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FIFTEENTH YEAR OF PUBLICATION.

The Canadian Mining Review

Established 1882

VOL. XVI.—No. 5. MONTREAL--OTTAWA—HALIFAX. MAY, 1897.

SCHOOL OF MINING,

KINGSTON, ONTARIO.

The Following Courses are offered

1—Three Years' Course for a Diploma in

(A) Mining Engineering.
(B) Analytical Chemistry and Assaying.

2—Four Years' Course for a Degree in

(A) Mining Engineering (M.E.)
(B) Chemistry and Mineralogy (B.Sc.)
(C) Mineralogy and Geology (B.Sc.)

3—Post-Graduate Course for the Degree of

Doctor of Science (D.Sc.)
For further information see the calendar of Queen's University for 1897-97, p. 128.

4—Prospector's Course.

The School offers to Mine Foremen, Assayers, Prospectors and Mining Men generally, Special Courses of Instruction beginning January 6th, 1897, and continuing eight weeks.

5—Extramural Classes for Prospectors and Mining Men.

Lecturers will be sent to Mining Centres to conduct Classes in Elementary Chemistry, Mineralogy and Geology as applied to the discovery and winning of valuable minerals.

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

The BRUCE CARRUTHERS SCHOLARSHIP (value $200 per annum) will be awarded in May. Its object is to aid one who has had some experience in amalgamating, etc., in acquiring a good education in Mining Engineering. The conditions of the award will be made known on application to the Director or the Bursar.

FOR CALENDAR OF THE SCHOOL AND FURTHER INFORMATION APPLY TO

WM. MASON, Bursar,

SCHOOL OF MINING, KINGSTON, ONTARIO.

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

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

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

MINES OTHER THAN GOLD AND SILVER.

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

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

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

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

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

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

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

THE HON. C. E. CHURCH,

Commissioner Public Works and Mines,

HALIFAX, NOVA SCOTIA.

15th YEAR OF PUBLICATION.

The Canadian Mining Review

Established 1882

Official Organ of the Mining Society of Nova Scotia; The General Mining Association of the Province of Quebec; The Asbestos Club; and the Representative Exponent of the Mineral Industries of Canada.

B. T. A. BELL, Editor and Proprietor. Published Monthly. OFFICES {Slater Building, Ottawa; Metropole Building, Halifax; Windsor Hotel, Montreal.

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A National Museum.

The attention of our legislators has again been directed to the oft-mooted question of a new building for a Geological Museum, and as in former days when this subject came before the public it appears to have been favorably received by all parties. The editorials which have appeared in the daily papers, representing all shades of political opinion have been uniformly favorable to the scheme and every one interested apparently desires to see the present eminently unsatisfactory condition of things, as regards the housing and display of the magnificent collections of minerals, rocks, and specimens of natural history, which have been made by the staff of the Geological Survey of Canada during the last fifty years, changed for the better. The question is not in any sense a local one except in the matter of mere building, but concerns every portion of Canada; since within the Museum walls are gathered, not only the representative specimens, illustrative of every mining location from the Atlantic to the Pacific, but also the specimens illustrative of the rock formations as well as the type specimens of fossils by which the age of the several geological formations have been determined and these have been brought together from every corner of the Dominion. Many of these are of immense scientific value not only to Canada, but, they have been studied by the scientific men interested in the subject of geology from nearly every civilized country where geological surveys are carried on.

The subject of the new Museum was introduced by Mr. N. A. Belcourt, Q.C., M.P., one of the Members for the city of Ottawa, in a capital practical speech, in which the merits of the question were fairly and ably presented, and the reply of the Hon. Mr. Laurier would appear to indicate that at last the Government of the day is disposed to move in the matter and to take active steps in the direction which has been indicated for so many years by all those interested in the development of the mining industries of the Dominion.

From the remarks one hears on every hand relating to this subject it may be fairly presumed that the great majority of our legislators of all shades of politics are disposed to support any reasonable scheme that may be brought forward by the cabinet in voting a certain sum of money towards the erection of a commodious, suitable, and fire-proof museum building. The question has repeatedly been before the members of the Government, and but little opposition has ever been expressed towards the scheme, but for some unexplained reason the decisive step of voting the necessary funds has never been reached.

While the necessity of making a change in the Museum location has ever been acknowledged, the matter has moved slowly, while in the meantime the risk of destruction, which has been repeatedly pointed out, continues, and the stability of the present building, under its great load of collections, becomes less year by year; so that from time to time the assistance of the Public Works Department has to be invoked and new relays of timber supports inserted to prevent a general collapse of the structure. This would inevitably have occurred long since had not such measures been promptly taken.

The history of the Survey, and the scope of its operations has already appeared in the pages of the REVIEW in a paper read before the Quebec Mining Association by Dr. Ells several years ago. Originally located in small apartments in St. Gabriel street, Montreal, at the corner of St. James, in the year 1843, the collections grew so rapidly that the staff was at length obliged to secure additional accommodation in the block adjoining. Here the work of the Survey was carried on under the able management of its founder and first director, Sir W. E. Logan, until 1869, with a somewhat limited staff, most of whom have passed over to the great majority. In the autumn of that year the control of the department was assumed by Dr. Selwyn, and the offices remained in the same place, though the staff was greatly crowded through lack of proper space, until 1880-81. At that time the yearly number of visitors rarely exceeded 1,000 persons, and the interest taken by the citizens of Montreal as a whole, to judge from their familiarity with the work that there went on, was apparently not very great. Upon the decision of the Government to remove the staff and collections to Ottawa, presumably for centralization and better supervision in the interests of the Department, the citizens of Montreal were at once aroused to the advantages which accrued to the city from the presence of the Institution in their midst, and made strenuous efforts to prevent the carrying out of the Government's plan.

The scheme of removal was, however, successfully achieved, and the old offices and Museum building on St. Gabriel street were abandoned. The new quarters in Ottawa were supposed to be merely temporary or to be used until such time as the Government could decide upon some fitting place where the collections, then grown to large size, could be safely and suitably housed and placed on exhibition. The staff, which in Montreal was small, speedily increased in numbers in view of the great increase of work thrown upon it through the opening of the new territory in the west, and this increase in the number of the working parties soon made a marked increase in the size of the collections illustrative of the mineral wealth and the fossil remains, found at many points. The establishment of the sub-departments of Natural History, such as Botany, Ornithology, Ethnology, &c., also made calls for large additions to the Museum space so that the collections of the various branches speedily became so large that further

exhibits were almost impossible without excessive crowding. In consequence of the greatly increased weight thus placed upon the Museum floors these soon began to settle, and a first row of timber supports was placed in the lowest flat about twelve years ago. These for a time served the purpose and prevented further settling of the floors; but owing to the insecurity of the foundations or continued weight on the upper flats, these again became unable to sustain the burden, and a second series of posts become necessary, though but little additional weight had been placed in the building. The aspect of the Museum flats with the long rows of painted posts is somewhat startling to the visitor on his first entrance and the utility of the whole place is very seriously impaired. In the meantime all new collections have of necessity to be placed in sheds or stored in the basement, so that these are largely unavailable for purposes of study by the Staff, and nothing is now brought in but what is actually required for the purposes of elucidating the structure of the several districts in which the members of the Staff are engaged. Should the necessity arise of placing another relay of supports to keep the several floors in place it will be a difficult matter to find room for further installation of posts.

Owing to the increase of the Staff also, and the necessity of enlarging the museum space to the fullest extent, it was found necessary several years ago to increase the office accommodation. This was done by finishing off the upper flat over the adjoining dry-goods store on Sussex street, and here four rooms were provided, in one of which the Mining Bureau, with all its store of data collected for some years is placed. In these four rooms particularly the danger of destruction by fire is very imminent, and several very narrow escapes in this direction have occurred within the last half-dozen years. This building is a mere shell, old, and as inflammable as tinder; while it is so insecure that it was condemned by the officials of the Public Works Department several years ago, and the contents of the several rooms are now restricted to the necessary office furniture. This condition of things is especially unsatisfactory; and a fire, lasting but a very short time, would destroy the whole of this flat with its mass of manuscripts, note books, instruments and much other material of value which would be impossible to replace.

It can be easily seen, therefore, that, small as are the accommodations in the entire building at the present time, the condition of things is such as not to warrant the addition of any greater load in the matter of materials for exhibit or development. What is to be particularly regretted, however, is the fact that the space available is so limited; since on this account a very large amount of very valuable and interesting material on hand is of necessity stored away in out of the way places through the lack of facilities for its display, and the usefulness of the Museum as an object lesson on Canada's resources is greatly restricted. The members of the Staff also on this account are obliged to make their collections as limited as possible in all branches of scientific or economic work connected with the department. It is needless to state that the collections stored in the sheds are not in fire-proof buildings.

The appreciation in which the Survery is held by the general public since its removal to Ottawa is evidenced by the constantly increasing lists of names in the visitors' book, which now reach a total of fully 30,000 a year.

The importance and value of such a source of information to the younger portion of our population can be scarcely over-estimated, at least to those who can avail themselves of this opportunity of studying the mineral collections as well as the other exhibitions illustrative of the natural history of our country; and will certainly result in developing a love for scientific pursuits on the part of the rising generation. The several collections in the Museum form most valuable sources of information and are not equalled anywhere in Canada, and their study by young and old will lead to a rapidly increased knowledge of and an increased appreciation of the boundless resources of the entire Dominion.

The reputation which the Geological and Natural History Survey enjoys both at home and abroad among those best qualified to express a competent opinion on the subject, is well known, and is highly gratifying to those who have its development in hand. The Survey has always been particularly fortunate in the choice of its directors, all of whom have aided largely in establishing the reputation of Canada throughout the scientific world. The most distinguished scientists in the United States as well as in England and on the Continent, have all spoken in most unqualified terms of approval concerning the great value of the collections both from an economic and scientific standpoint. The history of Canadian geological research, in which is included some of the most interesting questions as regards the earth's structure and the development of its mineral wealth, can be readily studied here. The original collections of the fossils from which the determination of the stratified rocks was made are placed in the Museum, and the destruction of these would be regretted by every one interested in this branch of science. This fact has been pointed out by many eminent men whose names are well known throughout the scientific world.

As regards the great collections of rocks and minerals which have been gotten together at such expense from all parts of the Dominion, while it is possible that a great portion of these might be replaced at some time, it can be readily seen that the outlay for such a purpose would be enormous. As for the hundreds of note books, manuscripts, maps, plans of surveys, &c., which have been made during the last fifty years, it may be said that these are all exposed to the chances of destruction by any fire that may occur in the vicinity. The age of the building, its well seasoned timbers, and the great weight of the collections on the upper floors would all serve to hasten its destruction, and any one going through the Museum flats, and then through the lower portion of the building, and examining the pine posts which support the upper portion, can easily perceive that a fire of but a few minutes duration would suffice to render these unequal to the task of supporting the weight of the present collections. The risk from fire has long been imminent. Should it break out in any of the adjacent buildings on Sussex street it would require very great exertion to save the Museum, while the danger from the wooden buildings at the back has been seen from the fires which have already occurred in that direction. Luckily in these cases circumstances were such that the Musuem buildings escaped, but the danger still exists and the country has too much at stake in the Geological Survey to run the risk any longer than is necessary of having these valuable collections destroyed. The time seems specially opportune to take some decisive step in the direction of providing fitting accommodation for this important branch of the public service, and it is earnestly hoped that the Government of the day will see the possibility of placing this scientific institution in such quarters as will not only ensure the safety and permanence of the materials there stored, but will be a credit to the Dominion, which is interested in the maintenance of this valuable aid to the development of the country's resources.

