and incandescent lights, and scientific instruments shown by the various great electrical firms; dynamos and motors developing from 75 H.P. to ⅛ H.P.; volt meters, arnmeters, and delicate instruments used for chronological and other purposes in observatories; and lights of all kinds and colors everywhere, illuminating every nook and



corner, and rendering the scene one of great brilliancy.

One of the principal exhibits in the rink, and the one certainly of great interest to mining men, was that of

THE THOMSON-HOUSTON INTERNATIONAL ELECTRIC COMPANY,

of Boston, which occupied at least one-fourth of the spacious floor. Moreover, more fortunate than some others, they had secured power to run their plant, and all the machinery on view was at one time or another in operation. This power was obtained from the Mechanical Building of the McGill University, three-quarters of a mile distant, where a battery of Babcock and Wilcox boilers supplied steam to a 12½ x 12 McIntosh and Seymour engine, the two driving wheels of which belt directly to two 50 H.P. 500 volt generators of Thomson-Houston manufacture. These generators have both series and shunt windings, so proportioned as to ensure the delivery of electric current at a difference of potential of 500 volts at the rink, and the amount of supervision they require is reduced to a minimum by the self-oiling boxes and carbon brushes with which the dynamos are equipped. Six insulated wires—three positive and three negative—conveyed the current to the hall, with a loss of about 10%; or in other words, delivered 90% of the power given out by the dynamos.

Four electric motors were driven by the power thus generated and transmitted, of 75, 45, 15 and 10 H.P. respectively, and all designed to run at a constant speed, regardless of the amount of work required of them. Except that they were without series winding, they resembled closely the generating dynamos in every respect. Each one was supported upon an adjustable sliding base, by which the tension of its belt was adjusted, and these bases were in turn securely bolted to insulating wooden frames. Each motor was equipped with self-oiling boxes and radial carbon brushes. The largest motor, of a rated output of 75 H.P., drove by direct belt connections a 650 light alternating current dynamo and its exciter; the 45 H.P. motor operated similarly an excelsior arc light dynamo, which in turn furnished a curent for 30 arc lamps and one 10 H.P. constant current motor; the 15 H.P. motor was belted to a Type D-15 direct current 110 volt dynamo, which carried 100 16-C.P. incandescent lamps, and the 10 H.P. motor drove the special direct current machine with its revolving brush device, which operated the electric rock drill. Each motor was controlled at the switch board, where were situated a double-pole switch, two fuse cutouts, a current indicator, and a rheostat for each motor.

A feature of their exhibit was the tramway truck manufactured by the Robinson Radial Car Truck Company, of Boston. This truck is equipped with two Thomson-Houston single reduction railway motors of 15 H.P. each. It is designed particularly for electric service, and is so proportioned that 95% of the entire weight of the truck is borne by the driving axles, 5% only being supported by the middle axle. The truck is built altogether of steel, and has a peculiar feature in the radial action which gives it its name. The middle axle by a motion at right angles to the truck, turns the end axles about the king-pins and places them radial to the curves. This is the distinctive feature of the truck, and it has many advantages, making the truck particularly suitable for roads where the traffic is great, where long cars are required, and where curves and grades are numerous and severe. The motor is the latest production in electrical railway apparatus, and is meeting with almost universal application upon the electric railway systems of the United States. It is practically iron-clad, having two internal pole pieces of ample spread, carrying two field spools, which nearly surround the armature coils. The magnetic circuit is completed on the front end of the motor by the nose-plate, and on the back end by the frame on which are cast the iron boxes and arms which serve as a support for the armature shaft bearings. The armature is of the Gramme-ring type, which is admitted to be superior to other forms of winding, any coil on this armature being easily replaced without disturbing its fellows. The weight of the motors and truck exhibited was 9,600 lbs., and is suitable for lines where the grades do not exceed 10%.

What most attracted the eyes of mining men was the Van Depœle Electric Rock Drill, and whenever it was being operated a crowd very quickly gathered. This drill is the invention of Mr. Charles J. Van Depœle, and is the result of several years' study and experiment. The object sought was to do away with the many drawbacks and imperfections of the steam and compressed air drills, while still retaining their invaluable properties. The result is seen to be a machine closely resembling older forms of rock drills in external appearance—the only advantage which is at once apparent being the substitution of a simple insulated cable for an expensive and inefficient system of piping. But the advance is far greater than this; an iron casing enclosing three coils of insulated wire replaces a complicated piece of mechanism with vapor-tight bearings, joints and valves, which is so liable to breakage from rough handling that in some cases even as many as 50% of the steam or air drills for a mine or quarry are kept in the repair shop at all times. A solid iron core, and a copper shaft to which it is rigidly attached, form the moving portion of the machine. There are no commutating devices and no make-and-break of the electric circuit. A ratchet device in the head of the machine causes the drill rod to revolve ⅛ of a revolution at every stroke, thus ensuring a round, even hole. The electric drill has a capacity to bore a hole 1½ to 2 inches in diameter at the rate of something over 2 inches a minute in very hard granite. It can bore if necessary to a depth of 10 or 12 feet, as the power of the coils is sufficient to raise a very heavy drill rod. This latter point is

one of much importance, and is a peculiarity of the Van Depoele machine. The drill received its current from a Type D-10 direct current dynamo of the motor type, fitted with a special mechanism consisting of a third or rotating brush. The power absorbed by the drill is only about 2 H.P., and as the voltage employed is 220, it may be placed at a very considerable distance from the dynamo with a comparatively small outlay for copper.

The electric hoist shown by the Thomson-Houston

Company was also the object of much interest. A 15 H.P. motor is geared directly to the hoisting drum, making a very compact and semi-portable arrangement of considerable value in mines either for use at the head of the shaft or underground.

Another very fine mining exhibit was that displayed by

THE EDISON GENERAL ELECTRIC COMPANY.

Their space occupied one-half of the entire hall, and included many new appliances. Notable among these were the various mining apparatus recently developed and perfected. The following despatch, sent out by the Associated Press indicates the interest manifested in this new field of electrical work :

"Great interest has been manifested here in the new Edison electric mining appliances, exhibited in the Electrical Exposition.

"The most striking of these is the electric percussion drill, which will bore at the rate of three inches per minute in the hardest granite. It requires but little power to operate, and can be worked any distance from the dynamo to a limit of three miles. The drill is very simple in construction, having no moving parts except the plunger, and nothing that will be affected by moisture. This device, it is said by experts, will completely revolutionize mining work.

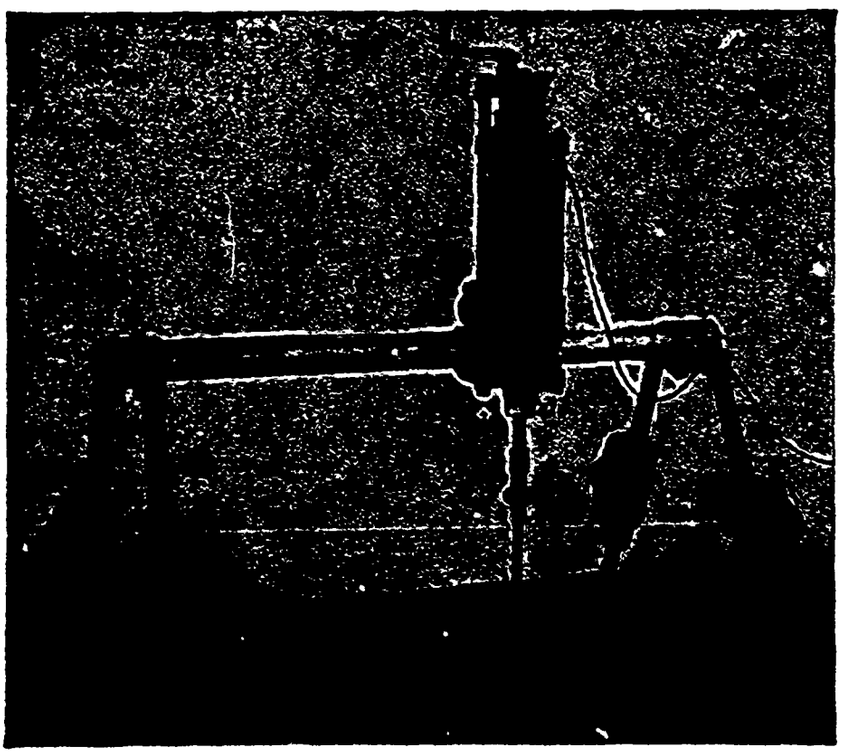
"The next in importance is the diamond prospecting core drill, designed for locating mineral deposits. It will bore 150 feet into the earth, bringing out a specimen of the mineral for the purpose of determining its value. Some have likened this drill to the mythical 'divining rod' which was supposed to indicate the location of minerals. The Edison drill certainly resembles such an invaluable instrument.

"Aside from these are exhibited electric coal drills, electric hoists, electric fans and electric pumps, showing that Edison has turned his attention in earnest to mining work, and many are expecting marvellous results from this branch of electricity in the near future."

Herewith is shown a view of these truly remarkable drills, taken from a photograph made at Denver, Col.

A point of especial interest to Canadians is the fact that all the apparatus in the immense Edison exhibit was made on Canadian soil and by Canadian workmen.

The Edison General Electric Company have recently completed their new factory at Peterborough, Ont., enabling them to supply the Canadian market with great promptness.



The Sources of Petroleum.

In a lengthy paper on the sources of petroleum and natural gas, Mr. W. Topley gives a general survey of the geological conditions under which they occur in various parts of the world, and enumerates the conclusions to which geologists of the United States have been led as regards the vast areas with which they deal. Two theories of the origin of petroleum have been advanced. The first ascribes it to a purely chemical origin, and is drawn chiefly from the data of the Russian fields; the second is the organic theory of distillation from organic remains, and explains best the facts over the greater part of North America. The great pressure of gas and petroleum does not prove its deep-seated origin, but arises from the form of the stratification in the American fields. In Canada and the United States the petroleum is usually found in anticlinals or interruptions to the dip in porous beds, such as sandstones and limestones. At the outcrop of these rocks the petroleum has disappeared, and its place is taken by water, which by its hydrostatic pressure causes the petroleum or gas to rise in the wells. This is readily seen in Indiana, according to Professor W. J. McCree, in the Cincinnati Arch, which is practically a dome some fifty miles across. Dr. T. Sterry Hunt, too, has shown that oil was produced in beds near where it is found; that their perosity accounts for the stores in them, and that petroleum and gas mainly occur along anticlinal lines. When the strata are much disturbed, large stores of oil or gas are not likely to be found.

There is no uniformity in the geological ages of the strata which yield petroleum. Even in North America, the age ranges from lower silurian to tertiary; both gas and oil also occur in the drifts.

Rocks of secondary age, however, with the exception of the cretaceous, are not oil-bearing in North America. In Europe, only small quantities occur in palæozoic rocks. In Holland, the range is from trias to cretaceous. In Eastern Europe it is mainly tertiary, and wholly so in the Caucasus.

In other parts of the world the petroleum-bearing beds are, so far as is known, rarely of older date than upper secondary. Volcanic rocks occasionally contain petroleum, but there is good reason to believe that these cases are generally impregnations into porous reservoirs of volcanic rocks from neighbouring sedimentary strata.

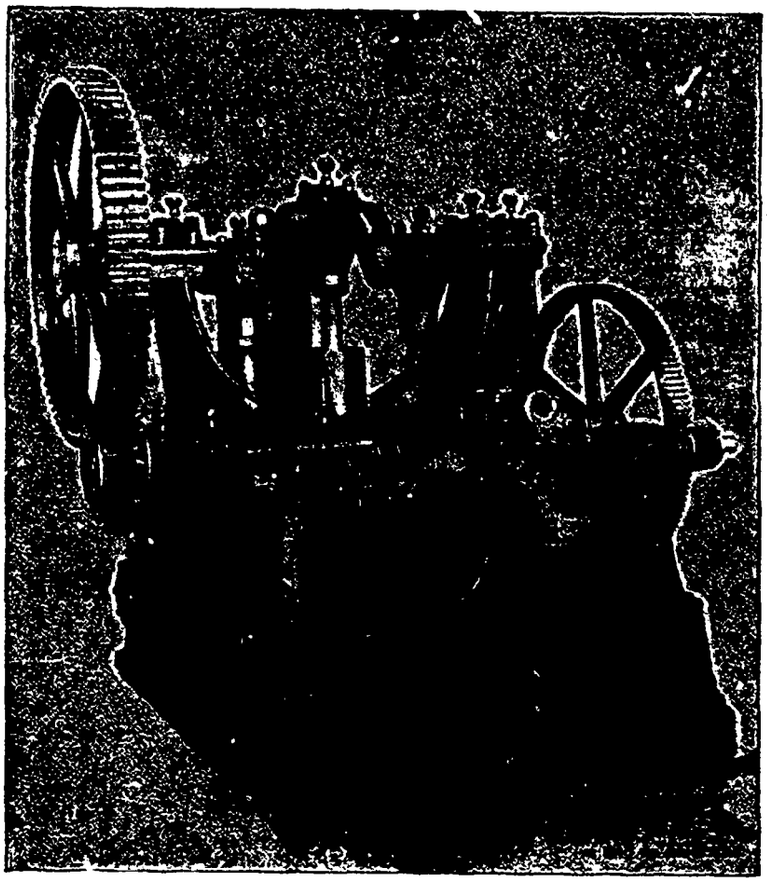
The author then proceeds to deal at length with the oil

and gas deposits of the United States, Canada and the Caucasus. Besides these countries, the following are mentioned as producers, and are more or less briefly described: Mexico, Venezuela, Trinidad, Columbia, Peru, Argentine Republic, Egypt, Algeria, the Carpathians, Germany, Italy, France, Spain, India, Burmah, Japan, China, and New Zealand. As regards the United Kingdom, the author gives particulars of the various instances in which gas or oil has been found in small quantities. The production of petroleum in Derbyshire, in the three years, 1886 to 1889, was 43, 66 and 35 tons respectively. In spite of the frequent occurrence of brine in borings, and the presence of fossiliferous strata, but very little oil has been found up to the present. This may be due to the frequent foldings and contortions of the palæozoic rocks, so that volatile matters have had every chance of escaping, though otherwise these rocks are most likely to contain oil. In many cases the brine may have replaced the escaped oil. The Sub-Wealden boring in Sussex was favourably placed for discovering petroleum, but none was found.

With regard to the duration of the supply, the author states that the recent diminution in the American supply is due to the restrictions imposed.

If the records of each field be examined separately it is seen that the production has rapidly developed, and then slowly declined, in some cases to zero.

The increased production is due to the discovery and development of new productive areas. This is especially the case with districts of high pressure gas or oil, whereas low pressure fields have longer lines. The chief exception to this rapid exhaustion of high pressure areas is Baku; but even here there are said by some to be signs of exhaustion.



The history of all high pressure wells is substantially the same; first, an enormous supply, and then signs of brine, followed by an increasing quantity, which finally spoils the well. To yield brine, with only a small proportion of oil, is the final stage of almost all high pressure wells. It is true that a small supply of oil with much brine may continue for several years.

Such wells may pay in Germany, where there is a protective duty on imported petroleum, but they are at present worthless in highly productive areas. The time may, however, come when even the American oil men will return to their now deserted "pools," and be content with the small production of old wells, now shut down and abandoned.

The comparative permanence of low pressure areas is a hopeful sign for the future of petroleum. What is most wanted is a steady production, not subject to enormous variations in quantity, and consequently in price.

Mining at Great Depths.—The question of working coal at depths from 2,000 to 4,000 feet was investigated by the Royal Commission of 1869, but since then, according to Mr. W. E. Garforth, some three thousand million tons of coal have been raised, and the depth of workings have been increased from 2,376 feet up to 3,120 feet. Discoveries in connection with colliery appliances, especially in electrical work and increased knowledge in methods of working coal, have produced a feeling that coal may be worked at much greater depths than at present. At the same time there are many difficulties in the way. At Ashton Moss Colliery the increase of temperature is one degree for every 75 feet, but there are reasons for believing that the increase has a diminishing ratio. In the six-foot seam in this colliery, at a depth of 3,120 feet, the temperature is 87° F., and the air in the roadway and at the face is dry and not surcharged with moisture, as has been predicted. The men work for the same hours, but not with the same energy and vigor as in shallow pits. No water is met with, and not more gas than in other mines. The quality of the coal is as good as, if not superior to, that of coal found at less depths. The author makes a number of suggestions for working deep mines. He is of opinion that coal ought to be won without greater loss than in the past; and he believes that coal will be worked at as great depths as it can be proved to exist.

In the construction of the new iron bridge over the River Weichsel, Germany, ignot metal will be used. There will be five spans of 328 feet, and thirteen of 203 feet.

Mining Taxes in Michigan.

Iron mining companies will be particularly interested in the work of the Michigan State Board of Equalization, just brought to a close. The valuation of the state was equalized at $1,230,000,000, an increase of $184,550,000 over its value as equalized five years ago. This increase includes $75,000,000 worth of mining property which will this year be subjected to direct taxation for state purposes for the first time. After having adjusted the difficulties which they deemed existed between the valuation of the several counties, as equalized by the boards of supervisers, the state board added 15 per cent. to cover the material growth of the state during the last half decade. The books of the Auditor General's Office show that the specific taxes received from mines for the past five years averaged $80,000 per year, and this amount the mining counties, as equalized, will pay in direct taxes. It was also ascertained by the board that the non-producing mines, valued at $10,000,000, paid nothing in state taxes under the old law These will now pay their proportion of the state tax, being directly assessed therefor, on the same value at which they were assessed for local purposes.—*Cleveland Iron Trade Review.*

Storage of Petroleum.—Mr. W. T. H. Carrington, in a paper read before the Institution of Civil Engineers, March 24, 1891, describes the appliances necessary for dealing with petroleum in bulk and the methods of using them. The mains forming the pipe lines are from 6 to 8 inches in diameter, and are usually of wrought iron. A flexible tube of canvas or other material is used for making connection with the steamer. The petroleum is passed through a dirt tank into the storage tanks by pipes entering at the sides or bottom. The suction and delivery pipes should preferably be kept independent. The author deals with the size of the tanks and their construction, special attention being given to the foundation. In hot climates the top of the tank is covered with water. The bottom of the tank should be placed so that it can be inspected. Petroleum can be withdrawn from the tanks by gravity, or by power when it is barrelled. A description of the method of barrelling is also given.

New Bar Mill.—A new bar mill has recently been erected at the Milwaukee works of the Illinois Steel Company. It has a 9 inch train, consisting of five stands of housings. Three sets of rolls are three high; there is one set of oval rolls, and one of finishing rolls. The three-high sets are made with closed tops, having brass centre-screw box, steel screws and bronze journal bearings. The oval and finishing sets have open tops with spring carriers for the upper roll, thus doing away with liners when rolling different thicknesses of flats, the spring bringing the upper roll into proper position when the bolts are slackened. The pinions of the train are also open tops, with Hunter's self-oiling bearings. A Smythe-Laughlin regenerative furnace is used, 14 feet in length from bridge to bridge, and 7 feet from wall to wall, with four doors. —*Iron Age.*

Minimum First Cost of Plant and Maximum Economy of Operation in the Electrical Transmission of Power.

(By H. Ward Leonard, New York.)

A great deal has been, and is being written and said about the condition governing the minimum first cost of a plant for the transmission of power by electricity, and also about the conditions governing the maximum economy of operation of such a plant, and some radical errors and false deductions have been made by those who are considered authorities upon this subject, so that it is not surprising that a somewhat erroneous idea at present exists in the mind of the electrical public upon this question.

As a rule, the theories and deductions developed by the various papers on this subject have given as a conclusion certain formulæ and laws the application of which is practically impossible because of the necessity of using factors, the determination of the value of which is fully as great, if not greater, a problem than that, the solution of which is attempted. The result of this has been that vital errors in some of the most noteworthy papers on this subject have remained unnoticed by most readers, and even if others besides the writer have been familiar with these errors, they have probably felt as he did, that no good purpose would be served by calling attention to them, as no practical application seemed to have been attempted of these formulæ or laws.

The recent publication, however, of a compilation entitled, "Electrical Transmission Hand-Book," by F. B. Badt, makes it appear of importance to call attention to the serious errors contained therein, for Mr. Badt not only publishes all the original errors of the authorities he quotes, but he proceeds to carry the erroneous deductions further and to give and solve practical problems in a manner such that the reader cannot but receive a clear and definite, although entirely incorrect understanding of the subject. Furthermore, some of the formulæ published by Mr. Badt, and for which the present writer is responsible, have been interpreted by means of erroneous laws laid down by Mr. F. J. Sprague, and consequently an entirely false meaning has been given to formulæ which, when properly interpreted, are entirely correct. In order to point out the errors mentioned in as clear a manner as possible, I shall first treat the subject generally and deduce the correct laws, and then point out the inconsistencies and inaccuracies of the conclusions, formulæ and laws given by Mr. Sprague and Mr. Badt.

Under date of August 16, 1886, the writer published a general formula for the determination of the size of conductors which should supply devices arranged in multiple arc, the form of which was as follows:—

$$M=\frac{\text{K. W.}\times D\times 21{,}400}{V\,(E-V)} \qquad (1)$$

in which M = Circular millage of conductor.
K. W. = Kilo watts at terminals of translating device.
D = Distance of transmission in feet.
E = E. M. F. at generator brushes.
V = Volts lost in transmission.

For the sake of explicitness I will indicate the derivation of the formulæ.

Res. of 1 foot cir. mil of commercial copper ..... = 10.7 ohms.
Res. of 2 D feet of conductor of 1 cir. mil. ..... = 21.4 D
Res. of 2 D feet of conductor of M cir. mil. ..... $=\frac{21.4\ D}{M}$

$$M=\frac{21.4\ D.}{R} \qquad \text{Now } R=\frac{V}{C}=\frac{V}{\frac{1{,}000\ \text{K. W.}}{E-V}}=\frac{V\,(E-V)}{1{,}000\ \text{K.W.}}$$

$$\therefore M=\frac{21.4\ D\times 1{,}000\ \text{K.W.}}{V\,(E-V)}=\frac{\text{K. W.}\times D\times 21{,}400}{V\,(E-V)} \qquad (1)$$

Weight of 1 ft. cir. mil of copper = .000003027 lb.
∴ Calling T the weight of conductor in lbs. and allowing 3 per cent. for sag, etc.

$$T=\frac{D\times \text{K. W.}}{V\,(E-V)\times 7.5} \qquad (2)$$

Calling B the cost of conductor in dollars, we have, with copper at L cents per pound.

$$B=\frac{D\times \text{K. W.}\times L}{750\ V\,(E-V)} \qquad (3)$$

∴ The cost of the conductor per K. W. at motor brushes is:

$$\frac{B}{\text{K.W.}}=\frac{D\times L}{750\ V\,(E-V)} \qquad (4)$$

Calling G the cost of dynamo electric machinery per K. W. at brushes and $\frac{A}{\text{K.W.}}$, the cost of generator per K.W. at motor brushes, we have

$$\frac{A}{\text{K.W.}}=\frac{100\ G}{100-P} \qquad (5)$$

where P = the percentage of loss in the conductor; this may also be expressed as follows:

Cost of generator per K. W. at motor brushes,

$$\frac{A}{\text{K.W.}}=\frac{G\ E}{E-V} \qquad (6)$$

The cost of the generator and of the bare copper for the conductors are the only two elements of the cost of a power transmission plant which it is necessary to consider in the determination of the condition of Minimum First Cost of Plant, for the other factors of the cost of the plant, such as the development of the motive power, the labor of erecting the line, etc., are not proportionate to the power delivered, and hence should not be considered in the determination of the minimum conditions.

With any given initial E. M. F. and distance, it is evident that the more volts we lose in the transmission, the less will be the cost of the conductor; but at the same time the cost of the generator per unit of power transmitted will be increased because of the additional generator capacity required to take care of the increased amount of energy lost in the conductors.

Hence it is evident that for any given initial E. M. F. and distance there must be some particular loss in the conductor which will make the combined cost of the generator and conductor a minimum. We can determine the minimum value by placing the first differential of the expression indicating the sum of the costs of the generator and the conductor equal to zero.

From (4) and (6) we have, cost of generator plus cost of conductor.

$$\frac{A+B}{\text{K.W.}}=\frac{G\ E}{E-V}+\frac{D^2\ L}{750\ V\,(E-V)} \qquad (7)$$

Placing the first differential = 0 we have:

$$\frac{G\ E}{(E-V)^2}-\frac{750\ D^2\ L\,(E-2V)}{750^2\ V^2\ (E-V)}=0. \qquad (8)$$

From which we get,

$$D^2=\frac{750\ G\ E\ V^2}{L\,(E-2V)} \qquad (9)$$

This last equation expresses the relation existing under the conditions of Minimum First Cost of generator and conductor, and consequently of the entire plant.

Since $\frac{E}{E-2V}=\frac{100}{100-2P}$ (10)

we have from (9) and (10)

$$D^2=\frac{75{,}000\ G\ V^2}{(L\ 100-2P)} \qquad (11)$$

Calling $\frac{Bm}{\text{K.W.}}$, the cost of conductor in dollars per K. W. at motor brushes under conditions of minimum first cost of plant, we have from (4) and (11)

$$\frac{Bm}{\text{K.W.}}=\frac{G\ E\ V}{(E-V)\,(E-2V)} \qquad (12)$$

$$\text{and}=\frac{100\ G\ P}{(100-P)\,(100-2\ P)} \qquad (13)$$

Calling $\frac{Am}{\text{K.W.}}$ the cost of generator in dollars per K. W. at motor brushes under conditions of minimum first cost of plant, we have from (6) and (9)

$$\frac{Am}{\text{K.W.}}=\frac{D^2\ L\,(E-2V)}{750\ V^2\ (E-V)} \text{ and} \qquad (14)$$

$$=\frac{D^2\ L\,(100-2P)}{750\ V^2\,(100-P)} \qquad (15)$$

When the cost of dynamo is $33 per K. W. at brushes and copper is 20 cents per lb., that is, when G = 33 and L = 20, we have, from (11),

$$D^2=\frac{123{,}750\ V^2}{100-2P} \qquad (16)$$

$$\text{From (3) we have } D^2=\frac{\frac{Bm}{\text{K.W.}}\times 750\ V\,(E-V)}{L} \qquad (17)$$

With any fixed initial E. M. F. and a certain percentage of loss, we can get by (13) the value of $\frac{Bm}{\text{K.W.}}$, the cost of the conductor under conditions of minimum cost; and knowing the cost of the conductor, we can by (17) get the value of D. Thus for any initial voltage and percentage of loss we can determine the cost of conductor and the distance of transmission which corresponds to the minimum first cost of plant. By determining such values at 10, 12½, 15, 20, 25, 30, and 40 per cent., we are able to plot the lines of minimum first cost as given by the accompanying Chart 1.