We are pleased to announce that Mr. Wm. Blakemore, recently mining engineer to the Dominion Coal Co., Ltd., has been awarded a prize of £3 3s. for his valuable contribution to the proceedings of the North of England Institute of Mining and Mechanical Engineers on the subject of "Coal Cutting by Machinery." This paper was reproduced recently in this Review.

Free Milling and Chlorination of Gold Ores at North Brookfield, Queen's County, N.S.

Numerous descriptive articles have been published from time to time regarding the new milling and chlorination plant at North Brookfield, but it has been thought that a more detailed description of the plant, (which has cost over $80,000 to erect) and the process might be of interest to the readers of the REVIEW, and more particularly that section of them representing the gold mining fraternity of Nova Scotia. The question in issue was the most economical method of getting the largest possible percentage of gold from an arsenical pyrites which has given an average of $14 to $16 per ton of ore crushed, leaving varying values in the tailings running, so far as assayed, never less than $6, and frequently running much higher. Before erecting the new plant much ore was left below ground, and on the dump, which would not pay to crush but which now will pay well. The result of utilizing all this hitherto waste material will be that the value per ton of ore treated will not be greater than of old, but the available quantity of crushing material will be at once increased and the cost of mining and milling decreased. Cyaniding has been tried here and proved a dismal failure, although recent experiments would indicate the possibility of cyanide proving successful on this ore. Mine operators, however, would do well to be wary of anyone with a scheme or patented process, either on Cyanide or Chlorination, as both principles have been so long known and worked with various improvements and modifications as to render it extremely doubtful if any one individual has a right to any more profits than his own services are worth in extracting gold by either process.

Generally the method of treating the ore is by stamping the ore wet, passing the pulp over electro silver plated copper plates and then saving the sulphurets by means of the Improved Triumph Concentrators. The resulting concentrates are roasted in single hearth reverberatory furnaces and then subjected to barrel chlorination by the Thies process—a process without patents, which is used with many adaptations by a large number of successful mines, in the mining regions of the United States, and other parts of the world.

The mill, with power and capacity for 40 stamps, at present fitted with 20, is placed directly over the working shaft. Th shaft is perpendicular for 100 feet and then dips south to the depth of 400 feet at an angle of 23° cutting the pay chute on the fissure vein which has given to Brookfield its yield of gold. The shaft also dips north, cutting a large main lead at about the same angle, thus enabling the products of both leads to be hoisted to one deck on the top of the mill. The ore is hoisted to the iron-clad deck by a double cylinder steam hoisting engine placed on the ground floor of the mill, the whole arrangement being such that the engine-man hoists and dumps the self acting skip of one ton capacity without assistance from the deck-man. The ore is shovelled from the deck into a 10 x 15 Dodge rock breaker placed below the level of the deck, whence it is fed through shoots into any desired ore bin. A waste rock car runs beneath the deck to take waste over a tramway elevated 50 feet high. In fact although this mill is in a low swampy place the most ample elevation has been given, by means of a massive stone foundation, for the concentrators below the stamps and for the deposit for years of both waste rock and tailings. On the lower floor are two sixty-horse power boilers, the main engine, the hoisting engine, 20 stamps with 8 foot silver plates and a large amalgamating room fitted up with hot and cold water, panning tubs, iron sheathed table to handle amalgam set retort, smelting furnace, and clean-up barrel. The whole building, including the large concentrator room, is heated with the exhaust steam and is lighted by two 5 K. W. dynamos, which likewise transmit power for the chlorination and furnace houses. The stamps are 900 pound stamps, run on a 5 to 6 inch drop, 92 to the minute; 30 mesh wire screen is used. The mortars are narrow, single discharge, the latter being about 8 inches. Experiments are being made however, at present with a 20 mesh screen the object being to strike the medium between making too much slimes and saving too little gold by amalgamation. After the tailings leave the plates they pass through modifications of the Rittinger pulp sizers, where the pulp is divided into four sizes, and thence over 8 triumph concentrators. The over-flow from the last sizing box runs through a slime box where considerable slimes are collected assaying thus far about $30 to the ton. Whether or not these slimes can be treated by roasting and chlorination has not been determined. The managers are aware that the question of sizing before concentration has been, and is much discussed, but having tried both methods the conclusion thus far for the Brookfield ore is in favor of sizing. After leaving the slime boxes the tailings are converyed through sluices lined with riffles to the dump. A very small amount of concentrates are obtained from the sluices. The losses after leaving the concentrators are apparently largely from slimes and from sulphurets so exceedingly fine as to float. The concentration is done on eight Improved Triumph Concentrators 4 x 12 feet with smooth rubber belts. (This machine was patented by Mr. W. A. Sanders, now manager of the Equitable Mining Co., at Caribou Gold Mines, Nova Scotia and by him sold to the Joshua Hendy Machine Co., of San Francisco). They are set at an inclination of 2½ inches in 12 feet and receive 230 shakes per minute. The load is distributed over the endless rubber belt which travels about four feet per minute, at a depth of about 5-16 of an inch and of about the consistency of paint. Great care is necessary to keep even speed and not to allow pulp to become too thick or too thin. These two points added to the absolute necessity for cleanliness are the three most important points in running the machines, and it may be added most difficult to obtain. The average value of the concentrates now being made is about $65 per ton; assays, however, made by Mr. F. H. Mason, of Halifax, have run, on pure sulphurets from this ore, as high as 6 ounces per ton. From the concentrating room the sulphurets are hauled on the tramways by electric power to the furnace house. Here there are three single hearth reverberatory furnaces each 8 x 70 feet, with a capacity of two tons each per twenty-four hours. Each furnace is worked by two men to a shift of twelve hours. These concentrates contain, according to Mr. Mason, about 28 per cent. of sulphur and 16 per cent. of arsenic, practically all of which is eliminated in roasting. The ore when cooked is run onto a brick cooling floor whence, when cooled, it is elevated by chain bucket elevator to the top of a 5 storey frame building containing four chlorination barrels, 16 filtering tanks, four storage tanks, 16 precipitating tanks, two settling tanks, two acid tanks and one tank in which to make ferrous sulphate. The ore is discharged from the elevators into cars containing one ton each, wheeled along over the desired barrel and dumped through a hopper into the steel barrel 60 inches long, 42 inches in diameter and lined with lead 12 pounds to the square foot. The entire charge consists of 125 gallons water, 15 lbs. chloride of lime, then the ore and last 40 lbs. of sulphuric acid 66° Beaume. The barrel is at once hermetically closed and revolved at 20 revolutions per minute for five hours. The barrel is then discharged through a lead lined half circle in the floor to a filter tank on the floor below. There are four of these lead lined filter tanks to each barrel, each being 6 x 8 feet by 18 inches deep in front and 17 inches back. The bottoms are covered by specially made mineral tiles 8 x 12 inches, perforated, and having 1½ inch gutters underneath. On top of these

is a rack of 1¼ inch slats 4 inches high and 6 inches apart. Three sizes of quartz from ½ inch to ordinary gravel are placed in the rack for the filter. Before emptying the barrel, sufficient clean water is let into the filter to cover the gravel. This acts as a cushion to receive the pulp. Then the barrel is dumped, the contents striking on a wooden float to prevent disarranging the filter bed. The pulp is then washed three times with clean water. Tests being made with ferrous sulphate to determine when the chloride of gold is all out of the pulp.

The resulting solution is conveyed through lead pipes to the stock tanks on the floor below and there retained until it is desired to precipitate the gold. It may be here remarked that all the tanks in this building are lead lined except the 16 precipitating tanks which are made of Florida cypress and coated several times with an acid-proof paint. When it is desired to precipitate, the solution is drawn down to the tanks, which are eight feet in diameter and three feet high. Each tank is provided with three outlets, one 18 inches from the bottom, another one inch and the third in the bottom. About eight or ten buckets of the ferrous sulphate is added to each tank of liquor and thoroughly stirred, then the whole is allowed to settle for three or four days, the gold being precipitated in the form of a brown powder on the bottom of the tank. The solution is drawn off through the two upper outlets opening one after the other to prevent stirring up.

The remainder is swept out through the bottom hole and placed in a small settling tank 2 x 2 x 4 feet and allowed to stand 24 hours. The supernatant liquor is then carefully syphoned off and the precipitate filtered on paper, dried, mixed with one half its weight of bicarbonate of soda and glass borax and then smelted; the resulting brick averaging ·980 fine.

The solution drawn from the precipitating tanks in every case is run through a sawdust filter which every few months is subjected to chlorination to get any gold that may be in it.

So far as the Brookfield ores go chlorination is a success, and there is every reason to believe that many, if not most, Nova Scotia ores could be more profitably worked if concentrators were introduced with subsequent chlorination in view. After the character of an ore is definitely determined and the amount of chemicals necessary to use per ton of ore is settled the process is a very simple one, which is a special advantage to a country like Nova Scotia where there are no men in the line of chlorination who combine theory and practice. Small plants capable of handling say two tons per day can be erected for a comparatively small sum of money. Of course, such additions to the ordinary free milling plant increase the capital necessary to commence operations but until the operators in Nova Scotia gold mines quit putting up half built and equipped mills and expecting dividends from boulders with no underground development they need expect no dividends themselves nor any good report of their gold mines abroad. Some have advocated the idea of inducing the local government to establish a chlorination plant and assay office, but it may well be doubted if a pap-fed concern, which would most likely be managed by some laboratory expert with more "pull" than practical mining experience would prove of any benefit to the Government or the gold mining industry.

The plans and specifications for the roasting and chlorination plant were furnished by Dr. Adolph Thies of the Haile Gold Mine, Lancaster County, South Carolina, who is a thoroughly educated chemist and metallurgist with some 40 years of actual experience in gold mining in various parts of the world, and from him also were obtained many of the most useful ideas in fitting up the mill. The furnace house and chlorination plant were erected under the personal supervision of Mr. John. J. Bowers formerly of the Haile Gold Mine.

Mining at Great Depths.

By Bennet H. Brough, A.R.S.M.*

The recent announcement (1) that the Red Jacket shaft of the Calumet and Hecla mine in the Lake Superior copper region has been sunk to a depth of 4,900 feet, the greatest depth hitherto reached by a mine-shaft, opens up a large field of speculation as to future developments of mining at great depths. The subject is one of great importance in view of the rapid exhaustion of the thicker and more accessible seams in the British coalfields, and in view of the attention which at the present time is being devoted to the working of deep-level auriferous deposits in the Transvaal, California, and New Zealand. It appeared, therefore, that a well-considered summary of the existing literature of the subject, supplemented by observations made during visits to the mining districts of the Transvaal, Lake Superior, and the Continent, would not be out of place in the proceedings of the Society.

A.—Depths Hitherto Attained.

The epithet "deep" applied to a mine is a relative term. Early in the last century a shaft 60 fathoms in depth was an object of wonder, and tracing the history of the depths hitherto attained, the rapid progress in this respect is apparent. The first systematic writer on mining, Agricola, (2) describes mine shafts as being for the most part 2 paces long, two-third pace broad, and 30 paces deep. This depth had, however, been greatly exceeded in classic times at Laurium, where silver-lead mines were worked on a large scale by the ancient Athenians. There were 2,000 well-like shafts, many of which still exist and give a good idea of deep mining at that epoch. The workings were carefully laid out with the aid of geodetic instruments, a sighting instrument, and a water level, the use of which was described by Hero of Alexandria in the 3rd century B. C.

The shafts were perpendicular, square in sections, two yards across. The deepest was 360 feet, but most of them did not exceed 80 feet. These shafts are fully described in J. F. Reitemeier's "Geschichte des Bergbaues bey den alten Volkern" (Gottingen, 1785), in B. Caryophilus' "De antiquis fodinis" (Vienna, 1757), and in A. Cordella's "Le Laurium" (Marseilles, 1869).