By the use of Chart 1 we can quickly determine the percentage of loss necessary for any initial E. M. F. and distance in order that the cost of plant shall be minimum; and we also learn at the same time the corresponding cost of the generator and of the conductor.

Thus, if we have an initial E. M. F. of 3,000 volts and a distance of 50,000 feet, we must in order to secure the minimum first cost of plant, operate with a loss of 30 per cent. and in such case the cost of generator = $47.15, and cost of conductor = $35.35, per K. W. at motor brushes; so that adding the cost of motor, $33 per K. W., we have total cost of generator, conductor and motor $115.50. (*Example 1.*)

Similarly, if we have a distance of 30,000 feet and 3,300 volts initial E. M. F. we must operate at 20 per cent. loss, and the total cost of the generator, conductor and motor will be $88.00. (*Example 2.*)

Now, it by no means follows, because we are working with the minimum first cost of plant for a certain voltage and distance, that we are working at the highest economy, for, evidently, it is possible that if we work with a less percentage of loss in the case cited in Example 1, although our investment be increased thereby, the interest and depreciation on this increase of investment may be much less than the saving we would effect, due to the reduction of the loss of energy in the conductors. In other words, we must consider the variation in the interest and depreciation upon the investment, as well as the variation in the value of the energy wasted in the conductors, and must make the sum of the interest and depreciation on investments plus the value of the energy wasted in the conductor, a minimum, in order to operate at the maximum economy.

The interest on the investment can be definitely determined, but the value of the energy wasted it is very difficult to determine before the installation is made, for the reason that it is usually impossible to ascertain exactly how much of our total power will be transmitted in the future, as this is usually dependent upon an unknown demand. In addition to this, the value per K. W. of the power wasted will frequently be almost nothing in the beginning, when a large water power is available and there is a demand for but a small portion of it, but later the value per K. W. of the energy wasted would probably be much greater.

Thus, while we can determine with absolute accuracy the Minimum First Cost, the question of the Most Economical First Cost is a question almost entirely for the investor to decide. We should be able to tell him not only the minimum first cost and its corresponding percentage of loss, but also the cost corresponding to any other loss than that demanded for the minimum cost.

In order to accomplish this I have designed Chart 2, which gives not only the cost of plant and necessary percentage of loss for any case, of initial E. M. F. and distance under the conditions of Minimum First Cost, but it also gives the cost of plant for the given initial E. M. F. and distance with any other percentage of loss.

Thus if, as in Example 1, the distance is 50,000 feet and the initial E. M. F. 3,000 volts, we find, by examining the curve in which the initial E. M. F. equals 60 volts per 1,000 feet, that the minimum first cost of plant will be realized when we operate at 30 per cent. loss and that the corresponding cost of generator and conductor is $82.50, making the total cost of the generator, conductor and motor $115.50.

We also learn that if, with the same initial E. M. F. and distance, we operate at various losses, the cost of generator and conductor varies as follows:—

30	per cent.	loss.....	$ 82.50
25	"	"	83.20
20	"	"	87.20
15	"	"	90.60
10	"	"	119.00

If now we have a superabundance of water power and are transmitting but a small fraction of it and the value of the energy wasted is consequently negligible, we would do better to operate at 30 per cent. loss and reduce our investment to a minimum. But if our power be limited and valuable so that the value of the energy wasted becomes an important consideration, we must then, for the highest economy, operate at such a loss in conductors that, although the cost of plant may not be a minimum, the sum of the interest and depreciation on such cost, plus the value of the energy wasted will be a minimum. It will be evident that when such sum is a minimum we will be operating at the highest economy. To determine this minimum let us call I the rate of interest and depreciation on the investment, expressing I in per cent. Let U be the value of 1 K. W. at the brushes of the motor, used as it will be used in practice. Then from (7) we have:

$$\left.\begin{array}{l}\text{Int. and depreciat'n on capital invested in generator and conductor per K. W. at motor brushes....}\end{array}\right\}=\frac{I}{100}\left(\frac{G\ E}{E-V}+\frac{D^2\ L}{750\ V\,(E-V)}\right). \qquad (18)$$

The value per K. W. at motor brushes of the energy wasted in the conductor per annum will be

$$\frac{V\ U}{E-V} \qquad (19)$$

The sum of (18)+(19) is that portion of the cost of operating subject to variation by a variation in the loss in the line, and to learn when this is a minimum we will place the first differential of

$$(18)+(19)=0.$$

Doing this, we find that the equation expressing the condition of Minimum Operating Expenses, or, in other words, Maximum Economy of Operation, is

$$D^2 = \frac{750\ E\ V^2\ (I\ G + 100\ U)}{L\ I\ (E-2V)} \qquad (20)$$

From this, calling B_K the cost of conductor under conditions of maximum economy, we find

$$B_K = \frac{E\ V\ (I\ G + 100\ U)}{I\ (E-V)\ (E-2V)} \qquad (21)$$

and calling Ac the cost of generator under conditions of maximum economy, we find,

$$Ac\ \frac{D^2\ L\ (E-2V)}{750\ V^2\ (E-V)} \quad \frac{100\ E\ U}{I\ (E-V)} \qquad (22)$$

From this relation we can plot curves which will enable us to quickly determine the conditions of maximum economy in practice. A set of such curves is shown in CHART 3.

CHART 3 is designed for transmission in which 100 volts are allowed per 1,000 feet of transmission. Two sets of curves are plotted, one marked X, assuming the combined interest and depreciation to be 10 per cent. per annum, and the other set assuming 15 per cent. for these items.

The value of the energy wasted is also plotted when the value of the energy is $5, $10 and $20 respectively, per kilo-watt at motor brushes; and then each of these latter curves is combined with each of the former, giving as a result the operating cost under six different conditions and indicating the maximum economy in each case, and also the variation in the expense due to any deviation from the loss corresponding to the maximum economy.

Example 3. For instance, suppose a transmission of 30,000 feet with 3,000 volts initial E. M. F., and suppose we value interest and depreciation at 15 per cent. per annum. Also, suppose our power to have a value at first of $5 per K. W. at generator brushes. By CHARTS 2 and 3 we find that the maximum economy will be realized when we operate at 17 per cent. loss, although the minimum first cost of plant alone would be realized when we operate at 21.47 per cent.

If later on in this same plant the increasing scarcity of power makes its value $20, instead of $5, per K. W. we find that we must arrange our plant as we increase it, so that the loss shall be 11½ per cent. since by CHART 3 we find we will then be operating at the maximum economy.

It will be seen that by the use of these formulæ and their resultant curves any problem in the transmission of power can be readily and accurately determined. The value of these curves will be evident, when attention is called to the fact that there is in use in this country a plant put in by one of the leading companies, in which the equivalent of the following conditions prevail. Initial E. M. F. 2,200 volts; distance 50,000 feet; loss in conductor 50 per cent. The company who installed this plant even now consider it satisfactory; yet we see from CHART 2, by examining the curve of 44 volts per 1,000 feet, that with exactly the same cost of generator and conductor they could have operated at 22 per cent. loss instead of 50 per cent., making a net gain in the power delivered of 56 per cent., or they might have made a saving in their investment of $10 per kilo-watt delivered by conductor with an increase in power of 30 per cent., had they worked at 35 per cent. loss in conductor, which is that required for minimum first cost.

The following examples will serve to give a clear idea of the use of these curves:

Example 4. Suppose a proposed transmission of 30,000 feet, and that 6,000 volts is the highest voltage we have dynamos for; that is, 200 volts per 1,000 feet. By CHART 1 we learn that for minimum first cost we must lose 12½ per cent. in conductor, that the cost of bare copper conductor will be $6.28 per K. W., that of the generator $37.72; total cost of generator, conductor and motor $77.

Example 5. If we have but 3,000 volts available for the initial E. M. F., we must for the minimum first cost lose 21½ per cent. The cost of conductor will be $15.81, that of generator, $42.02; and that of generator, conductor and motor, $90.83.

Example 6. If, instead of 12½ per cent. loss, we wish

CHART No. 1.

TRANSMISSION OF POWER.

BY H. WARD LEONARD.

Showing Minimum First Cost of Plant, under Varying Distances and Initial E. M. F.'s.

D = Distance of transmission in feet.
E = Initial E. M. F.
V = Volts lost in transmission.
G = Cost of dynamos per K. W. at brushes.
L = Cost of bare copper in cents, per lb.

$\frac{Am}{K.W.}$ = Cost of generator per K. W. at motor brushes under conditions of minimum first cost.

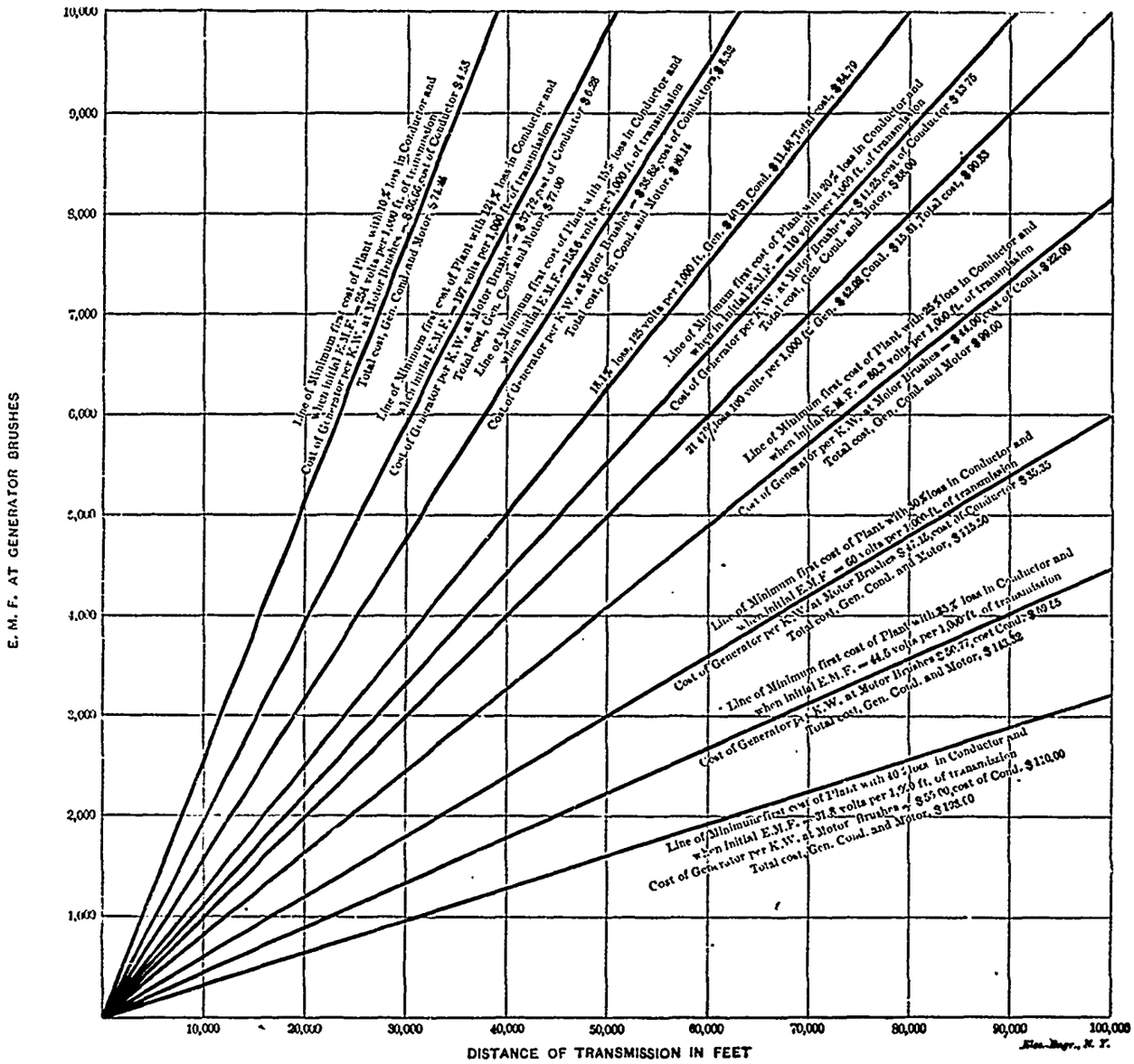
$\frac{Bm}{K.W.}$ = Cost of conductor per K. W. at motor brushes under conditions of minimum first cost.

Under conditions of minimum first cost of plant and when G = $33.00 and L = 20 cents.

$$D^2 = \frac{123{,}750\ V^2}{100-2P}$$

$$\frac{Am}{K.W.} = \frac{D^2\ L\ (E-2V)}{750\ V^2\ (E-V)} = \frac{D^2\ L\ (100-2P)}{750\ V^2\ (100-P)}$$

$$\frac{Bm}{K.W.} = \frac{G\ E\ V}{(E-V)\ (E-2V)} = \frac{100\ G\ P}{(100-P)\ (100-2P)}$$



to lose less, we find from CHART 2 that the cost of such generator and conductor will be as follows: 6,000 volts and 5 per cent., $50; 6,000 volts 10 per cent., $43.25. Knowing the value of the power and the rate of interest and depreciation, we can determine which loss to operate at. It will be noticed that with 6,000 volts, we should, under no circumstances, lose more than 12½ per cent. in the conductor, as with greater losses not only the waste of energy increases, but also the cost of plant.

that the cost of generator and conductor must be $55 per K. W. invested in the best possible way. By CHART 2 we find that with 110 volts per 1,000 feet, that is, 3,300 volts initial E. M. F., our loss will be exactly 20 per cent. and the cost exactly $55. Also, that with 7,620 volts initial we need only lose 10 per cent., and still the cost will be only $41; and by using 3,750 volts and 11 per cent. the cost will still be but $55; also by using 6,000 volts initial and 3½ per cent. loss the cost would be only $55.

loss to be fixed, and we want to find the maximum possible distance of transmission.

Example 9. Suppose investment, in generator and conductor fixed at $60; initial volts, 2,400; percentage of loss, 15 per cent. We find that the maximum distance corresponding is 24,000 feet.

Let us now briefly examine the formulæ and laws which have been referred to by Mr. Badt in his "Electric Transmission Hand-Book." Mr. Badt quotes freely from

CHART No. 2
TRANSMISSION OF POWER.

BY H. WARD LEONARD.

Showing Minimum First Cost of Plant for any Distance and Initial E. M. F. with Corresponding Necessary Loss in Conductor, and also Showing Variation in Such Cost Occasioned by Losses other than those Necessary for Minimum First Cost.

D = Distance of transmission in feet.
E = Initial E. M. F.
V = Volts lost in transmission.
G = Cost of dynamos per K. W. at brushes.
L = Cost of bare copper in cents per lb.

$\frac{Am}{K.W.}$ = Cost of generator per K. W. at motor brushes under conditions of minimum first cost.

$\frac{Bm}{K.W.}$ = Cost of conductor per K. W. at motor brushes under conditions of minimum first cost.

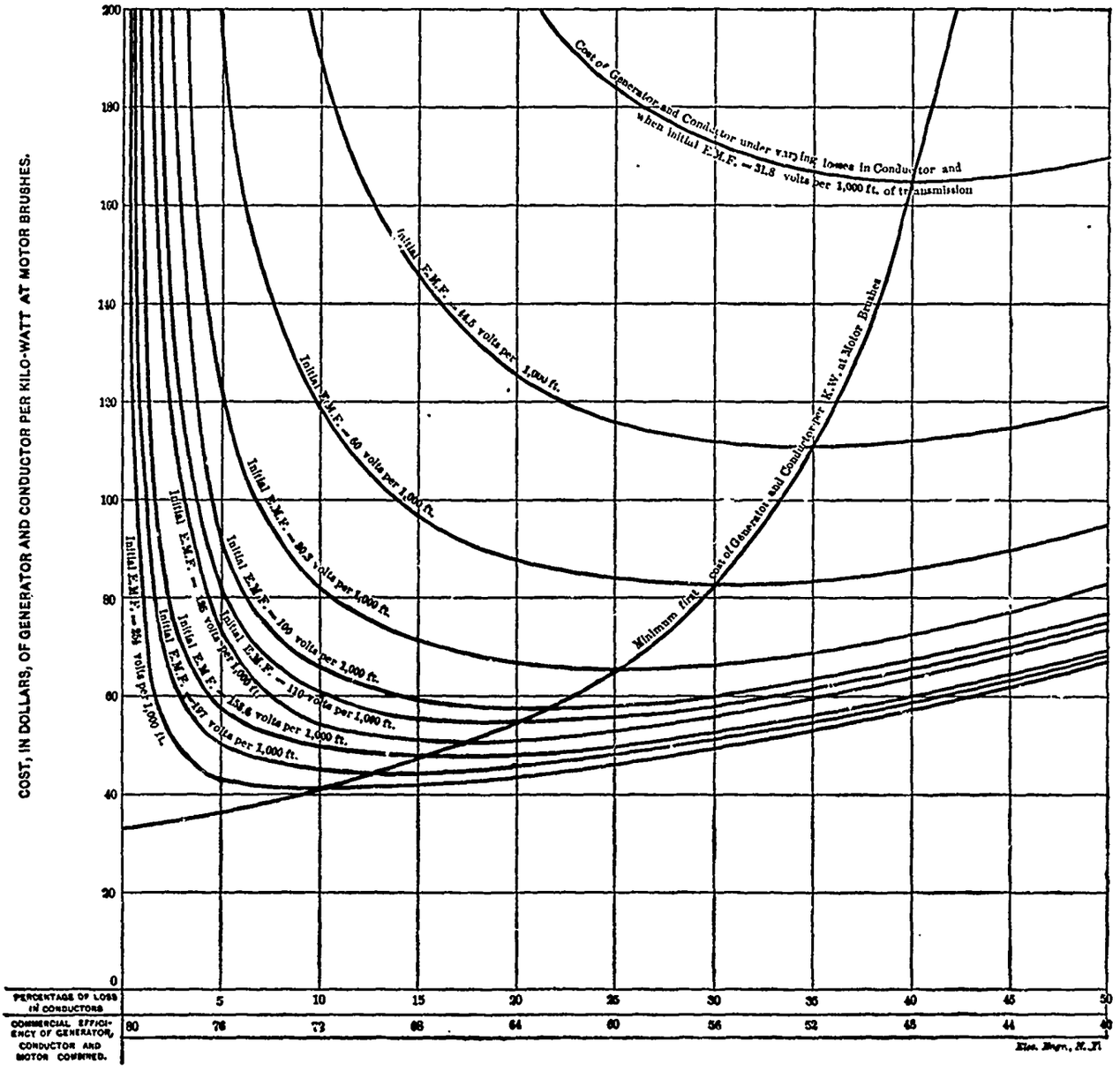
Cost (in dollars) of bare copper conductor per K. W. at motor brushes (general case). $= \frac{D^2 L}{750\ V\ (E-V)}$

Under conditions of minimum first cost of plant and when G = $33.00 and L = 20 cents.

$$D^2 = \frac{123{,}750\ V^2}{100-2P}$$

$$\frac{Am}{K.W.} = \frac{D^2 L\ (E-2V)}{750\ V^2\ (E-V)} = \frac{D^2 L\ (100-2P)}{750\ V^2\ (100-P)}$$

$$\frac{Bm}{K.W.} = \frac{G\ E\ V}{(E-V)\ (E-2V)} = \frac{100\ G\ P}{(100-P)\ (100-2P)}$$



There are four factors in a transmission plant—the distance, the initial E. M. F., the percentage of loss, and the cost of plant, and knowing any three we can by CHART 2 get the fourth. We have already considered the case of fixed distance, initial E. M. F. and per cent. of loss.

Suppose now, distance, loss and cost be fixed and we want to determine initial E. M. F. necessary.

Example 7. Suppose the distance as before 30,000 feet, and that the loss must not exceed 20 per cent., an

The next case will be where distance, initial E. M. F. and capital to be invested are fixed, and we wish to determine the percentage of loss necessary.

Example 8. Suppose distance 30,000 feet; initial E. M. F. 1,800 volts; capital to be invested, $100 per K. W. for generator and conductor. Having 60 volts per 1,000 feet available, we find that we must operate at 14 per cent. loss.

Now suppose investment, initial volts and permissible

a paper by Mr. F. J. Sprague, read before the Franklin Institute, which was printed in the *Journal* of the Franklin Institute for April, 1889. By careful examination of the paper it will be found that, after having assumed the value of the E. M. F. at the motor brushes and the distance also being fixed, the error is made afterward of considering the results obtained as applicable to cases in which these values are variable. Hence it is not surprising that we find Mr. Sprague saying: "That is with

fixed conditions of cost and efficiency of apparatus the number of volts fall, to get the minimum cost, is a function of the distance alone and is independent of the E. M. F. at the motor, a somewhat startling conclusion."

In the light of what we have already seen, it will be evident that this statement is entirely incorrect. To make this more clear (*Example 10*), suppose that with the same distance as in *Example 1*, that is, 50,000 feet, and the same efficiency of apparatus, that is 30 per cent. loss in conductor, we use the initial E. M. F. of 6,000 instead of 3,000, and consequently have an E. M. F. at the motor of

means follows that if we fix the distance and percentage of loss there is a definite initial E. M. F. which corresponds to a minimum first cost of plant; for evidently, the higher we make the initial E. M. F., meantime keeping the percentage of loss constant, the more we reduce the cost of plant, and there is no minimum value under these conditions.

Following out the same error, Mr. Sprague also lays down the following incorrect law: "With any fixed couple and commercial efficiency the cost of the wire should bear a definite and fixed ratio to the cost of the

some of these surprising conclusions, saying: "At the same time it seems somewhat startling that for the minimum cost of the installation under given conditions as mentioned before (*i. e.*, fixed cost and efficiency of apparatus), the volts lost in the conductor are dependent upon the distance alone."

It seems almost impossible that such a statement as this could be seriously made by an electrical engineer of practical experience, yet we find Mr. Badt giving examples and tables in which it is surprising that he did not see the absurdity of this statement. For instance, on

Chart No. 3.
TRANSMISSION OF POWER.

BY H. WARD LEONARD.

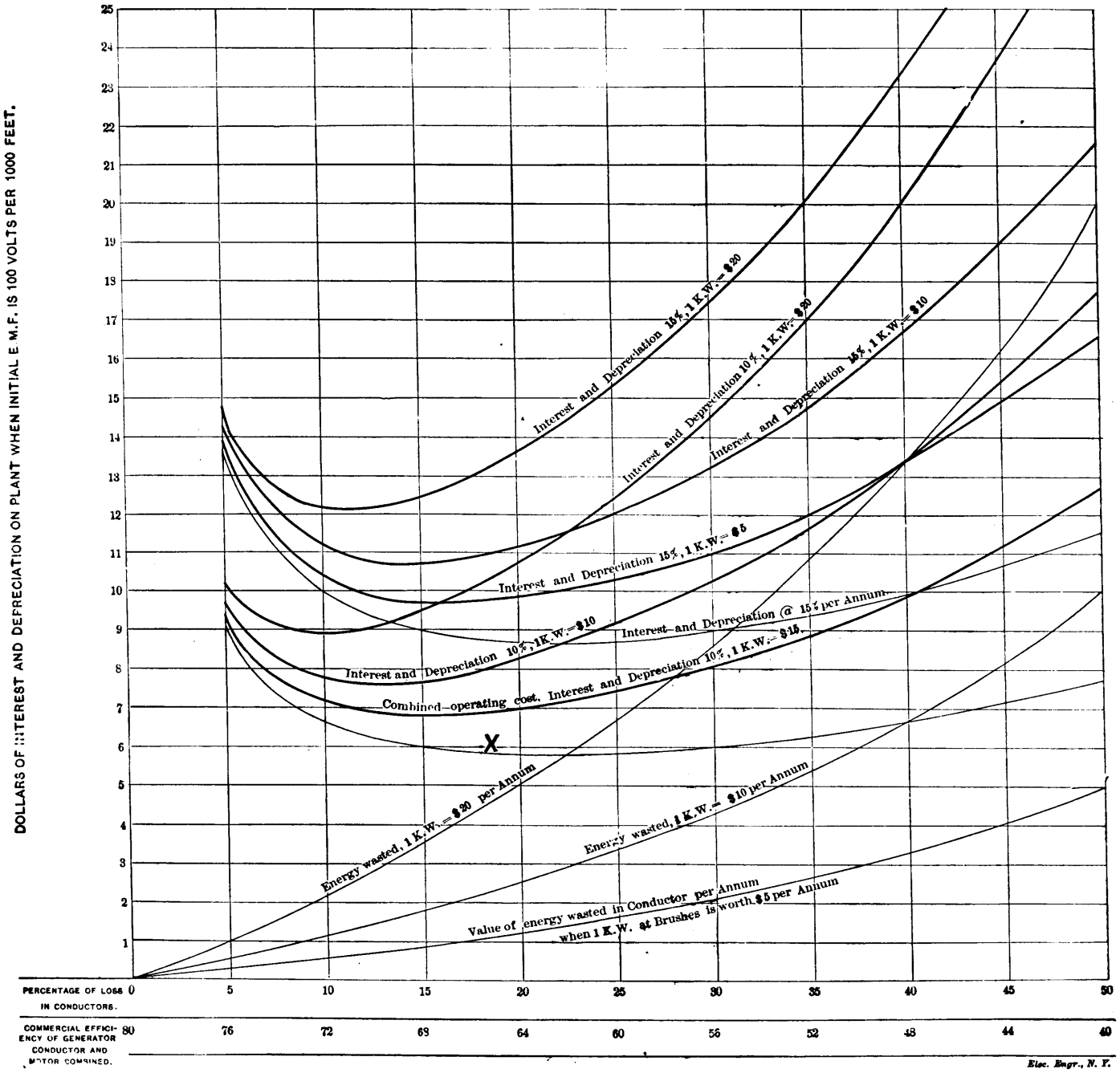
Showing Maximum Economy of Operation when 100 Volts per 1,000 Feet are Used, and when Interest and Depreciation on Plant is 10 per cent. and 15 per cent., and when Value of Power at Generator Brushes is $5.00, $10.00 and $20 per K. W. respectively.