As a rule in those ancient times, of which we have records in the works of Herodotus, Diodorus Siculus, and Pliny, the mines were of small depth. The rock was generally not difficult to deal with, the minerals extracted were of great intrinsic value, and labour was plentiful and cheap, or, as in the Egyptian and Athenian mines large numbers of slaves were employed.

In this country the mines worked in the early days were evidently very shallow. A variety of details regarding the working of a small colliery, belonging to the monks of Durham and situated in the vicinity of the city, are preserved in the Durham Household Book, (3) which contains the accounts of the bursar of the monastery during the years 1530-1534. At this 16th-century colliery five men were employed, who were paid an aggregate sum of 21d. or about 4d. each per day. The pits worked a very small area, lasting less than a year; but the cost of sinking new ones was a mere nothing, ranging from 2s. 6. to 5s. Among incidental charges are payments for winding ropes at 2s. each, and windlasses at 2d. each.

At the end of the 16th century, shafts were sunk from 70 to 120 feet deep. They were drained by water-levels or adits which were,

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* A paper read before the Society of Arts.

1 *Mining Journal*, September 26th, 1896.

2 "De Re Metallica," 1556, Book.

3 Published by the Surtees Society, Vol. xviii., and quoted by Mr. R. L. Galloway in the *Colliery Guardian*, July 24th, 1896.

we are told, very expensive, costing £20 or more. The invention of blasting at Schemnitz, (4) in Hungary, in 1627, rendered it possible to mine at greater depths. Blasting was introduced into this country by German miners at the Ecton copper mines in 1638 (5) and in 1689 it was adopted in the Cornish mines.

In 1668 the Shafts of the Mendip lead mines were 4 feet by 2½ feet, and were remarkable in the early days for their depth. Indeed, an ancient charter exists of the date of Edward IV. (1408) which, in a rude attempt at plan drawing, curiously represents the "Myne deeps" as they were then called. Writing in 1670, Sir John Pettus (6) describes the shafts of that period in the following terms:—

"The *Shaft* is that which is digged round or square, like a Well, from which the Earth that is digged is wound up in Baskets by Ropes, as we do buckets of water; and these are not only for that use, but likewise to give air to the Mine. Now oftentimes Pumps are put into these *Shafts* to fetch out the Water, for these *Shafts* are in many places 40, 50, or 60 fatham deep before the Miners come to the *Metal* or minerals for which they dig."

In 1672 George Sinclair (7) described the pumping operations in the North of England in colliery shafts 420 feet deep in the following words:—

"But there are to be seen in the North of England, in Bishoprick, water-works by which water is drawn above 40 fathom in perpendicular, but not all in one sink. The manner whereof is this, there being a sink from the end of their level to the surface of the earth where their works are going 40 fathom deep which must dry the coal sinks at 60 to 70, which lie above the banks of the river. Where the water-works are situated there is first one 40 fathom deep from the grass; another in a right line from that of 24; another of 12; upon all which there are waterworks."

According to Robert Plot, (8) the collieries at Beaudesert in 1686 were the deepest in this country. Here cannel coal was mined at a depth of 240 feet. Dr. Plot describes with great minuteness the working of coal at Tunstall, in North Staffordshire, where ancient coal-pits, 3½ feet in diameter and 36 feet deep, have recently been discovered. Waller, in his essay on the value of the mines late of Sir Carbery Price, in 1698, mentions (p. 48) the Rudolphus shaft in Hungary as having attained the great depth of 108 fathoms, and the Leopold shaft that of 150 fathoms. These figures he obtained from Edward Brown's (9) Travels.

Similar statements are made by J. B. Merin, (10) who describes a visit to the Schemnitz mines in 1615. Though giving an interesting picture of the state of mining at that date, his description can hardly be considered scientifically accurate, as he gives great prominence to the appearance in the mines of "demons in the shape of little negro boys."

In 1700, (11) some shafts on the Continent were 120 feet deep, 9 feet long, and 4 feet wide. The author of the "Compleat Collier," (12) in 1703, mentions shafts as deep as 250 to 369 feet. The cost of sinking them amounted to £1,000 and more. The majority of the shafts, however, did not exceed 120 to 180 feet, and their cost was not more than £55.

The earliest applications of the steam-engine were directed solely to the drainage of deep mines. Savery, in 1702, in his pamphlet on the subject entitled "The Miners' Friend, or an engine to raise water by fire," described the first application of steam, but Newcomen and Crawley, in 1710, were the first to render the steam-engine suitable for practical use. The introduction of the steam-engine, crude as it was, rendered it possible to sink deeper shafts.

In 1755 the Potosi mines were remarkable for their great depth. The ladders there are stated (1) to have been made of cowhide. They were 10 fathoms in length, and with their aid men carried ½ cwt. up 150 fathoms.

In 1786 we are told by de Morveau that the deepest mines in England were at Whitehaven, and in East Northumberland shafts were often to be seen 50 fathoms deep.

At the beginning of the present century, in the North of England shafts were usually 8 to 10 feet in diameter. (2) Here and there the equipment of shafts remained in a primitive condition. Even in 1837 a land-sale colliery was in operation in the county of Durham, at which coals were drawn by a donkey, and banked out and sold by an old woman. Nevertheless, there were some fairly extensive collieries, and some ambitious undertakings were begun, notably at Wearmouth colliery. Here shaft-sinking began in May, 1826; it reached 344 feet in August 1831, was metal-tubbed in October, 1834, reached 1,578 feet and struck coal. In April, 1835, it was down 1,590 feet. The cost is said to have been £80,000 to £100,000. (3) For many years this was the deepest colliery in the world.

Thus, in 1830, it was a miraculous achievement when a shaft approached 300 fathoms. At this period in the Cornish tin-mines, the wonderful improvements of the steam-engine caused mines which had been stopped for want of steam-power to be materially deepened, and large quantities of ore rendered available, which would otherwise never have been reached. Wheal Abraham had then obtained a depth of 1,452 feet, Dolcoath 1,410 feet, whilst Tresavean copper-mine was 1,920 feet deep below the adit level.

At the present time, Dolcoath (2,582 feet) is the deepest mine in Cornwall, its neighbour, Cook's Kitchen (2,436 feet), taking the second place.

The deepest shaft in the United Kingdom is that of the Ashton Moss Colliery, near Manchester, which has attained a depth of 2,880 feet. The seams dip at the rate of 9 inches per yard, so that parts of the workings are now 3,360 feet deep. (4) Even this depth has been exceeded at the Pendleton Colliery, where, Mr. Israel Barker, the manager, informs me, an incline of 1 in 3 has been sunk 4,700 feet long from the bottom of the shaft, which is 1,575 feet deep. The greatest vertical depth attained is, therefore, 3,474 feet. Many other deep shafts are over 1,800 feet, whilst the workings extend to over 2 miles from the shaft. The raising of some 1,500 tons per day from such depths, as compared with 300 tons from a depth of 500 feet, gives an idea of the development that has taken place within a comparatively recent period.

On the continent, the silver lead mines of Przibram, in Bohemia, in 1876, attained a depth of 1,000 metres (3,280 feet), and since that date, workings have been carried down for another 100 metres (328 feet). The Freiberg shafts, in Saxony, have reached the maximum depth of 2,060 feet, and those of Clausthal, in the Harz Mountains, 2,960 feet.

In America, the gold veins of California have been followed to a depth of 2,200 feet, and explorations have been made on the Com-

4 Neusohl archives quoted in "Jahrbuch der k. k. geologischen Reichsanstalt." 1867. p. 367.

5 Bishop Watson's "Chemical Essays." London, 1781. Vol. i., p. 332.

6 Sir John Pettus. "Fodinae Regales." London, 1670, p. 2.

7 "The Hydrostaticks." Edinburgh, 1672, p. 298-299.

8 "The Natural History of Staffordshire." Oxford, 1686, p. 125.

9 "A brief Account of some Travels in Hungaria." London, 1673, p. 98.

10 "Churchill's Collection of Voyages and Travels." 1704. Vol. iv., p. 822

11 B. Roessler, "Speculum Metallurgiæ Politissimum." Dresden, 1700, p. 5.

12 "The Compleat Collier: or the whole art of sinking, getting, and working coal mines, &c., as now in use in the northern parts, especially about Sunderland and Newcastle." By F. C. London, 1703.

1. "Essay on the Gold and Silver Mines of Peru." 1755, p. 26.

2. J. J. H. Holmes. "A Treatise on the Coal Mines of Durham and Northumberland." London. 1816.

3. John Holland. "The history and description of Fossil Fuel." Second edition. London. 1841. p. 186.

4. These figures were kindly supplied by Mr. T. H. Wordsworth, New Moss Colliery, Limited, November 28th, 1896.

stock lode, in Nevada, to a depth of upwards of 3,000 feet, whilst the Lake Superior copper-mines have reached, in the case of the Red Jacket shaft of the Calumet and Hecla Company, the fabulous depth of nearly 5,000 feet, mentioned at the beginning of this paper.

Two shafts were begun by the owners of the neighbouring mine, the Tamarack Mining Company, in the spring of 1889, and the progress was as follows:—

To the end of	No. 3.	No. 4.
	Feet.	Feet.
August, 1889	128	54
August, 1890	600	500
August, 1891	1,211	1,029
August, 1892	2,226	2,030
August, 1893	3,426	3,080
February, 1894	3,824	3,698

The cost in 1893-94 of sinking No. 3 shaft was £12 8s. 4d. per foot, and that of No. 4 was £12 15s. 7d. In each shaft 54 men were engaged. Early in the present year these two shafts were each 4,450 feet deep, and being situated at an elevation of 650 feet above Lake Superior, they penetrate far below the bottom of that lake, and, in fact, nearly three-quarters of a mile below the ocean level.

The accompanying list of the more important deep shafts will give a clear idea of the depth to which mining workings up to the present time have penetrated:—

Deep Shafts.

	Feet.
United States:—	
Red Jacket, Calumet and Hecla, Lake Superior	4,900
Tamarack, Lake Superior	4,450
Yellow Jacket, Comstock, Nevada	3,123
California Mine, Colorado	2,260
Grass Valley, Idaho	2,182
Kennedy Mine, Jackson, California	2,150
Pottsville shaft (disused), Philadelphia and Reading Coal and Iron Company	2,000
Belgium:—	
Produits Colliery, Mons	3,937
Viviers shaft, Gilly	3,750
Viernoy shaft, Anderlues	3,300
Marchienne Colliery	3,117
St. Andre shaft, Poirier Colliery, Charleroi	3,100
Ciply Colliery, Mons	2,950
Houssu Colliery, Centre	2,300
Marihaye Colliery, Liege	2,100
Average depth of all Belgian collieries	1,420
Austria-Hungary:—	
Adalbert, Przibram, Bohemia	3,672
Maria, Przibram	3,281
Anna, Przibram	3,100
Franz Josef, Przibram	2,900
Procopi, Przibram	2,900
Einigkeit, Joachimsthal, Bohemia	1,750
Amalia, Schemnitz, Hungary	1,750
Great Britain:—	
Pendleton, Manchester (workings)	3,474
Ashton Moss, Manchester, (workings)	3,360
Astley Pitt, Dukinfield (workings)	3,150
Dolcoath Mine, Cornwall	2,582
Rose Bridge Colliery, Wigan	2,446
Cook's Kitchen, Cornwall	2,436
Harris' Navigation, Pontypridd	2,367
Cadeby Main Colliery	2,250
Bickershaw Colliery, Leigh	2,210
Moss Collieries (No. 4 pit), Wigan	2,205
Astley Pit, Dukinfield (shaft)	2,058
Niddrie, Portobello, N.B.	2,010
Wearmouth Colliery	1,722
Loanhead Colliery, Shott's Iron Company	1,700
Victoria:—	
Lansell's Bendigo	3,302
Lazarus, Bendigo	3,024
Magdala, Stawell	2,409
Twenty-five gold mines exceed	2,000
Germany:—	
Kaiser Wilhelm II., Clausthal, Harz	2,960
Einigkeit, Lugau, Saxony	2,620
Samson, St. Andreasberg, Harz	2,560
Frieden Colliery, Olsnitz, Saxony	2,515
Concordia Colliery, Olsnitz, Saxony	2,420
Hansa Colliery, Huckarde, Westphalia	2,330
Maria Colliery, Hongen, Westphalia	2,300
Camphausen Colliery, Saarbrucken	2,296
Freiberg, Saxony (maximum depth)	2,060
France:—	
Montchanin Colliery, Le Creuzot	2,300
Treuil Colliery, Saint Etienne	2,034
Hottinguer shaft, Epinac	2,000
Ronchamp Colliery, Haute-Saone	1,870
South Africa —	
Robinson Deep, S. A. R.	1,991
Nourse Deep	1,578
Crown Deep	1,321
Langlaagte Deep	1,302
Jumpers' Deep	1,260
Kimberley Mine, Cape Colony	1,261
De Beers' Mine	1,097
Norway:—	
Kongsberg Silver Mine	1,900

The results here recorded afford clear evidence that a great many of the difficulties which were formerly connected with the sinking of deep shafts have now disappeared. The valuable inventions and appliances available to the mining engineers have rendered such sinking operations easy, and comparatively inexpensive. It, therefore, appears that no considerations of a mechanical nature need limit the prospective depths of shafts.