Ae = Cost of generator per K. W. at motor brushes under conditions of maximum economy of operation.
Be = Cost of conductor per K. W. at motor brushes under conditions of maximum economy of operation.
L = Cost of bare copper in cents per lb.
D = Distance of transmission in feet.
E = Initial E. M. F.
V = Volts lost in transmission.
G = Cost of dynamo per K. W. at brushes.
I = Interest and depreciation on cost of generator and conductor per K. W. at motor brushes.
U = Value of 1 K. W. per annum at brushes of motor as used.

$$D^2 = \frac{750\ E\ V^2\ (I\ G + 100\ U)}{L\ I\ (E-2V)}$$

$$Be = \frac{E\ V\ (I\ G + 100\ U)}{I\ (E-V)\ (E-2V)}$$

$$Ae = \frac{D^2\ L\ (E-2V)}{750\ V^2\ (E-V)} - \frac{100\ E\ U}{I\ (E-V)}$$



4,200 volts, instead of 2,100 volts as before. Now, according to Mr. Sprague, the "minimum cost of plant is a function of the distance alone and is independent of the E. M. F. used at the motor;" yet it will be evident that in *Example 10* the cost of the conductor is only ¼ of that in *Example 1*, and the cost of the generator is the same; hence the total cost is much reduced. In other words, while, if we fix the initial E. M. F. and distance, there is a definite loss in conductor at which we must operate in order to have a minimum first cost of plant, it by no

generating plant." It will be evident from what we have just seen regarding the preceding law, that this one is equally as incorrect and formulæ (13) and (15) clearly indicate the impossibility of either of them being correct. In his paper Mr. Sprague gives several tables based upon these laws, and since this same error is maintained throughout, his results are entirely incorrect.

Mr. Badt has not only followed Mr. Sprague blindly, but has gone much further and has finally brought up with such remarkable results, that we find him, after stating

page 28 he gives "*Example 1*. Distance, including 5 per cent. for sag, 7,000 feet; E. M. F. at motor terminals, 500 volts. What must be the loss in the wire and E. M. F. of generator for minimum cost of plant?"

Mr. Badt, by the aid of Mr. Sprague's laws, with his own additions, concludes that he must have 20 per cent. loss in conductor; hence 625 volts at the generator. Since the E. M. F. at the motor is fixed, is it not evident that the higher the initial E. M. F. and the less the percentage of loss in the line, the less will be the cost of

plant? In other words, if the cost be a certain amount at 20 per cent. loss in conductor with 625 volts initial, would it not be less with 10,000 volts initial and 1,000 volts loss in conductor or 10 per cent?

Similarly, "*Example 2.* Distance (including 5 per cent. for sag) 50,000 feet; we want to obtain at least 55 per cent. efficiency (from generating pulley to motor shaft). What is the voltage to be employed at motor and generator for minimum cost of plant?"

Mr. Badt finds that the E. M. F. generated must be 2,741 and that of the motor 1,850, with a loss in conductor of 32.5 per cent. Is it not evident that by using 5,482 volts at generator and 3,700 at motor the cost of generator is the same and the cost of conductor only ¼ what it was, and that there is no limit to the possible reduction in cost of the conductor; and hence no minimum value?

Mr. Badt, following the law that, "the number of volts to get the minimum cost of plant is a function of the distance alone," finds that for every 1,000 feet we must lose 17.5 volts and with fixed cost and efficiency of apparatus no other factors need be considered. This, certainly has the beauty of simplicity, and the tables built upon this conclusion leave little to be desired in that direction; but the transmitter of power who follows these tables will pay heavily for his faith in them.

Another law which Mr. Badt deduces after making the assumption that $\frac{D}{V}$, the relation of distance to volts drop for a minimum cost of plant, is a constant," appears on page 37, and is as follows: "For minimum cost of plant the total weight of the conductor per horse power delivered by the motor shaft remains the same at a certain percentage of loss in the conductor, regardless of the voltage of motor and the distance." This involves the same erroneous assumptions and is evidently absurd, as is another law on page 39: "For minimum cost of plant the weight of the conductor depends only on the percentage of loss in the conductor and the number of mechanical horse power delivered by the motor."

Mr. Badt, on page 42, quotes from Mr. Sprague another equally misleading rule, viz: "For minimum initial cost of plant, and assuming certain prices per horse power of motors, generators and power plants (all erected and ready for operation), and assuming a certain price per pound of copper (delivered at the poles), the total cost of plant, excluding line construction, is a constant for a certain efficiency of the electric system, no matter what the E. M. F. of the motor and the distance may be." The absurdity of this is evident from what we have seen and is clearly shown by CHART 2.

We now come to a consideration of the conditions governing the maximum economy of operation.

Sir William Thomson, in a paper entitled "The Economy of Metal Conductors of Electricity," read before the British Association in 1881, stated the following law: "The most economical area of conductor will be that for which the annual interest on capital equals the annual cost of energy wasted."

This law has been accepted ever since that date with slight modifications, but upon close and practical investigation it proves to be entirely incorrect as applied to maximum economy of operation of a plant, for the very surprising reason that no account whatever is taken of the fact that the cost of the generator per horse power transmitted will vary as the loss in the line varies.

Since the variation in the cost of the generator is the principal factor, it is not surprising that the correct minimum and that obtained from Thomson's law are widely different. In act, it will frequently be impossible to apply Thomsor 's law, as it will frequently occur that the interest on the plant, even when at its minimum cost, will far exceed the value of the energy wasted; and, evidently, if we depart from the condition of minimum first cost with an endeavour to increase the loss and thereby to make the value of the increasing loss in the line finally equal the interest on the increased cost of plant, since we are increasing both items, we evidently are not approaching a minimum value. CHART 3 clearly shows that, frequently, the curve of interest and depreciation and the curve of value of energy wasted will never cross, and hence will never be equal under any conditions of loss.

Formulæ (21) and (22) clearly show that no such relation can exist, and CHART 3 makes it evident graphically. *Example 11.* We find that by Sir William Thomson's law if the power is worth $20 per K. W. at generator brushes, and the interest and depreciation is 10 per cent., we should work at 22½ per cent. loss; whereas, in reality, for the maximum economy we should work at 10 per cent.

We also find that in all the seven other cases indicated by the curves it is impossible to apply Thomson's law, as we cannot, by any means, make the interest on capital outlay and the value of energy wasted equal.

Both Kapp and Ayrton and Parry have discussed Thomson's law and made certain limitations and modifications, but have only complicated, and not corrected it. In Mr. Badt's present work he refers to Kapp's latest formulæ contained in a lecture of March 2, 1891, a copy of which lecture I have not as yet seen; hence the formulæ quoted by Mr. Badt cannot be commented on by me further than that Mr. Kapp's formulæ as given by Mr. Badt point to one fact which is very evident from formulæ (13) and (21), CHART 1, namely, that under no circumstances will it be economical to lose more than 50 per cent. in the conductor, for when E=2V, we have E−2V=0, and an infinite cost of conductor as a resulting condition.

Practical Results in the Magnetic Concentration of Iron Ore at Croton, N.Y.

By W. H. HOFFMAN, M.E.

The ore is described as consisting of compact, moderately fine-grained magnetite in a gangue composed mainly of quartz and hornblende, besides feldspar, apatite and mica, and more or less pyrite and pyrrhotite. It is highly satisfactory that the grain of the ore permits a fair disintegration of its constituents by crushing it to pass a 12-mesh screen, inasmuch as a finer mineralization would increase the cost of concentration, as hereafter described.

The average metallic iron in the ore ranges from 37 to 42 per cent.; the sulphur from 1.7 to 2.2, and the phosphorous from 0.070 to 0.426. Practical work has shown the average phosphorous to be 0.232. Since May 1, 1891, we have been roasting and concentrating this material to 68 per cent. in metallic iron, 0.44 in sulphur, and 0.036 in phosphorus. Previous to this the concentrates ran about 66 per cent. in iron. The average of eleven analyses taken from the workings between June 6 and August 13, 1890, gives the following composition:

Metallic iron 40.64 per cent. Sulphur.. 1.540 per cent.
Phosphorus.. .302 "

Before the old water-jigging mill was erected some eight years ago, the product of these mines was sorted to remove the more sulphury ore, and was shipped directly to furnaces making foundry irons. In order to meet the requirements of purchasers the mining company was obliged to reject, in cobbing, 2¾ tons to get 1 ton of shipping ore containing 51 per cent. of metallic iron and not more than 1 per cent. in sulphur. About 50,000 tons of this class of ore was shipped from these mines. The old dumps from this sorting are now being crushed and separated by the new process. Mr. John Birkinbine, in his paper on "Progress in Magnetic Concentration of Iron Ore" (*Trans.* Am. Inst. M. E., xix. 656), quotes from the private letter of a member of the Institute an expression of emphatic doubt whether, at any American mine, it would pay to mine and concentrate a lean magnetite. The writer says: "So far as I can see at this stage of our practice, waste-dumps only, or the rejected portion of an output, other portions of which have been shipped at a profit covering the whole cost of mining, can be used as the raw material of concentration." I can assert, and prove beyond question, that the Croton mines have produced and sold at a fair profit from 500 to 220 tons of concentrates per day during the past year and a half; and the mill has been actually running but 20 months.

Commercial success in concentrating any ore includes economical mining, preparation and separation; but in the Croton ore the presence of sulphur calls for very economical roasting as well as economy in all the other processes. The cheap roasting of the ore, which contains about 2 per cent. of sulphur, was really one of the first problems encountered in reclaiming that property, and was as important a factor as the concentration.

A series of experiments was made to determine the best size for economical roasting, and at the end of three months a size that would pass through a 2¼-inch ring was adopted, as giving the most rapid work for the quantity of fuel consumed. Crude Lima oil is used for roasting. Through experiments we found the average consumption of fuel oil to be 3.75 gallons; but by enlarging the combustion chambers we have reduced this amount to a little over 3.6 gallons per ton of raw ore. The cost of the oil is 2¼ cents per gallon, making a fuel cost of 8½ cents per ton of raw ore. The labor of filling and discharging amounts to only 3 cents per ton, as this work is largely automatic. The average temperature is 1,250° Fah. Davis-Colby roasters, remodelled to burn fuel oil, are used for a portion of this work, the remaining portion being done in a roaster of new type designed by the writer. The Davis-Colby roasters have been in operation nearly three years and have done excellent service.

The ore is conveyed automatically from the roasters to the Sturtevant mills, where it is ground to 12-mesh size, all coarser material from the screens being returned to these mills by elevators. Barring the numerous experiments with the various types of magnetic separators, the experiments in crushing have been the most elaborate. Nearly all the best-known methods of grinding ores have been tried during the past three years. Some of these machines have been tested for a year or more, but about 15 months ago we became thoroughly satisfied that the Sturtevant mill was far superior to any other machine for *grinding* iron ores. I consider it necessary to mention this machine thus somewhat prominently, as its economical and uniform granulation plays an important part in answering the question in Mr. Birkinbine's paper: "Does magnetic concentration pay?" If the ore is not properly granulated and screened, no known method of separation or concentration can make it a commercial success.

The screen-block openings in the Sturtevant mills are ¼ inch wide, and the coarsest material passing through them is less than 7-32 of an inch thick, while the finest material would be rejected by a 60 mesh screen.

The ore enters the Sturtevant mills at a temperature of about 350°, being cooled from about 1,200° by a water bath on its way up the conveyor. Under these conditions the ore is quite friable, and we have no difficulty in grinding 22 tons per hour with the 20 inch mill, and 16 tons in the same time with the 15 inch mill. One set of Sturtevant mill bushings will grind from 4,000 to 6,000 tons of ore, according to the depth of the chill in the bushing, the cost of each set being $16. The screen blocks for this amount of ore cost $9. This is less than one-half the cost of renewal on any other machine formerly used at our mill. At 22 tons per hour the 20 inch mill requires 94 horse power to drive it, but it will be remembered that the product is finished on these mills. The 15 inch mill requires 70 horse power. The ground ore is elevated from the discharging nozzles of the Sturtevant mills to the several screens, covered with slotted steel plates. The slots are 1-12 by ½ inch in some plates, and 1-12 by ¾ in others.

The slotted plates are easily removed, and when the requirements are exacting as to phosphorus, we substitute plates of 1-14 mesh on two of our five screens. We have demonstrated by exhaustive experiments that two sizes of screen-plates, three sets coarse and two sets fine, will prepare the ore containing 0.426 in phosphorus (the greatest amount we have in the mine) for a separation having 0.036 with two passes on the magnetic separators. Ordinarily, the phosphorus runs from 1-10 to 3-10. When it runs higher than 6-10 three sizes of screen plates should be used, delivering to three receiving bins, and each size should be treated separately on the magnetic separators; and I am positive that this treatment will insure a Bessemer product running not over 0.050 in phosphorus, using nearly any of the New York State magnetites that are free from titanium. In some experiments we have used 18 mesh screens, and with ore prepared for this grade we were enabled to produce continuously, with two passes, concentrates showing 70.60 metallic iron, 0.018 phosphorus and 0.220 sulphur. Of course the silica was extremely low. With the latest Hoffman separator, using 12 mesh screen, and making two passes, we have produced concentrates showing 70.93 metallic iron 0.017 phosphorus and 0.231 sulphur; and by using 18 mesh screens we can depend on 71 per cent. concentrates with one pass on this machine. The screens deliver their finished product to two bins placed on the floor above the separating department, each having a capacity of 80 tons. Eight shutes deliver the ore to the separators, nine in number. On eight of the machines the ore is passed before the magnets twice to bring the loss in tailings to 8 per cent. I have lately designed two new separators, one of which is giving with one pass, concentrates of 68 to 70 per cent., with a loss of only 6½ per cent. of iron in the tailings. As patents are now pending, these machines cannot be described here. People frequently ask how much it costs to separate the iron ore from the gangue. We always reply as little as any other portion of the process. Seven cents per gross ton of concentrates is a liberal allowance, and this includes all repairs to separators. We shall reduce this to less than six cents soon. Repairs and supplies throughout our milling plant amount to one and eight-tenth cents per ton of raw ore ground. Hence, it will be readily seen that *the* feature of the problem of magnetic separation is the initial mill grinding or granulating.

Using Sturtevant mills, and 22 per cent. ore, we can pay a small profit at our plant. Crushers and rolls require 28 per cent. ore to pay at the present price of concentrates. We contract our mining and initial crushing ready for, and delivered to roasters, at an average price of $1.38 per cubic yard. The ore weighs from 5,500 to 6,800 pounds per yard. We are selling concentrates at present to six furnaces, which use from 35 to 53 per cent. of them in their regular mixture. The furnacemen tell us that their flux and fuel are reduced, but most of them decline to give the exact amount. We have yet to receive a complaint from any of our customers as to quality or fineness. I have personally witnessed the use of several hundred tons of our concentrates at the experimental Kamel Conley steel works, near our mines. They were used in the various ways; sometimes loosely thrown into the bath, and at other times made into briquettes and charged in the open-hearth furnace along with the piles of scrap or African ore. Every one of the practical open-hearth melters employed there at different times has informed me that he was surprised at the rapidity with which he could handle the furnace when using concentrates.

An accurate, though condensed, statement of the cost of mining, crushing, roasting, preparing and separating, one gross ton of 68 per cent. concentrates, from two and one-fifth tons of 38 per cent. ore, according to the present daily practice at the mines, is given below. The tailings run, in iron, from 7 to 8 per cent. About one-third of the ore is taken from the old dumps. On the basis given below, 580 tons is crushed every 20 hours, with a production of about 265 tons of concentrates in the same time:

Statement of Cost.

Mining, crushing and delivering to roasters, 2 1-5 tons of raw ore, at 2¾ gross tons per yard	$1.13
Roasting, including top filling	.23
Handling at roasters	.03
Preparation at screening	.22
Daily renewals, supplies and repairs of all machinery and roasters	.05½
Separating, including labor and power	.07
Deliv'y to Harlem R.R. switch, includ'g R.R. repairs	.04
Office and laboratory expenses	.04½
Insurance, interest and taxes on plant	.13
	$1.95

During the last winter and spring, a continuous run of five months was made of twenty hours each day, and the average cost of a gross ton of concentrates for the whole term was $2.10. Improvements have reduced this amount to the figures of $1.95, given above.

The following analyses cover an average two weeks shipments in July, August and September of the present year. All concentrates were from screens with slots 1-12 x ½ inch, and all samples were from carloads:—

	July 7.	July 15.	Aug. 27.	Sept. 5.
Metallic iron..	68.55	68.080	68.250	70.090
Phosphorus	.0365	.0368	.030	.045
Sulphur	.240	0.340	.475	.170
Silica	3.500	3.610	2.951	2.513

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SINKING MACHINE. *To illustrate Mr. Sutcliffe's Paper.* WALLING APPARATUS.

Fig 1

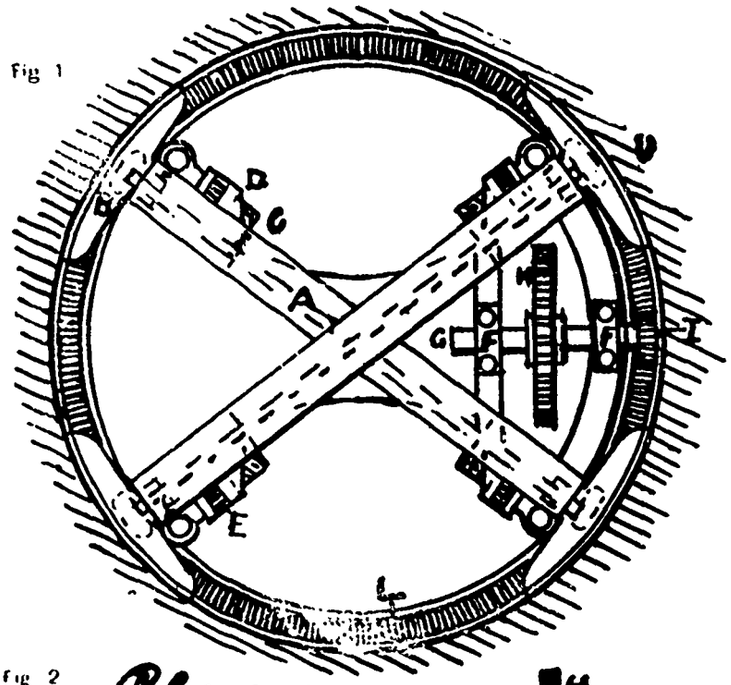


Fig. 3.

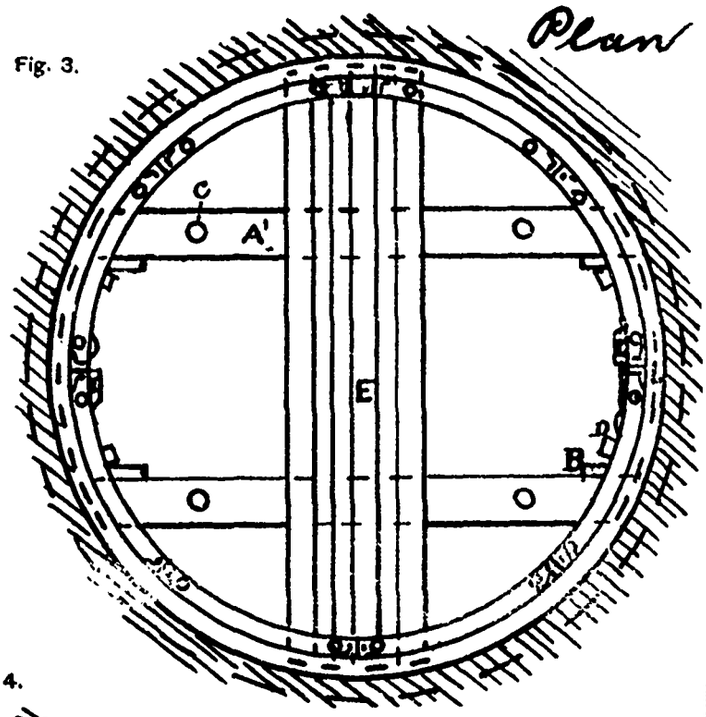
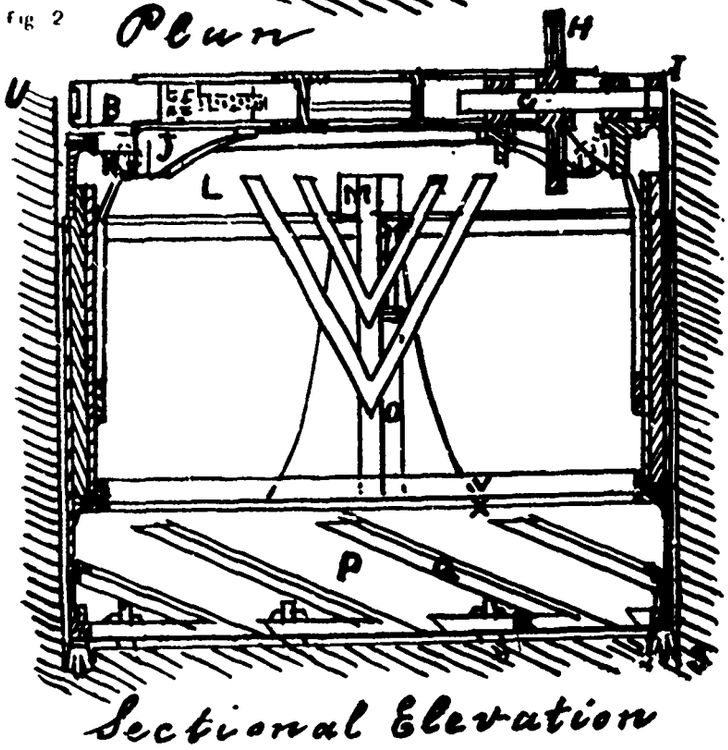
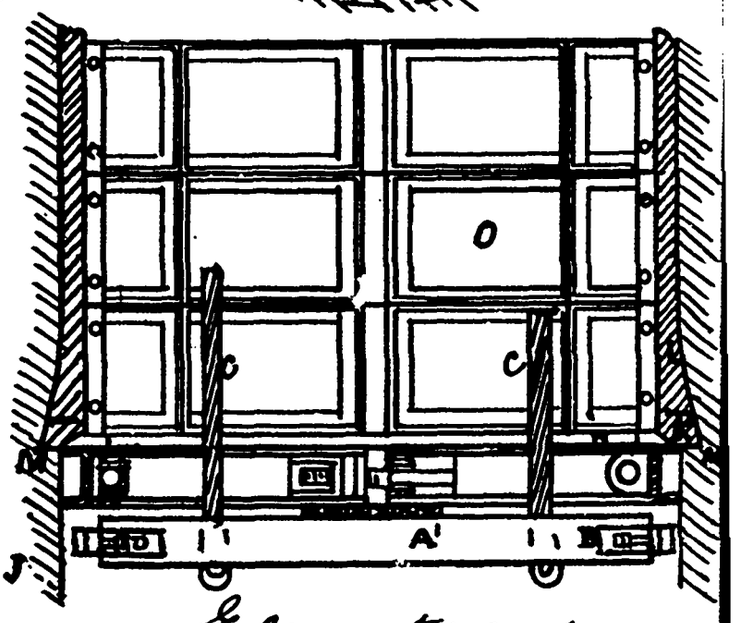


Fig 2



Sectional Elevation

Fig. 4.



Elevation

A Sinking Machine and a New System of Sinking Pits.*

By R. Sutcliffe.

Having seen that a number of colliery owners all over the country proposed sinking new pits, most of which are intended to reach a very considerable depth, and therefore must occupy a long period of time before winning the coal, I began to study and enquire in my own mind to see if there was no means of improving the slow method of sinking which at present prevails, and I came to the conclusion that it was quite easy to devise a more speedy, safe and cheaper system by the adoption of machinery instead of hand labor, and by replacing the present practice of sumping in the middle of the pit by what I think to be a more rational mode of cutting out or setting free the layers of strata all round the pit bottom in advance of the sinking. To accomplish this I have designed and patented a machine as shown in position within a pit, and ready for work, but without the motive power in the accompanying drawings. This machine can be worked by means of compressed air, electricity or such other motive power as the user may decide to adopt, but I prefer the former (compressed air) on account of its cooling effects on the pit bottom, as well as its general utility in a mine. I need not stop here to point out the many and great advantages of having the walls or sides of a pit cut in the solid to the exact size required, and left smooth and even and perfectly circular, instead of the rugged and uneven walls too often seen in our best made pits.

The sinking machine (figs. 1 and 2) consists of:—

1. A frame of steel or iron girders, A, firmly secured together with angle brackets at the centre and cross-girders at one end, to carry bearings F and F, which takes the driving shaft G. Four shoes, B, are fitted, one at each end, to the girders A, and allowed to slide freely on the same to the extent of two or three inches, and having a flange at each side of the webs of the girders. Brackets D, are also secured to the sides of the girders near the ends, and these brackets contain two flanges each, between which flanges a nut F, fits and is worked by means of a ratchet, etc., and in these flanges are suitable holes through which a screw, C, passes and is coupled, as shown, to the shoe B, at each end of the girders.

2. The air engines, or their equivalents (not shown on the drawings) are fixed on the girders A, so as to gear into the cog-wheel H, which is keyed on the shaft G, as is also the pinion I, which meshes or gears into an annular rack, L, and rotates it when the engines are set in motion. Size of engine cylinders, about 8 inches by 12 inches.

3. An annular rack L, composed of four or more pieces for convenience in handling, and with which is cast a vertical flange or shroud, about 2 feet deep and 1 inch thick, to take guides, M, and their strengthening stays. To the under side of the girders A, are secured four strong brackets, J, one at each end, fitted with journals, which carry runners, K, upon which runners the annular rack travels, carrying with it the whole of the under portion of the machine.

4. A cutting barrel or cylinder, P, composed of eight segmental steel castings, four of which are extended upwards to take slides which work within the guides M, and also the pistons of hydraulics, O. On the under end of the cutting barrel are cast tool boxes or sockets, R, to hold cutting tools, S, and on the internal side of the barrel are spirally placed ribs, Q, at frequent intervals, which serve to keep the groove or annular channel clear of broken earth or debris by scooping out the material, and they also assist to preserve the rotundity of the barrel by strengthening it. Also for the latter purpose an interval flange is placed at the top of these ribs.

5. Four hydraulics, O, for the purpose of regulating the feed and withdrawing the cutting barrel from the groove cut, or to lower the girders, A, and their connections for a fresh cut.

When the machine (figs. 1 and 2) is being made ready for a cut, the girders A, are securely and firmly fixed in a horizontal position by pressing the shoes B, (which are packed with wood to increase friction and absorb vibration) against the sides of the pit, U, by means of the screws C and nuts E, care being taken that a small space is left between the annular rings V and X, in order that the weight may be lifted off the cutting pieces. S, before starting the machine. And when working, it should be allowed to feed as it cuts. When out to its full extent the shoes should be released from the pit sides and the upper portion allowed to descend either by means of the hydraulics or the capstan rope, on which the whole machine may hang. Small flexible tubes are conveyed from a small plunger fixed at the engine to the hydraulics so as to be able to work them from the engine when desirable, instead of by hand. The girders in this machine are arranged to allow two sinking buckets to pass (one on each side), but where it is desirable to have only

* Paper read before the Mining Institute of Scotland.

one sinking rope near the centre of the pit, the girders can be placed parallel and kept sufficiently apart.

Assuming this machine to have 20 single and 20 double cutting pieces acting at same time in the groove, and making one revolution per minute in the pit bottom, it should cut at least 30 inches per hour in ordinary sinking stone, and, with the stone set free all around, layer after layer can be filled away without any powder. Sheet iron shields are allowed to hang from the stationary girders A, to protect the workmen from the rotating portion of the machine.