B.—Obstacles to Deep Mining.

The elements needing consideration regarding the limits of depth in mining, are:—

1. The decreasing capacity of deep shafts.
2. The increase in pressure.
3. The increase in temperature.
4. The increase in expenditure.

These four obstacles I now propose briefly to discuss.

1.—Decreasing Capacity of Shafts.

It is obvious that the quantity of mineral extracted from a shaft diminishes in proportion to its depth. The methods adopted for obviating this inconvenience are as follows:—

(a) Increasing the speed of winding.

(b) Enlarging the skips or cages.

(c) New methods of extraction.

(a) Increasing Winding Speed.—Turning to the first of these methods, we find that the evolution of the winding arrangements forms one of the most interesting chapters in the history of mining industry. Starting with men or women carrying the mineral on their backs up ladders, the improvements successively introduced have been a pulley supported by a frame above the shaft; the hand-windlass, or the capstan; the whipsiderry (in which the bucket is drawn up by making a horse walk away from the shaft); the horse-whim; and the winding-drum, worked by natural water-power. This was followed by the

winding-drum, worked by water-power, pumped up for the purpose; the winding-drum, coupled direct to the steam-engine; an automatic collision-preventing arrangement for slowing the wicker-baskets when they passed each other in the shaft, rendered necessary by the increased speed of winding; next, the introduction in 1833, by Mr. T. Y. Hall, of South Hetton Colliery, of guides and cages to convey the waggons to the surface; and lastly, we come to the improved winding-engines of to-day.

The invention of wire-rope, by Oberbergrath Albert, in Clausthal, in 1833, rendered deep mining possible. Before that date, the cost of hemp-ropes for deep shafts was very serious, and often as much as 6d. per ton of output was required for their maintenance. The ropes at Wearmouth Colliery cost £550 per pair. They weighed 5¾ tons, and only lasted 10 months. Iron wire-rope has now been superseded by steel. At the deep shafts at Przibram, crucible cast-steel, with a tensile strength of 76 tons per square inch, was used up to 1885. Since then, special crucible cast-steel, with a tensile strength of 114 to 120 tons per square inch, has been used with most satisfactory results. At these mines the advantage of using tapering ropes is especially noticeable.

Flat steel ropes are in use in Belgium, at the Providence shaft at Marchiennes. They are made of eight parallel four-stranded ropes, tapered by reducing the number of wires in the strand from 12 to 11 and 10, the wire which is of crucible cast-steel, of a tensile strength of 89 tons per square inch, being of the same diameter (0·08 inch) throughout. The breadth of the rope varies from 7·87 inches at the thick, to 6·69 inches at the thin end, and the average weight is 8·2 lbs. per foot. The winding engines of 2,000 horse-power have cylinders 43 inches in diameter, and 78 inches stroke, and draw a load of 12½ tons (6½ tons for the cage and tubs, and 6 tons of coal) from a depth of 3,117 feet. The life of the rope is about 12 months.

At another deep Belgian colliery, the Sainte Henriette shaft of Produits Company, at Flenu, aloe ropes are used to lift a load of 6½ tons from a depth of 3,937 feet. They are of flat section, with ten strands, tapering in breadth from 16·5 inches to 8·6 inches, and in thickness from 1·93 inch to 1·14 inch. The average weight per foot is 7·4 lbs. The life of these ropes is about 24 months.

At the deep mines of the Lake Superior copper region, machinery of a very high-class is employed. The following interesting particulars, for which I am indebted to Mr. John Birkinbine, Past-President of the American Institute of Mining Engineers, will serve to illustrate this.

In the case of one pair of quadruple engines at the Calumet and Hecla Mine, each engine has its four cylinders, 18 inches, 27¾ inches, 48 inches, and 90 inches in diameter, with a stroke of 60 inches, driving through gearing conical winding-drums 14 to 24 feet in diameter, and 12 feet wide, which lift cages carrying 6 tons of ore at the rate of a mile in 1½ minute.

At the Tamarack Mine, an average winding speed of 3,200 feet per minute has been obtained by a direct acting engine, having 42 by 84 inch steam cylinders, driving winding drums 30 feet in diameter. At the same mine a 32 by 84 inch engine, driving a double conical drum 13 feet 6 inches to 36 feet in diameter, lifts a cage carrying 2½ to 3 tons 4,500 feet in 1½ minutes. These are vertical shafts.

At the Quincy Mine, there are two principal shafts. No. 6, on a slope of 51° 44′, has a total depth of 3,680 feet, the weight raised being about 6 tons. No. 2 shaft, with the same dip, has a total depth along the slope of 3,954 feet, the weight raised being 10 tons.

It is interesting to compare results obtained at these three mines with those obtained at English collieries. Three illustrations which are given on good authority may be cited. In the "Encyclopædia Britannica," 1877, Mr. Bauerman selects as a good example of modern winding, such as is required to draw 1,200 tons in 10 hours, that at Shireoaks Colliery, Nottingham. There the cage with a load of 34 cwt. in five tubs is raised from a depth of 1,548 feet in 45 seconds, an average of 2,100 feet per minute. Mr. Emerson Bainbridge cites as an illustration of swift winding a North Derbyshire colliery, where in June, 1890, as much as 6,309 tons was raised from a depth of 1,527 feet in 8½ hours. Figures of cage speed published by the North of England Institute of Mining Engineers in 1876 show that the greatest maximum speed of the cage in the shaft recorded was at Rose Bridge Colliery, where it reached 5,100 feet per minute, or about 57 miles an hour.

The selection of the best form of drum is a matter of importance in winding from great depths. It appears best to replace large and expensive drums by small ones, and to have more revolutions for each journey. This object is attained in the system of winding engines patented in 1866 by Mr. S. B. Whiting, the manager of the Culumet and Hecla Mine. In this system, there are two grooved drums, one directly in line with the other, coupled by two connecting rods. The rope from one compartment of the shaft winds round both of these drums for three turns and is then led to the other compartment of the shaft. In order to allow of winding from different levels the rope is led back round a sheave on a tension-carriage running on rails, and a steam winch is connected to it so as to adjust its distance from the shaft. The following are particulars of a winding plant of this type at the Red Jacket shaft:—

Depth of shaft	4,900 feet.
Size of shaft	13½ by 23 feet.
Diameter of rope	1¼ inch.
Diameter of drums	7 feet.
Cage speed per minute	1,900 feet.
Weight of cage	2,500 lbs.
Weight of load	3,000 lbs.

Remarbable economy in fuel and winding efficiency has been attained with the machinery designed by Mr. L. I. Seymour for the De Beers Diamond Mines, Kimberley, and built by Messrs. James Simpson & Co., of London. The plant consists of a pair of inverted vertical tandem compound condensing engines driving two reels, which are capable of carrying flat wire ropes 3⅝ by 13·16 inch. The winding is from the 1,200-foot level. Two automatically discharging skips are used, each weighing 4,400 lbs. and holding 9,600 lbs. of mineral. According to Mr. W. McDermott, on one occasion during a single shift of 11 hours 43 minutes, the weight of blue-ground raised was 3,665 tons. The engines have been in use for over 3 years, and consume only 2¼ lbs. of coal per horse-power per hour.

For highest speeds, vertical shafts and wire-rope guides are absolutely necessary. In metal mines time is saved by adopting vertical shafts and cages instead of inclined shafts and skips. The number of loading places should be reduced to the lowest limit. A great deal of the ore obtained from the upper levels could be dropped down winzes by balance cages, as is done in working inclined coal seams. In the Niddrie Collieries, near Edinburgh, experience shows that it pays better to drop coal 100 yards down a staple pit than to wind it from an intermediate landing.

The best method of increasing the speed of winding appears to be to slightly increase the size of the engines, and to greatly increase the steam pressure. Small engines start easily, get up speed quickly, and can be stopped more conveniently. Consequently time is saved at the bottom and at the top of the pit. This is important, as it is on stopping and starting that time is lost. In many cases endeavours have been made to obtain a combination of swift winding and econ-

omy in fuel, by adopting variable cut-off gear. Compound engines for winding have been adopted, not only at Lake Superior, but also at Llanbradach Colliery near Cardiff, at the Treuil Collieries, Saint Etienne, at the Idra Mercury Mines, in Carniola, and at other places; but apart from economy in fuel, no particular advantage appears to have been gained.

(b.) Enlarging Cages or Skips.—The problem of overcoming the diminishing capacity of a deep shaft has been solved at Marchiennes by Mr. Alfred Soupart, in a remarkable manner. At this colliery there are two winding shafts, an elliptical one, 8 feet 6 inches by 9 feet 3 inches, and 3,000 feet deep, and a circular one, 10 feet in diameter, and 3,100 feet deep. These shafts eventually will be carried to a depth of 4,000 feet. Owing to the small diameter of the shafts, only single tub decks could be used, and in order to be able to command a large output, it was decided to employ ten and twelve-deck cages, and thus to avoid running the engines at an abnormal working speed.

The cages with ten decks weigh 7,700 lbs., and the twelve-deck cages weigh 8,800 lbs. The dead weights with the empty tubs are 13,200 lbs. and 15,400 lbs. respectively. The loads amount to 11,000 and 13,200 lbs.

On the occasion of the visit of the Iron and Steel Institute to this colliery in 1894, the time occupied in changing was 120 seconds at No. 1 shaft, and only 80 seconds at No. 2. For winding, 120 seconds were required. The total time for each journey of a cage was thus four minutes at No. 1, and three and a-half minutes a No. 2.

In the Lake Superior copper mines, attempts have been made to overcome the difficulty by using larger skips. The Quincy Mine, for example, has introduced 7-ton skips, whilst formerly 2 and 3 ton skips were used. With heavier skips, there is, however, greater risk of breaking the ropes. In collieries, increasing the size of the tubs is not to be recommended. They become unwieldy, and are inconvenient to handle in the confined spaces underground.

The time occupied by a miner in descending to and ascending from his work is a matter for serious consideration. Before the application of winding machinery for raising men, and the invention of the man-engine, the means of access by steps, slides, and ladders were slow and exhausting.

With the increasing depth of mines, it becomes necessary to expedite the movements of the miners, and, with this object in view, there is a tendency to accelerate the speed of winding men in shafts. Careful experiments recently made by Mr. A. H. Stokes, H.M., Inspector of Mines, at a shaft 1,290 feet deep, show that, directly after starting away, the engine-man endeavours quickly to gain speed, whereas the last two revolutions show his care in reducing the speed to a controllable velocity near the pit top. At one point in the shaft the men travel at the rate of 37 miles per hour. The speed of coal-winding in the same shaft is only a little faster. In cases where both shafts are available for the descent and ascent of men, the time occupied in lowering and raising them is considerably reduced, and it is highly desirable that both shafts should be supplied with equal facilities for the purpose.

In lowering large numbers of men who have to work at many different levels, the man-engine has been found convenient. Introduced in the Harz mines by Doerell, in 1833, in the form of two reciprocating rods, carrying small platforms, on which the men stand, the man-engine was adopted at the Tresavean Mine, in Cornwall, in 1842. Since that date it has been employed at various deep mines in Bohemia, Saxony, Westphalia, and Belgium, but at the present time it is being gradually replaced by the less costly cage.

(c.) New Methods of Extraction.—The employment of round ropes is limited to a certain depth, as a point is reached beyond which they will not support their own weight. Theoretically taper ropes have no such limit. The use of ropes may, however, be dispensed with altogether. This was done at the Epinac Collieries, France, by Mr. Z. Blanchet. In the method of pneumatic hoisting, there successfully applied for ten years, there was fixed in the shaft a large tube with a piston from which was suspended a 9-deck cage carrying nine waggons, each holding half a ton of coal. By exhausting the air above the piston, the load was gradually forced up by the atmospheric pressure below it. While for descent, exhaustion was stopped and air allowed to pass upon the top of the piston. Three trucks were removed from the cage at a time by means of three double doors provided in the tube both at the top and the bottom. The Hottinguer shaft, where this method was applied, was 1,980 feet deep, and the tube was 5 feet 3 inches in diameter, made up of 485 rings of sheet iron 4 feet 4 inches high and 5-16 inch thick, riveted together. The total weight of the rings was 418 tons, and the speed of winding was 1,200 feet per minute. Unfortunately no coal was found, and the original idea of extracting 150,000 tons annually from a depth of 1,000 yards with two connected pipes, could not be carried out.

Ten years' experience proved that the method was a practical success, and if it had been possible to have installed two hoisting tubes in connection, the dead weights might have been made to counterbalance, and the power required would have merely been that necessary to overcome the weight of the useful load. While obviating the dangers due to the use of winding ropes, and improving the ventilation of the mine, the pneumatic method, though necessitating great expense in installation, must be looked to as the future method of winding when mines reach such depths as to render wire-ropes useless.

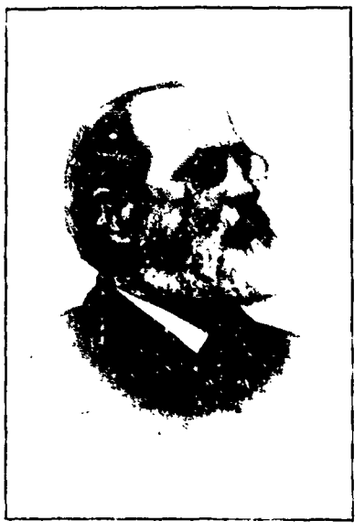
The idea of pneumatic hoisting is not altogether novel, for reference to the records of the Patent-office shows that quaint proposals with this object in view were patented in 1845 by J. Knowles and A. B. Woodcock, and in 1846 by G. H. Bovill and R. Griffiths.

With the object of increasing the shaft capacity almost indefinitely by devising a system in which several skips can occupy the shaft at the same time, it has frequently been proposed to wind in shafts by means of endless-chain bucket elevators, in a manner resembling endless rope haulage in levels. The method was in use in Harz before the invention of the wire rope, and was tried in the middle of this century in this country, notably, at a colliery near Liverpool, for winding from a shaft 360 feet deep. On an iron pit frame there was placed a mechanically-driven axle, at each end of which there was a vertical sprocket wheel. At the bottom of the shaft the chain passed over similar wheels. The two chains were connected at every 18 feet by cross-bars, with hooks in the middle to which the tubs were attached.

An endless elevator was used in 1875 at a Saxon lignite mine; but, owing to the moisture in the coal, the buckets would not discharge automatically, and the arrangement was discarded.

Hoisting, by means of reciprocating rods, like those of the man-engine, has also been tried. The idea is not a new one; for it was, according to F. E. Bruckmann, (1) actually applied at Falun, in Sweden, as far back as 1694, by Christian Polhammer. A similar arrangement was devised by Hubert Sarton, a Belgian watchmaker, in 1776. In both methods an endless chain was used for lowering, whilst for raising, Polhammer had two reciprocating rods, with hooks to which the buckets were hung, whilst Sarton intended to use only one rod. The idea was revived in 1849 by Mehu, and carried into

1. "Magnalia Dei in Locis subterraneis." Brunswick, 1727.



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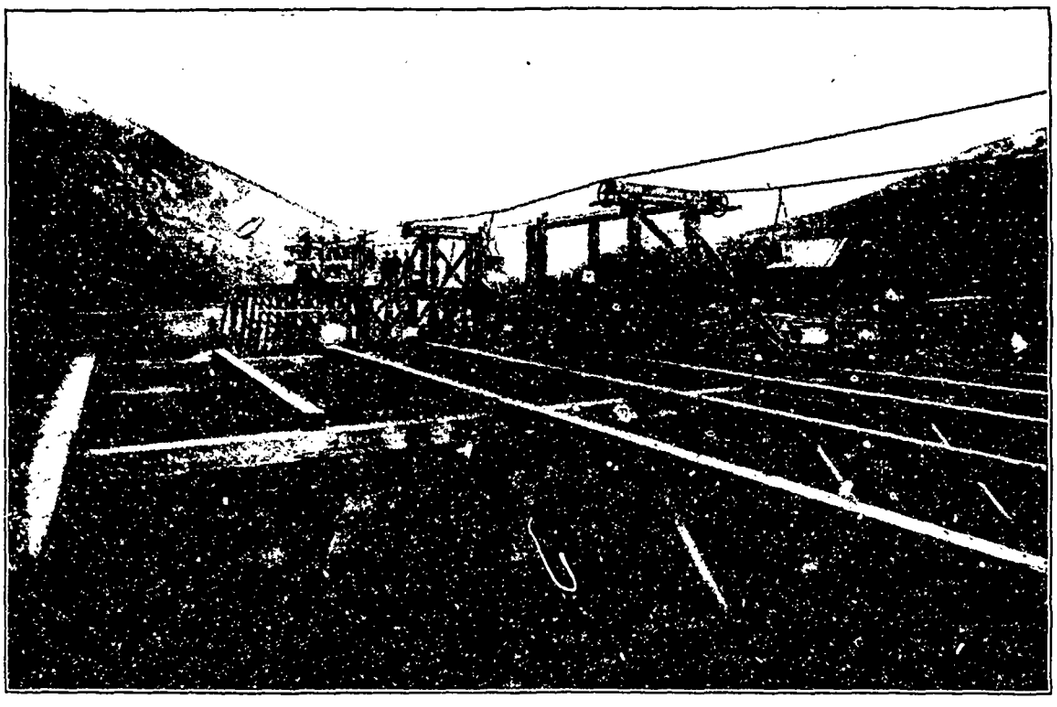
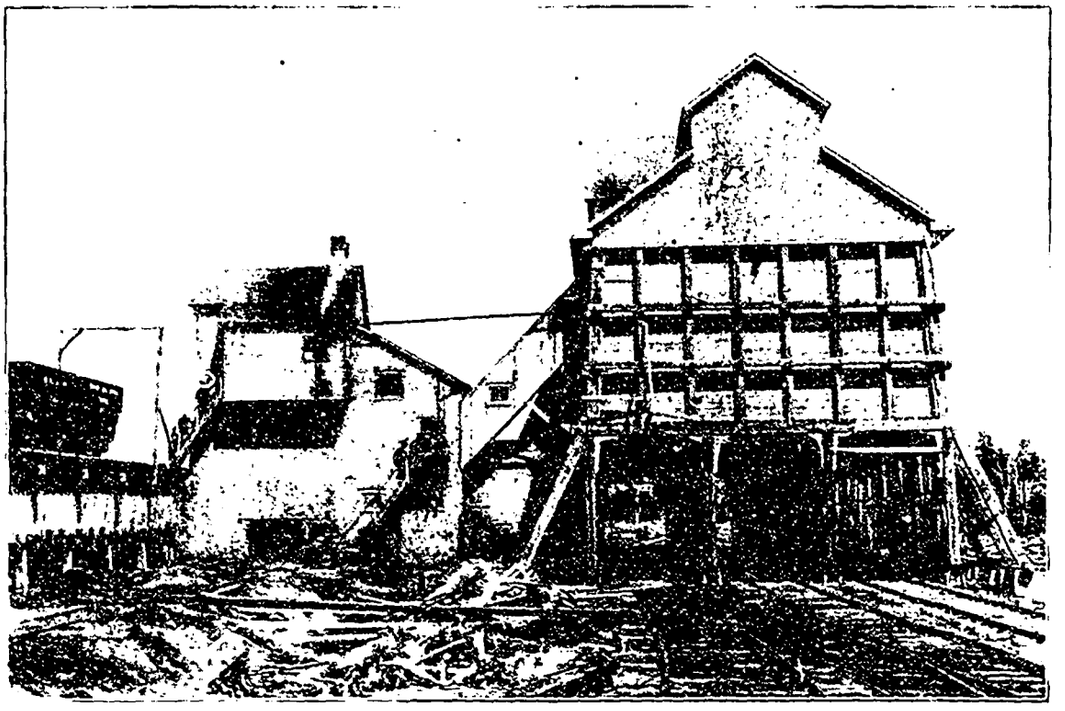
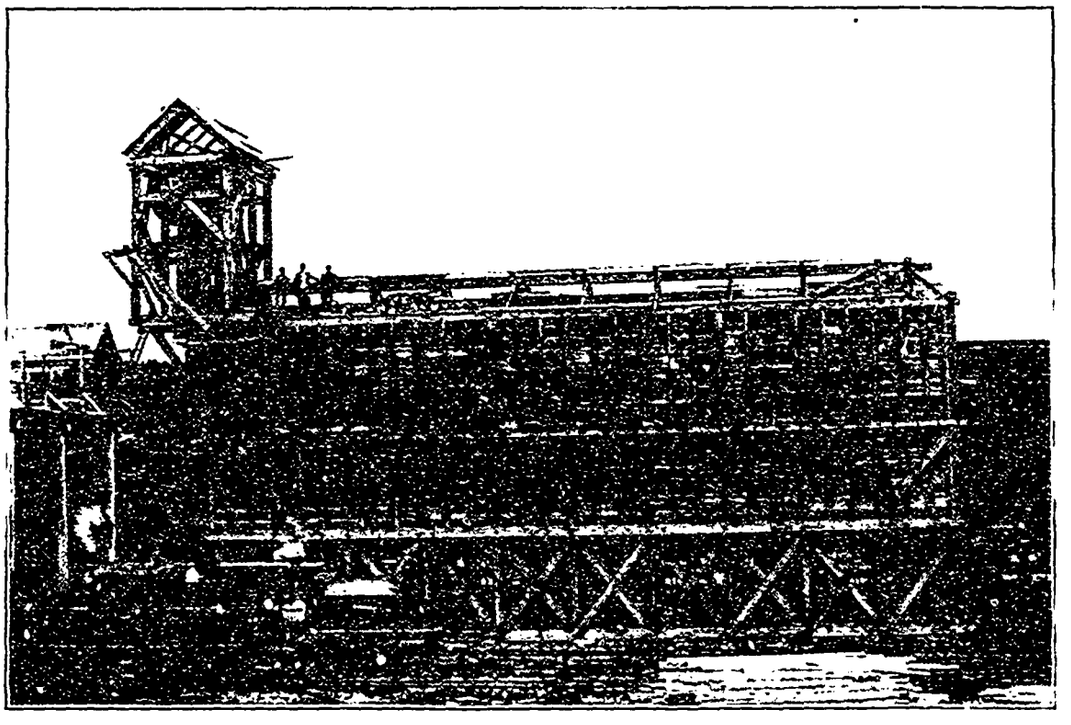
Theo. Briedenbach, M.E.
Mikado Gold Mine, Lake of the Woods, Ont.