When it is necessary to cut a walling bed, special cutters are secured to the machine, and these cutters expand outwardly as the cutting barrel descends from the annular rack. In order to expedite the raising of the sinking material, I adopt the use of guide ropes, and utilize them in the following manner: Suspended on four guide ropes c^1, (figs. 3 and 4, Walling Apparatus), are two parallel beams of timber, A^1, tied together at each end by iron plates B^1, in which are fixed four set screws, D^1, which press against the sides of the pit in order to steady the guide ropes and beams in their proper position. On these beams are secured flooring deals E^1, so as to cover the whole of the pit except the openings required for the sinking buckets, air pipes, etc., in order to facilitate working thereon and to afford additional protection to the sinkers underneath to that supplied by the special walling scaffold to be used in putting in the walling simultaneously with the sinking. For the walling or lining of the shaft I employ concrete, and to do so I place on the flooring deals, above referred to, a temporary walling crib, composed of iron or steel and made in four pieces or segments, which are connected together by four bolts or screws and nuts, with suitable brackets, as shown on drawing (figs. 3 and 4). The top of this temporary walling crib is placed on a level with the wall bed or annular step M^1, and there expanded by the screws or bolts and nuts until made securely fast from pressure against the sides of the pit, when segments of wood, N^1, are placed upon it in order to facilitate the closing of the next lift below to be afterwards put in underneath. A course of bricks or blocks with quick setting cement or a low course of rich concrete, K^1, is next set, partly resting on the annular step out for walling bed and partly on the temporary walling crib. On the inner side of the wood packing N^1, is next placed a circular course of casing O^1, composed of angle iron frames lined with corrugated sheet iron (having the undulations placed horizontally), in eight segments, of a height of three feet, bolted together and having a wood packing piece R^1, in one vertical joint of the course to facilitate the withdrawal of the same. The freshly made concrete is poured in behind this casing, taking care that it is properly placed and packed all around by a careful hand and suitable utensils, and when filled and packed to the top, another course of casing is placed on the first and filled in at the back with concrete in like manner, and so on, placing course upon course, and fitting them with concrete at the back, until the bottom of the lift of lining or walling above is reached and closed up. When the lift or walling to be put in is a long one, the annular steps might be cut at intervals of from eight to twelve yards, so as to distribute the weight of the walling on the surrounding strata for extra security, instead of allowing it to rest entirely on the material composing the lining of the pit. It will be at once seen that a short time suffices to allow the withdrawal of the temporary walling crib, when it can be lowered with the guide ropes and re-set for another lift of walling, leaving the corrugated casings in position above (secured by undulations in the lining) until required for the fresh lift, when they can be brought down and re-set at the same time as the sinking proceeds.

In conclusion, I may say that I expect and believe that six yards per day of three shifts can be sunk and lined as safely and as easily as the amount now attained in ordinary sinking.

MINING NOTES.

[From Our Own Correspondents.]

Nova Scotia.

Cumberland County.

The Springhill collieries continue to flourish. Though the output was somewhat reduced owing to the fearful explosion in February, it is again up to 1,600 tons daily, from three slopes. Just now 1,460 men and boys are steadily employed, and shipments by rail and water are large.

Judging from the extensive improvements and alterations made this season, it is the intention of the management to equip these collieries with the most approved appliances for the mining and handling of an enormous output. At least thirty thousand dollars—probably more—has been expended on new buildings and machinery this season, besides expensive improvements underground, the cost of which it is difficult to accurately estimate.

The new bankhead building at No. 2 slope, is the most conspicuous improvement It is nearly finished and will cost about $6,000. The bankhead is horse-shoe shaped. As the boxes are hoisted from the slope they will run round a sharp curve to the screens. This building is 360 feet long, 30 feet average width, increasing to 42 feet at the screens. It is built on a trestle work 30 feet high, and the 12 foot post of the building gives a total height of 42 feet. There are five well laid tracks of steel rails, 40 lbs. to the yard. Two tracks are elevated, and over these the empty boxes will be conveyed by an endless chain to the pit head. The loaded boxes will also run by gravitation to the screens. There are six coal chutes, 54 feet long and 5 feet wide. As the coal runs down, it passes over longitudinal bars fifteen feet long. Two chutes are arranged for loading closed box cars, and the other four for ordinary coal cars. The old building is to be demolished about 15th November, when the new one is expected to be in readiness.

No. 2 slope has been sunk an additional 1,100 feet, making the total depth 3,000 feet. The seam is 13 feet thick, of superior quality. The levels at the 3,000 ft. lift are now driven over 3,000 feet, and the coal is taken through a tunnel and hoisted up No. 1 slope. Hoisting from the lower lift up No. 2 slope will begin in about a year. At present the coal all comes from the 1,300 foot level. The underground workings have been greatly extended. The slope has been re-timbered. Old steel rails have been used as booms for supporting the roof. The slope has likewise been re-laid with steels similar to those already described, on the new pit head. The fan-way has been enlarged from 36 to 80 feet area, thus giving an increased circulation of air. At this slope 56,000 cubic feet per minute circulates at the bottom of the slope.

At No. 3 slope six new tubular boilers, built by John McDougal & Co., Montreal, have been placed in position. These boilers are 30 feet long, 5 feet diameter. The additional power is required for driving a powerful pump, and the tail rope system is shortly to be introduced.

The new pump was built at Jeansville, Pa., and was selected by the mechanical foreman in charge, Mr. George Hall, after a personal inspection of the various pumps in use at the best equipped collieries of Pennsylvania. The water column pipes are 12 inches diameter, lined with wood, and were specially imported to resist the corrosive properties of the pit water here, which is most destructive to iron. The pipes are laid on the travelling slope which has been widened three feet a distance of 1,300 feet. The underground pump house, in which the new pump is to be placed, is 50 feet long and 15 feet wide. The walls are of solid masonry, three feet thick, and it is arched with brick. It is said to be one of the best on this continent.

At this slope the fanway has also been enlarged, giving a seventy foot area. The levels have been extended and pierce the workings of an abandoned slope one mile distant, for ventilating purposes. The slope has been put down an additional 600 feet, which gives a depth of 1,900 feet. The work of sinking has been carried on at all the slopes by means of bore-holes, and engines placed on the surface. These holes are five inches diameter and were bored by oil well borers from Ontario. The long-wall system is being worked very successfully in No. 3 slope in a four foot seam.

No. 1 slope —the seat of the explosion—has been sunk 700 feet, and will soon be hoisting from the 2,600 feet lift. Two boilers have been placed to give additional power for this purpose. Underground the workings have been extended a considerable distance. The two balances in which the explosions occurred will soon be stripped of all pillars and abandoned. These balances and the bords connected therewith have always been dry and dusty. No powder has been used in any of the slopes since February, and safety lamps are used exclusively in all the pits except a part of No. 2 slope. The "Marsant" lamp is preferred and 1,000 of these are in use.

Alexander McInnes, formerly assistant manager, was promoted at the time of Manager Swift's death. All underground work is under his supervision. His assistant is Chris. Hargreaves, and the underground managers in each slope are Wm. Conway, No. 1; George Wilson, No. 2; Wm D. Matthews, No. 3. The general manager of the company is J. R. Cowans, of Montreal, who resides here.

Beaver Dam.

This promising district, besides lying idle nearly all summer, is to remain unworked this winter. It is understood that one or more attachments will be made for reasons private to the company, and next summer may see the property working under new ownership.

Dufferin.

The quartz of this company has been very low grade all summer, but is reported to be looking much better of late. The mill continues to give great satisfaction.

Montague.

The new ten stamp mill of the New Albion Co. was started on the 7th inst. The batteries and iron work are from I. Matheson & Co., New Glasgow. The mill is well built and solid. Some very fine specimens were taken from the mine this month. It is understood that this property with an adjacent one is now being floated in London. Other properties in the district are idle.

North Brookfield.

The mine, which was sold at public sale in August, for something over $4,000, is now being unwatered preparatory to working. The syndicate which now controls the property has several practical miners in it, and the future of the mine looks prosperous.

Oldham.

It is reported that the Baker mine of the Oldham Co. will soon be closed down owing to poor grade of quartz. The mine is now 420 feet deep in a nearly vertical direction, and has been opened for a considerable length disclosing reserves which unfortunately are too low grade to pay.

Oxford.

Owing to a disagreement between bondholders and shareholders, two attachments have been placed upon the property of the Oxford Co. and the mine has been closed. The difficulty is entirely factional amongst the shareholders and the company is solvent.

Waverley.

The Sophia Mining Co., after unwatering the Tudor lode, started to sink the main shaft for another 100 ft. lift, but the recent heavy rains have drowned the pumps and sinking is temporarily suspended.

The Lake View Co., after several years work, announced in July a closing down because the ore was too low grade to pay. Mr. Hayward, the superintendent of the company, has obtained a two years lease of the property, and reports good grade of quartz now being stoped. It is rumored that this company will amalgamate with the Windsor Junction company in a new organization to be floated in London shortly.

The property of the Nova Scotia syndicate, known as the Windsor Junction Co., has lately been examined by Mr. Alfred Woodhouse, an English mining engineer. In consequence of his visit, work on the Union lode has been discontinued, and a new programme has been arranged, the details of which comprise a vertical shaft to a depth of 500 feet. The sinking of this shaft will be watched with interest by the mining fraternity.

The West Waverley Co. have not yet completed their plant and report progress as slow. The air compressor from Canadian Rand Drill Co. is now being set up. The management fix no date for starting.

Wine Harbor.

The McNaughton Mining Co. suddenly closed down last month. As the quartz in stopes and shaft was looking as good, if not better than ever, the cause of stoppage is a query. Mr. Robt. McNaughton was the manager of the company, and he is now prospecting in Seal Harbor district, which reports a valuable find.

New Brunswick.

Coal mining is beginning to loom up again at Manners Sutton, N.B. There is a very good quality of coal to be found there, but it has never been ascertained as to whether it exists in any large quantities. A vein of 22 inches was struck at Cork, but nothing further was done. For years an old blacksmith got enough coal to run his forge at a place known as the Raer Settlement. It was a surface outcrop, and a pick-axe and a sledge were all the tools that he used. A license covering the ground has been secured, and a successful find may be reported in a few days.

Quebec.

There is absolutely nothing worthy of record from the Province this month. As our readers are aware, nearly the whole of the phosphate mines are shut down awaiting a better market and the removal of the Mercier tax, the only exceptions being the High Rock and Squaw Hill mines on the Lievres River and some development in the Templeton field. In the Eastern Townships, as noted last month, there will be on 15th November a universal closing down for the winter of the Asbestos mines. Some activity is still noticeable, however, in the production of pyrites at the Eustis and Nichols mines at Capelton.

Ontario.

Sudbury District.

The long looked for Report of the investigations into the mineral resources of this district by Dr. Robert Bell will be issued in a few days by the Geological Survey. An excellent map accompanies the Report.

Mr. George Attwood, M.E., General Manager of the Dominion Mineral Company, sailed for England during the month. Mr. Attwood speaks highly of the district and its rapid development.

The Belmont Bessemer Ore Co., of New York, have done further development on their iron mine in Belmont Township and have uncovered a considerable amount of fine ore. They have a few hundred tons ready to ship. They are, however, at present building a railway into the mine to connect with the Central Ontario Railway. Two miles of the branch railway is already completed and they expect to have trains running over it in two months. Over 100 men are employed, besides about 30 teams. As soon as the railway is built the Company intend to ship at least 100 tons of ore daily. They have laid out a village at the mine and have built a boarding house, office, boiler-house and machine shop, large stable, etc.

The magnetic ore deposits in Snowdon Township on the line of the Irondale, Bancroft & Ottawa Railway are being developed and are showing up good ore. These ores are particularly free from phosphorus, the analyses showing only slight traces up to 0.025 phosphorus. A shipment of 200 tons some time ago gave, by the analyses of the chemist at the furnace, 0.01 phosphorus. This ore is therefore suited to make the finest steel

Port Arthur District.

Both veins in the Badger mine, (Porcupine), are producing well; the mill running full time, and the mine making regular shipments. About 75 men employed.

The Climax is a new mine now being opened up, adjoining the Porcupine. Two very promising veins have been discovered on this property, and are showing up well, producing good mill rock and high grade shipping ore. The owners are Port Arthur people, but, like all other good things, it is bonded to our American friends.

It is ascertained through a reliable source that the owners of the Climax mine have struck it rich in silver in the adit on No. 2 vein. They have recently given an option upon the property and now feel that they have offered it too cheaply.

The Silver Mountain East, have again resumed work with a small force of men. Reports say the results are encouraging.

The Silver Mountain West, is producing richer ore and in larger quantities than ever before; and making continuous shipments of high grade shipping ore. Everything here appears to be booming under the management of Capt. Rapsey.

Kingston District.

Mica in large crystals, white, and of tough, strong quality, has been obtained on lots 11, 12 and 13, of the south west Range, on the Colonization Road, in Abinger township, and on lot 7 in the 5th and 6th Concessions of Effingham township. On a part of the latter property, a large vein of quartz, said to be 20 feet wide, gives samples containing free gold. No milling test is yet reported.

Manitoba and North-West Territories.

Further confirmatory reports come from Edmonton, in the North-West, that coal has been found at Red Deer, on the line of the Calgary & Edmonton railway, and about half way between the two towns. It is said that large seams of coal are found within a short distance of the surface, and that its quality is fully equal to the best Pennsylvania hard. Hitherto the only hard coal found in Canada was at Banff, so that the importance of the reported discovery to British Columbia and the North-West Territories cannot be over-estimated.