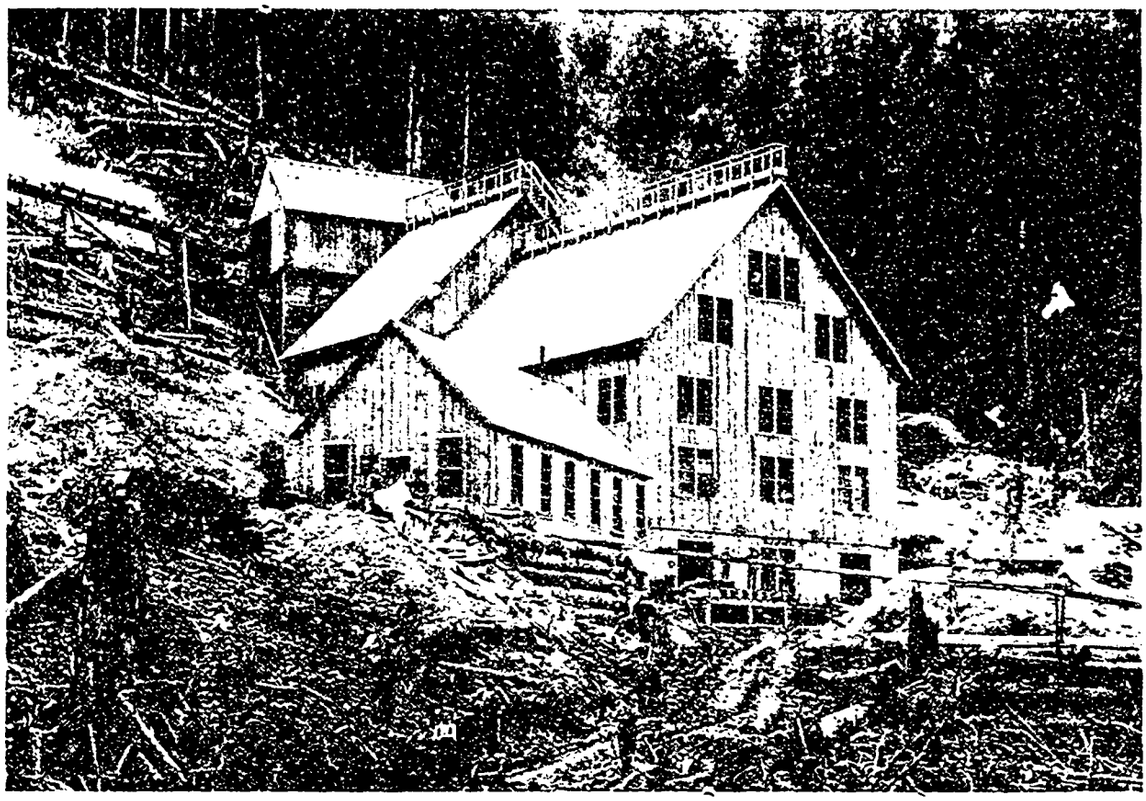
Hall Mines, Nelson—View showing Ore Bins and Halliedie Cable-way at Smelter, Nelson, B.C.



DOMINION COAL CO. LTD.—New Coal Washing Plant, Wash House, Elevator and Storage Bin erected on the S. & L. Railway, three miles west of Morien Junction. Capaci y, 500 tons per day.



DOMINION COAL CO. LTD.—Coal Pocket, Reserve Colliery, C.B.



BYRON N. WHITE Co.—Concentrator at Slocan Star Mine, Sandon Creek, Slocan District, British Columbia.

H. P. H. BRUMMELL, Manager,
North American Graphite Co., Ottawa.

E. WALLINGFORD, Manager,
Wallingford Mica Mine, Templeton, Que.

A. E. DOIDGE, Asst. Manager,
Mikado Gold Mine, Lake of the Woods, Ont.

R. H. Brown, M.E., Sydney Mines, C.B.
Gen'l Mining Ass'n, Ltd.

Hugh Fletcher, Ottawa,
Field Geologist, Geological Survey.

J. R. Cowans, Springhill, N.S.
Cumberland Railway and Coal Co.

Harvey Graham, New Glasgow, N.S.
Nova Scotia Steel Co.

W. Penn Hussey, Broad Cove, C.B.
Broad Cove Coal Co.

W. H. Prest, Lunenburg, N.S.
Blockhouse Gold Mining Co.

Robt. Archibald, C. & M. E.
Can. Coals & Ry. Co., Joggins, N.S.

Joseph Austen, Renfrew, N.S.
Empress Gold Mine.

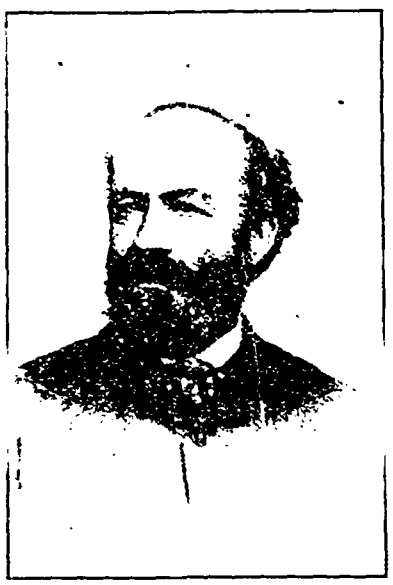
E. D. Ingall, A.R.S.M.
Chief of Div. Min. Stat., Geol. Survey.

L. A. KLEIN, M.E.
Black Lake, Que.

GEORGE R. F. SMITH, M.L.A.
Bell's Asbestos Co., Thetford Mines, Q.

JOHN J. PENHALE,
United Asbestos Co., Black Lake, Q.

R. T. HOPPER,
Anglo-Can. Asbestos Co., Montreal.

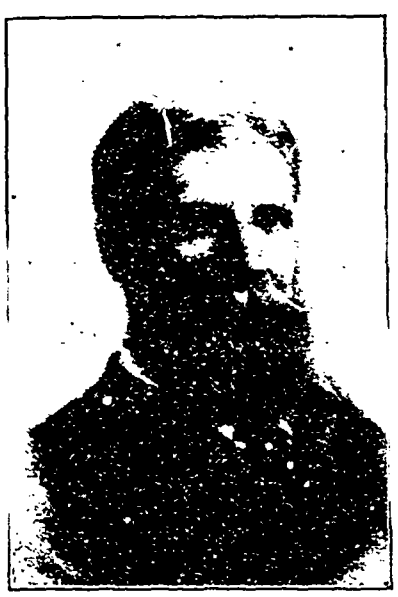


CAPT. R. C. ADAMS,
Mount Adams Mining Co., Montreal.

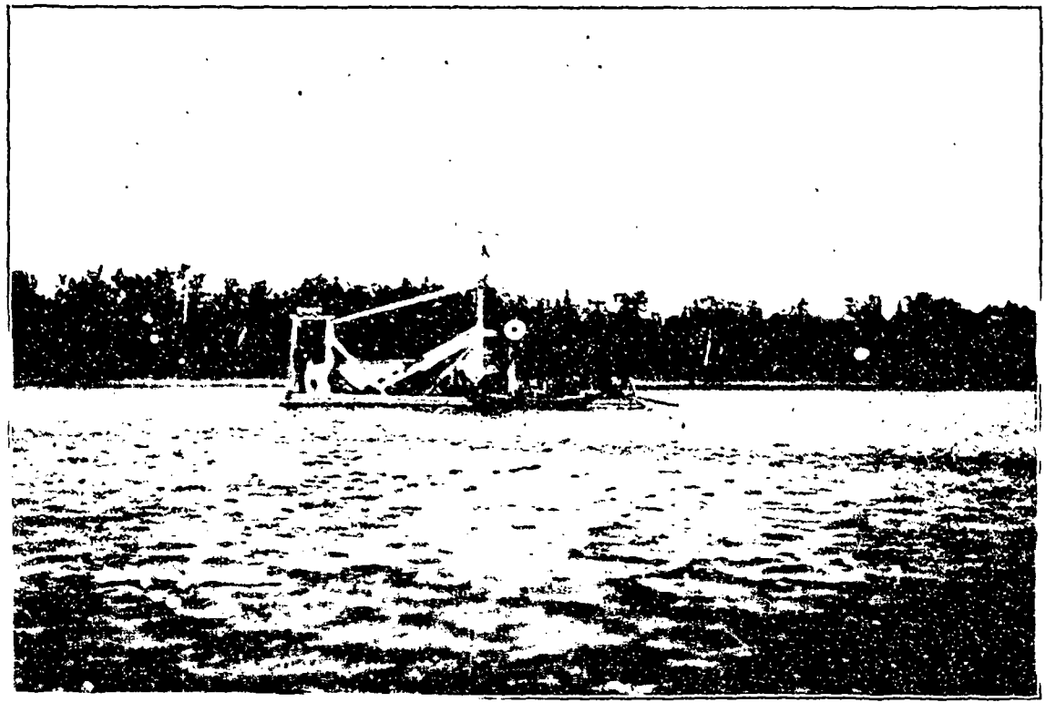
HON. T. CHAPAIS,
(Late Com'r Mines P.Q.), Quebec.

T. P. BACON, Montreal,
New Rockland Slate Co.

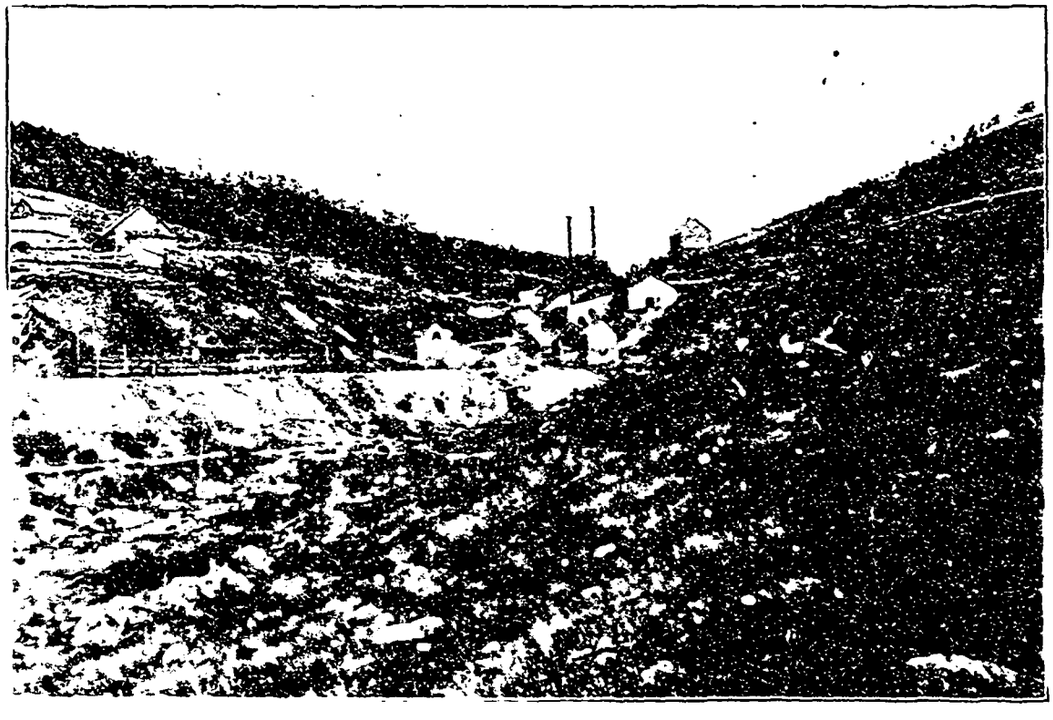
J. T. DONALD, M.A.
Analytical Chemist, Montreal.



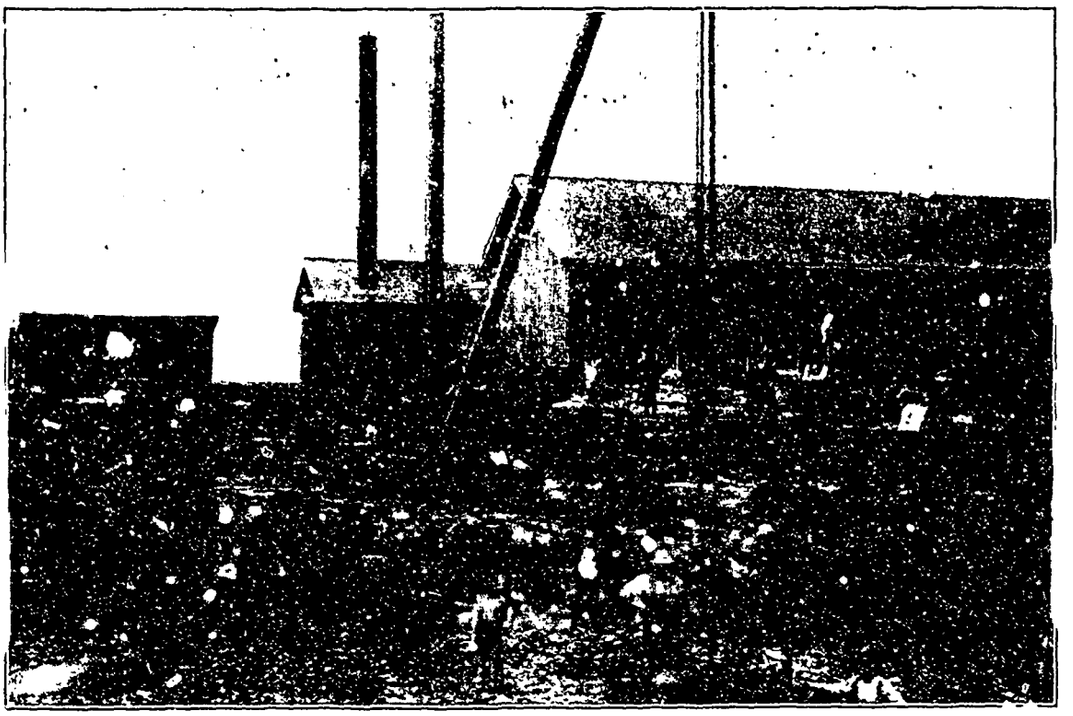
J. BURLEY SMITH, M.E.
Rat Portage, Ont.



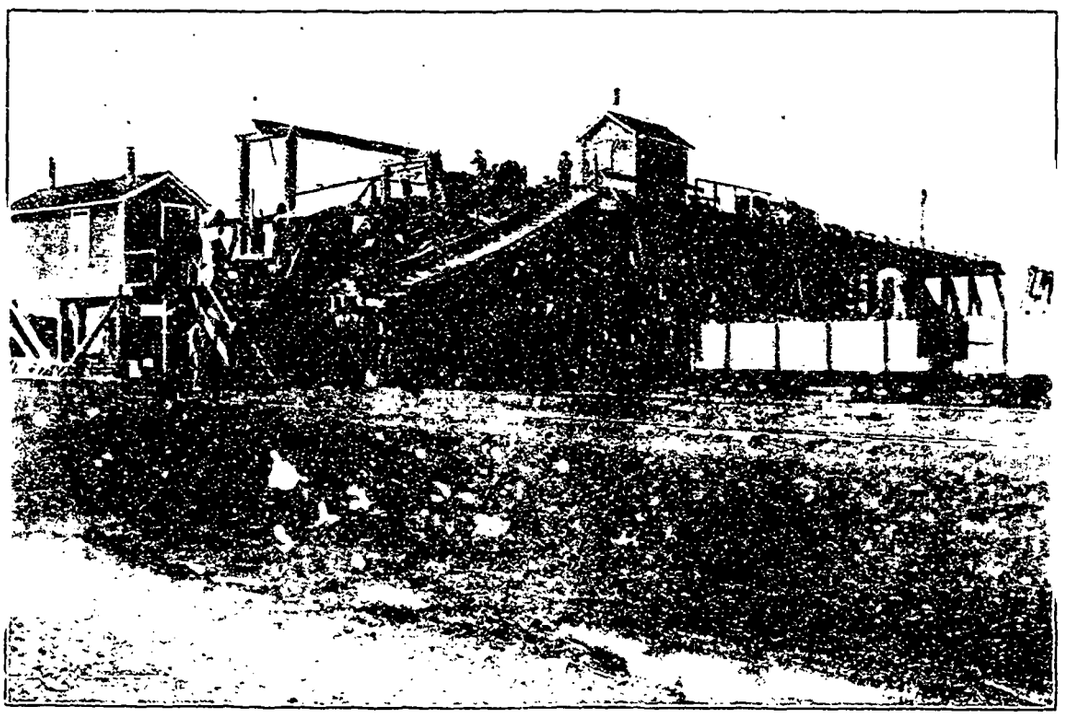
CANADA IRON FURNACE CO LTD.—Dredging for Bog Iron Ores on Lac a la Tortue, Champlain Co., Que.



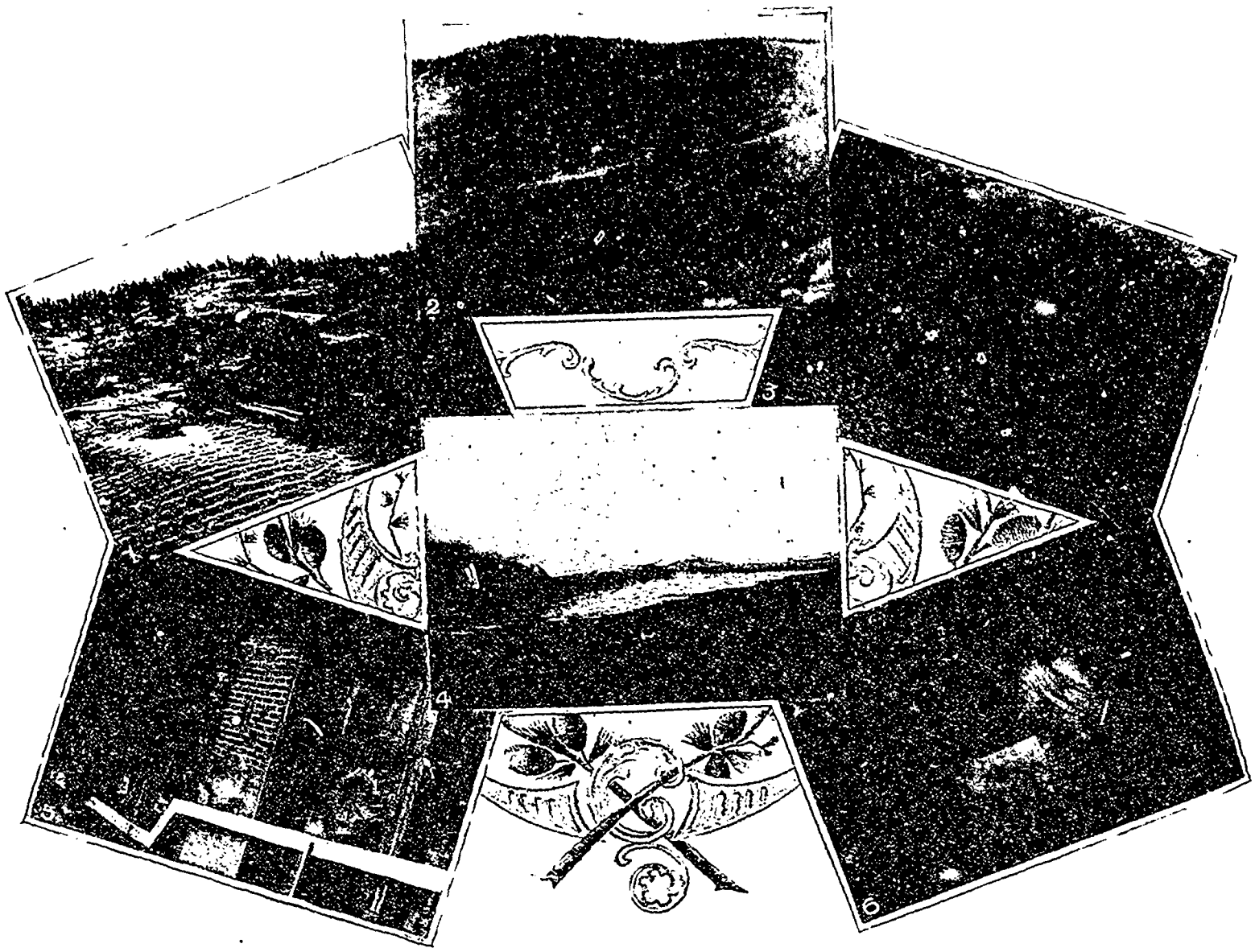
EUSTIS MINING CO.—Surface Works at Eustis, Que This extensive deposit of Copper Pyrites is opened by an adit and by Shafts No. I. and No II., down at last advices 2,500 and 2,700 feet Over 400,000 tons have been won; the annual output in recent years averaging about 30,000 tons



QUARRY OF LITHOGRAPHIC STONE, MARMORA, HASTINGS CO., ONTARIO.



ALBERTA RAILWAY AND COAL CO., LETHBRIDGE, N.W.T.—View showing Screening and Loading arrangements at Bank Head.



THE CINNABAR MINING COMPANY'S PROPERTY AT SAVONAS, B.C.

practice at Anzin for raising coals, and at the same time as a man-engine. The arrangement was very cumbersome, and after the inventor's death it was discarded. The method was also used with unfortunate results at Ronchamp Colliery, where no less than 1,500 yards of shaft and inclines were equipped with a complicated system of moving rods, slides, and counter-poises.

2.—The Increase in Pressure.

As mines become deeper, the pressure of the strata will increase, and heavier timbering will perhaps be required. No increase of timbering due to the depth has, however, yet been observed. Nevertheless, existing methods of timbering may in the future require modification. This has already been the case at the Comstock mines in Nevada, which were undoubtedly the best timbered in the world. There the old post and lintel system was replaced by the square set system, introduced in 1860 by Philip Deidesheimer. Although of great service in its day, and even now in general use in the Lake Superior iron ore mines, the latter system is likely to become less useful in the future, mainly owing to the difficulty of obtaining timbers 24 inches by 28 inches. Most California miners use very heavy timbers in large stopes, mostly round, and often 30 inches in diameter. With the use of these immense logs, filling has been neglected to the detriment of the mines. In view of the increasing scarcity of large timber, we may expect that, in the future of deep mining, methods based upon the use of bearing arches of iron and steel, or of rock and masonry, will take the place of timber in mining deposits of large size.