The operations of Messrs. H. W. McNeil & Co. at the Banff colleries progress favorably. The company are getting out five or six carloads per day, and are in a position to double up their working force weekly. About 100 miners are now on the pay sheet.

In addition to the regular mining at Anthracite the company are proceeding steadily with their horizontal rock tunnel, which is being driven by an Ingersoll steam drill at a depth of 380 feet, with a view to reaching the overlapping seams of which there is infallible evidence from surface development.

The H. W. McNeil Company are also developing their property at Canmore. As the coal from this point will be largely used for locomotive fuel on the Canadian Pacific Railway, the railway company have contracted to take 100 tons per day. It is also most valuable for smelting purposes, coking and general steam use. The C. P. R. are building a siding of 6,600 feet on the south side of the Bow to the pit's mouth, joining the siding into the Cochrane mine, the bridge over the Bow being common to both. There are 25 seams of coal here, varying from 22 feet down, the Jumbo vein being 22 feet thick. The White Man's Pass, directly opposite Canmore, is known to everyone who has been there as abounding in great coal seams. The McNeil Company are working a seam of 6 feet of clear coal and will be ready to ship before the C. P. R. siding has been finished. By the first November they will be producing 150 tons per day, of the finest quality.

The system adopted for carrying the slack from the breaker at Anthracite, is a perfect arrangement. A trestle 150 feet high is constructed with a tramway running up to the top at an angle of 60 or 70 degrees. The car is carried to the top by an endless chain worked by steam power, and it is so constructed (with a raised triangular bottom) that on reaching the top, by the pressure of a lever, the sides swing out and the car unloads itself and returns to the breaker. The estimated saving in this operation by steam is about $10 per day. The one engine runs both the breaker and the tram car. Another valuable contrivance is a double cable from the breaker to the mouth of the slope, which carries the loaded car to the breaker and the empties to the mine, dispensing with the use of mules and all manual labor. This cable is a quarter of a mile long.

British Columbia.

A meeting of miners was held in the School House, Golden, on Saturday evening, 3rd inst., for the purpose of discussing the operation of the new Mineral Act, particularly in reference to the staking of claims. The prevailing opinion was that claims should be staked out so as to give the miner a claim 1,500 feet long and 1,000 feet wide. The question of allowing a discoverer a square of 40 acres was also discussed pro and con, the objection being that by giving so much surface other lodes than the one originally staked might be included and thus seriously interfere with the operations of others. The *Era*, commenting on this point, says: "This in one way looks reasonable, but considering the fact that the country has an unlimited area, and that all share and share alike in this scheme, it is hard to see why any objection should be raised to such a simplification of the present difficulties. The Government may say that such a grant would be out of place, but they should remember that the miner and the State are one and the same; the benefit of the former would eventually be the advantage of the latter, in the revenue which could be derived from the country through its mines, by the momentary sacrifice of a little land which is virtually unproductive at present."

The bores now being put down on the New Vancouver Coal Company's estate, Nanaimo, are progressing satisfactorily. The Harewood bore is down 150 feet; the one near the beach, at Departure Bay, is down 500 feet, and the one in Mountain District, between Northfield and Departure Bay, 250 feet. The electric plant in No. 1 shaft is now in good working order. The plant is an expensive piece of machinery, costing in the neighborhood of $50,000, and by the time it is introduced into all the mines in conjunction with coal cutters and electric lights, it will cost the company about $150,000. So far no contract has been made for the latter, but it is thought it will shortly be arranged. There will be three motors to the present plant, and it is anticipated it will prove a great success.

The coal shipments from the Province for the month ended 30th ult., have been:

New Vancouver Coal Co.	25,464	tons.
Wellington Collieries	21,401	"
East Wellington Collieries	2,968	"
Union Colliery	9,490	"
Total tons	59,323	

Phosphate Shipments from Montreal.

The following are the official returns of the quantities of Canadian phosphates shipped to Europe from the port of Montreal from September 16 to date:

Date	Name of Vessel.	Destination.	Shippers.	Tons.
Sep. 16	SS. Amarynthia.	Glasgow.	Lomer Rohr & Co.	160
16	Bk. Sabrina.	Fleetwood.	Millar & Co.	50
19	SS. Bede.	London.	"	100
19	" "	"	Millar Rohr & Co.	150
21	" Pickuben.	Hamburg.	McRae & Co.	110
26	" Storm King.	London.	Anglo-Con. Ph. Co	150
26	Ship Tobique.	Liverpool.	Irwin & Hopper.	405
30	SS. Concordia.	Glasgow.	Lomer Rohr & Co.	100
Oct. 6	" Lake Nipegon.	Liverpool.	Wilson & Green.	42
7	" Alcides.	Glasgow.	Lomer Rohr & Co.	120
17	" Canopus.	Liverpool.	Wilson & Green.	501
17	" Amarynthia.	Glasgow.	Lomer Rohr & Co.	170
				2058

SHIPPERS' RECAPITULATION.

	Tons.
Lomer Rohr & Co.	700
Wilson & Green	543
Irwin, Hopper & Co	405
Anglo-Continental Phos. Co.	150
Millar & Co.	150
McRae & Co.	110
Total shipments to date	2058

RECAPITULATION OF EXPORTS.

	Tons.
Liverpool	948
Glasgow	550
London	400
Hamburg	110
Fleetwood	50
Total tons exported	2058

CANADIAN COMPANIES.

Jeanette Mining Company.—Charter of incorporation has been granted to this company. Head office at Ainsworth, B.C. Capital stock, $500,000, divided into 500,000 shares of $1 each. Formed to explore, mine, mill, buy, sell, lease, bond and to do any other necessary work for the development of the mines which the company now own or may hereafter acquire.

Stadacona Silver-Copper Mining Company. Formed to operate the Grizzly Bear mine. Capital $100,000, in $1 shares. Trustees: C. T. Dupond, P. C. Dunlevy, I. Irving, C. D. Rand, J. Grant, all of Victoria, B.C. J. E. Boss, Spokane Falls, Wash., owns half the stock. Houses have been built on the property, and three shifts are running a tunnel westerly from near the east end of the claim. The tunnel, which apparently is off the vein, there being practically no mineral in the face, is in about 80 feet.

The McNaughton Gold Mining Company.—This company has applied for a charter pursuant to the provisions of the "New Brunswick Joint Stock Companies Letters Patent Act." Head office, St. John, N.B. Capital $16,000, in 16,000 shares of $1. The object for which incorporation is sought is the mining, milling and developing of gold mining on the properties owned by the company. Directors: Robt. McNaughton, Truro, N.S.; J. G. Forbes, St. John, N.B.; A. C. Blair, St. John; A. Wishart, St. John, N.B., and J. D. Hazen, St. John, N.B.

A new Boring Apparatus.—A Russian engineer, in Baku, has constructed a boring apparatus, the superior qualities of which, says *Iron*, are exciting great interest in the Caspian oil districts. It is worked by hydraulic power, the pressure being duly recorded on a manometer, and requires but one attendant. For exploiting the naptha, an 18-inch boring is made; for trial work a 6-inch boring suffices. The 18-inch boring requires 6,000 pounds of water per hour; the 6-inch only 1,000 poods, the water on leaving the apparatus being caught and re-used. This machine is capable of cutting through hard rock at the rate of 15 millimetres per minute. The stone borings, etc., are continually washed out of the hole by the outrushing water.

Moore's Patent Hydraulic Pumping Arrangements.—One of Mr. Joseph Moore's patent hydraulic pumping arrangements has recently been put in operation, we learn, at Linlithgow, Scotland. The pump is capable of raising 300 gallons of water per minute, and is placed 400 yards down an incline at a vertical depth of 500 feet, the steam engine which drives it being on the surface. By Mr. Moore's arrangement, pump rods are dispensed with altogether. There are upwards of 50 pumps worked on this system in operation in various mines in Scotland, pumping from 20 to 500 gallons per minute from vertical depths up to 120 fathoms. We hope to deal more fully with this system in an early issue.

Winding Engine at the Wingate Grange Colliery.—Illustrations are given in *Engineering* of a vertical winding engine recently constructed at the Wingate Grange colliery, Durham. The Lord pit is 110 fathoms deep, and two-deck cages, carrying two tons are used. In full work the engine is capable of raising 1,200 tons per day of eleven hours. The 10-foot winding drum is carried by girders immediately over the cylinder, which is 40 inches in diameter, and has a stroke of 6 feet. The distributing valves are of the Cornish hand-geared type.

Compound Pumping Engine.—The *Engineer* gives a description, accompanied by a plate, of a large horizontal pumping engine, built for the South Staffordshire Mines Drainage Commissioners. The engine has 52-inch and 90-inch cylinders by 10 feet stroke. It works two 27 inch plunger pumps each 10 foot stroke, forcing to a height of 500 feet. The engine is provided with a surface condenser, through which passes all the water which is pumped. The pistons are connected to the cross-head by three piston rods, one for the high pressure, and two for the low pressure cylinders, and the pump rods are worked by the angle-lobs. The two rods balance one another, but provision is made for throwing one out of gear, in case of disablement, and arrangements are made so that the single pump can be driven.

Guttapercha for Colliery Pump Valves.—At the Maybach colliery, Saarbrucken, the valve packing for the pumps consists of guttapercha, and this has now been in use for over five years without renewal. The pumps work at a pressure of 50 atmospheres, about 10 hours a day and at a speed of from 60 to 72 double strokes per minute. The guttapercha should not be too hard, and should wear evenly.

Pumping Natural Gas.—Gas is now being pumped near Pittsburgh, from wells which, as far as pressure is concerned, had become exhausted. The experiments have shown that the gas can be pumped long distances through pipes of a size much smaller than those in use.

Damping the air in Collieries.—At the Planitz colliery in Saxony, the air used for ventilation is caused to turn a wooden lap-wheel working in water. The flaps or blades are thus being continually moistened, and a portion of the moisture given up to the incoming air.

The Prevention of Overwinding.—Mr. Archibald E. Pinching, vice-president of the Mining Association of Cornwall, has written to a contemporary describing an ingenious contrivance for the prevention of overwinding, which was inspected by the members of the Mining Association of Cornwall at the Lens Colliery, Lille, during their recent Continental excursion. Mr. Pinching says: "While being shown round the surface works by the chief engineer and director-general, who combines both offices in himself, and watching the fine engines at work hauling the coal with wonderful rapidity from underground, I was electrified to see the gentleman in question—while a large engine was winding on and off a 36-ft. drum a cage containing six full tubs of coal and a cage loaded with men proceeding underground—motion the engineman away from the handle and make him stand quite clear of the engine—and from the expression of the man's face it was quite evident that this had not been rehearsed—and thus leave the powerful machine entirely to itself. Almost immediately a warning bell rang, and we became aware that a powerful automatic brake—which I afterwards ascertained was on the Westinghouse principle—had been applied to the engine, and the drum was visibly slackening speed. The engineman, however, was still told to remain where he was. Shortly after another bell rang, steam was completely cut off, and the cage drew up to its platform exactly as if the engine had been controlled by the most practised driver. The apparatus consists of an arrangement of valves, which come into play directly the cage reaches a certain point in the shaft, and if the engine should at that moment not be under control, immediately apply the powerful air-brake. This, however, allows the cage to proceed at a certain speed, but should another point in the shaft be passed and the engine be still out of control, the brake is increased in power, steam entirely shut off, and the cage brought to a standstill. The arrangement imperfectly described above is the invention of M. Reumaux, who is the director-general of the society or corporation.

Production of Hollow Iron Spheres by Pressure.—A method which has recently been devised for this purpose consists in the use of a hemispherical mould and a similar die, a piece of sheet metal being first moulded, and then the sphere completed by removing it from the mould and reversing it, completing the moulding in the same mould. Frequent annealing is necessary.

Casting Solid Ingots.—Mr. W. R. Hinsdale has devised a method for casting solid ingots, which consists in the use of a mould of peculiar shape, so arranged as to chill the top of the casting, and then to turn the ingot upside down before solidifying.

Wire Ropes.—The principal causes which lead to the destruction of wire ropes are: the wearing away of the outer surface of the outside wires, the rubbing of the wires against one another, and fatigue of the steel, brought about when the rope is worked over pulleys relatively too small. Haulage cables for tramways wear out from the first cause, so that they may be made stiffer and the outside wires stronger, as they do not have to make sharp bends. Where small pulleys and sharp bends in the rope have to be used the rope must be flexible, and the experiments are chiefly directed to this point. The rope was strained over pulleys and reciprocated, the number of bends supported being counted. Tension and torsion tests of the wire used were also made. The failure of the ropes in all cases was occasioned by the individual wires gradually giving way, one by one. In no case were the outside wires severely worn even when the pulleys were so large that a great number of bends had to be supported. The principal stress to be regarded is that due to the bending of the individual wires and not that due to the load. The cutting of the wires where they cross each other, due to their longitudinal motion, accounts for the short life of ropes on small pulleys. The great effect of this factor is seen in the tests of Lang's lay of rope, which undergoes a much greater number of bends than the ordinary lay. Oiling, also, by reducing the friction due to the longitudinal motion in the rope, has a great effect in lengthening the life of the rope. The results obtained in the course of the experiments are fully tabulated.

Money Orders.

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Over $4, not exceeding			$10	5c.
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" 60,	"	"	80	40c.
" 80,	"	"	100	50c.

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

For further information see OFFICIAL POSTAL GUIDE.

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