The effect of the increase of atmospheric pressure on the men does not require serious consideration. Experience shows that men can work at a depth of 50 feet in water, that is, at a pressure of 37½ lbs to the square inch, which is equivalent to a mine depth of much more than 20,000 feet below sea-level. On the other hand, the effect on machinery driven by compressed air is to diminish the efficiency, the efficiency being inversely proportional to the barometric pressure.

3.—Increase in Temperature.

The most important element needing consideration in determining the limits of deep mining is the increase of temperature. As far back as the year 1664, observations on under-ground temperature were made by Athanasius Kircher, in 1740 Genssane found an increase of 1° Fah. per 50 feet in the mines of Alsace; and in 1803 Daubuisson found a somewhat greater increase in the mines of Saxony and France. In 1830 Reich cited 35 authors who had previously dealt with the subject of under ground temperature. Between that date and 1858, researches were made in the Cornish mines by John Forbes, Were Fox, and W. Jory Henwood. In 1871, the Royal Coal Commission made a special inquiry into the subject, and in 1867 a committee of the British Association was appointed for the same purpose. Twenty-one elaborate reports have been presented, and the work is not yet complete.

The influence of seasonal changes of temperature extends downwards to a limited depth, which varies in different latitudes. This zone of invariable temperature is higher in the equatorial regions than in temperate ones. In this country no annual variation of temperature is shown at a depth of 70 feet, whilst a shaft at Yakutsk, in North Siberia, shows that the soil is permanently frozen to a depth of 700 feet Below the zone of constant temperature, the temperature increases with the depth, even in frozen ground; the average rate of increase being thought to amount to 1° Fah. for every 50 or 60 feet of descent. Some of the results published differ widely from this average, and there can be no doubt that in many instances sufficient precautions have not been taken to secure accuracy. The accuracy of the results may be vitiated in boreholes by the heat generated by the percussion of the boring-tool, in mines by the generation of heat by local chemical action due to the decomposition of pyrites, or to decaying timber, and by convection of heat both by air and water. Again, in mines the temperature is increased by the presence of workmen and lights, by blasting or fire-setting, by the vicinity of hot springs, and by the compression the air undergoes in penetrating into the deeper workings. On the other hand, the temperature is lowered by the admission of air and water from the surface, and, it may be, by the vicinity of large masses of extremely cold water. These are some of the causes that may explain the irregularity of many recorded results.

Underground temperatures are most conveniently determined by the aid of boreholes filled with water; and it is desirable that the water should not be in motion. For the observations, thermometers must be employed, which on being drawn out of the borehole, should register the maximum temperature to which they have been subjected. In the deep borehole at Sperenberg, Dunker (1) employed an earth-thermometer, which gives its indications by the over-flowing of the mercury, which takes place when the instrument is exposed to a higher temperature than that at which it was set. The construction of the thermometer is shown in Fig. 1. The stem is open at the top, and bent sideways. It is graduated from the top bent point downwards.

Fig. 1.

Above the point is a small vessel, *e*, open at top and sealed at the bottom by a little mercury. This, as well as the stem, is surrounded by a glass cover with a side opening, by means of which the thermometer is brought in contact with the external air or water. In order to set the instrument, it is immersed in warm water, so that the mercury flows over from the stem into the sealed vessel *e*. The instrument is then inclined until the point is under mercury, and cooled to a temperature below that expected in the borehole. On lowering the instrument into the borehole, the increased temperature will cause some of the mercury to overflow at the point. Care must be taken to make the observation sometime after the cessation of boring, and the thermometer must remain for at least half an hour at the desired depth. Before it is withdrawn, it should be shaken, in order to remove any drops of mercury hanging from the point. When the instrument is drawn up, the glass cover is unscrewed, and the thermometer immersed in water at a lower temperature than that obtaining in the borehole. The temperature of the water is noted by means of a normal thermometer, and, at the same time, the number of degrees that are empty in the earth thermometer is also observed. The sum of the readings of the two thermometers gives the temperature of the borehole at the depth investigated. The reason of this is as follows:—The mercury, when in the borehole, extends to the point; and if the water in which the thermometers are placed is $x°$ cooler than the borehole, the mercury column is $x°$ shorter. These $x°$ must, therefore, be added to the temperature of the water to give the temperature of the borehole. In order to test the accuracy of the determination, warm water is added to the cold, until the mercury in the earth thermometer rises to the top. The normal thermometer should then give the temperature of the borehole.

If the latter method only is used for determining the temperature of the borehole, the scale on the earth thermometer may be dispensed with. In order to obtain accurate results, care must be taken to use perfectly pure mercury, prepared by distilling chemically the pure

1 "Die Warme im Innernder Erde." Stuttgart. 1896.

mercuric sulphide with iron filings, as slightest admixture of foreign metals favours the formation of breaks in the mercury column.

The best instrument for determining underground temperatures is Negretti and Zambra's inverted maximum thermometer. This (Fig. 2) has a bulb, *a*, at top, and a broad column of mercury graduated upwards. At *b*, in the stem, there is a sharp bend, which, together with the contraction of the mercury column at *d*, prevents the mercury from passing the bend except under pressure. The thermometer is enclosed in a hermetically sealed tube for protection against pressure, and is held in position by a cork, *g*. The method of using it is as follows:—With the bulb downwards the instrument is set by tapping on the palm of the hand till the contraction and the bulb is full of mercury. The thermometer is then placed, with the bulb still down, in water a little cooler than that in the borehole. If the instrument is now reversed all the mercury in the stem will run down to the lower end from which the gradations begin, and the top of the column will indicate the temperature of the setting. In this position, the thermometer is then lowered into the borehole, and remains there for half an hour. As a precautionary measure, the thermometer is fitted into a hinged copper protecting case provided with holes.

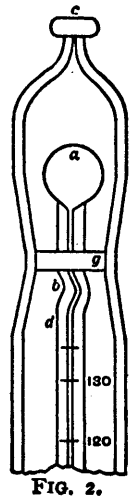


FIG. 2.

In the borehole, the mercury expands, and a portion of the liquid is forced through the contraction, and subsequent cooling in hauling up will not cause any of it to return. The instrument must then be inclined, when the mercury in the stem will all unite into one column, which will run down to its place on again raising the bulb. The reading then gives the temperature of the borehole at the point in question. On lowering the instrument into the borehole, care must be taken to avoid concussion, inasmuch as some of the mercury might thereby be forced through the narrow portion, and give results 1° too high. Fig. 3 illustrates this thermometer as now made by Negretti and Zambra, under special instructions from Professor Everett, for the British Association Committee on Undergound Temperature.

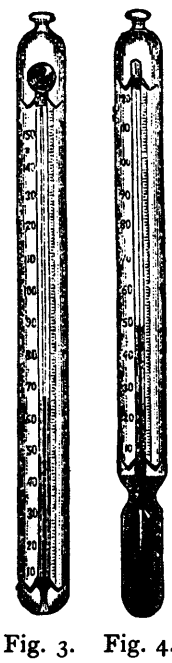


Fig. 3.

Fig. 4.

The same firm also manufacture a thermometer of very slow action, for taking direct earth temperatures. The bulb of this thermometer is shown, in Fig. 4, in its glass sheath, surrounded by a good non-conducting substance as suggested by Professor Everett. The thermometer is lowered down to the desired depth by a cord, and is allowed to remain a considerable time in the earth so as to acquire the existing temperature. It is then quickly withdrawn, and the reading noted, the non-conductor around the bulb preventing any rapid change taking place, so that an accurate reading may be obtained.

(To be continued.)

The next meeting of the British Columbia Association of Mining Engineers will be held at New Denver, B.C., next month. The question of federating with the Canadian Mining Institute, which was favourably received at the last meeting, will, it is expected, be settled at this meeting.

Asbestos and Asbestic: with some Account of the Recent Discovery of the Latter at Danville, in Lower Canada.

By ROBERT H. JONES.*

When the Canadian form of asbestos which is technically named chrysotile, was first discovered, about a score of years ago, I had occasion to go over to Quebec to examine what, to all intents and purposes, was a new mineral, and report upon its qualifications and capabilities. I then became so impressed with its manifest importance, that I determined to make a special study of it, as well as of asbestos generally.

My inquiries after, and searches for, asbestos have naturally led me into many remote and untravelled parts of the world; and some few years ago I published a book on the subject, since which time, whenever any new discovery has been made, I am frequently sent for to advise on the special quality found, the best mode of working it, and the proper channels in which to dispose of its produce.

First, I will say a few words on its nature and historical relations.

Asbestos is one of the most marvellous productions of inorganic nature. It is a physical paradox: a mineralogical vegetable, both fibrous and crystalline, elastic yet brittle, a floating stone, which is as capable of being carded, spun, and woven as wool, flax, or silk.

Occupying the apparent position of a connecting link between the animal and vegetable kingdoms, it would appear to possess some of the characteristics of both, while being strangely different from either. In appearance, it is as light and feathery as thistle or eider down, while, in its crude state, it is as dense and heavy as the rock which carries it. Ostensibly as perishable as grass, it is older than any animal or vegetable life on earth. So little, indeed, is it affected by the dissolving influences of time, that the action of unnumbered centuries, by which the hardest rocks are worn away, has had no perceptible effect on the asbestos found embedded in them. While some portion of its bulk is composed of the roughest and most gritty materials known, it is as smooth to the touch as soap or oil. Apparently as combustible as tow, the fiercest heat cannot consume it, and no combination of acids will affect the strength of its fibre, even after days of exposure to its influnce. Yet, notwithstanding its extreme delicacy, a single strand of it can be spun to weigh less than an ounce to one hundred yards of thread, and a cloth may be manufactured from its fibres which shall weigh less than eight ounces to the square yard, and still retain a fair tensile strength.

Perhaps, not the least remarkable of its many inconsistencies, is that, while in some form or other, it occurs in nearly every country in the world, it is never found to repeat itself. It nowhere appears, even in strata of the same age, in any two countries precisely alike, in appearance, texture, or general character, or in any two parts of the same country, or even of the same district. It varies greatly in accordance with different conditions of climate and locality, as well as of the nature and surroundings of the rock in which it is found. One remarkable difference, occasioned by variations of constituents, is shown in the sample of fibre from South Africa; and another, almost as startling, appears in one of the Australian varieties, which is of a bluish eucalyptus green. In some other cases, the variation may be the result of formation under different temperatures, or different rates of cooling.

Under the Romans, it was believed to be of vegetable origin, the silky appearance and unctuous feel of the fibre contributing to the idea that it was an organic substance. Herodotus tells us that his countrymen made a kind of cremation cloth of it, in which they enwrapped the bodies to be consumed on the funeral pyre, in order that the ashes and unconsumed particles of bone might be kept separate from the remains of the fuel, so as to be preserved in vases, or in the family urn. Pliny took it to be of vegetable origin, calling it *linum vivum*, but he says these were rare and costly cloths, the funeral dress of kings. One of these shrouds was found in a sarcophagus in the Via Praenestina in 1702, perfectly intact, and can be seen to this day in the library of the Vatican, where it was placed by order of Pope Clement XI.

The religious care also with which the Romans guarded the sacred fires in the temples of the gods from extinction, caused them to make use of asbestos as an auxiliary, the flame having been first enkindled by means of a crystal sphere.

The lamps of the Vestal Virgins were furnished with asbestos wick, the fine fibres of which, by their contiguity, form small tubes or channels, which serve to draw up and feed the flame with oil, themselves remaining unconsumed.

Kircher, the German philosopher, formerly made a wick of this kind, which he says he used for two years without injury, until at last it was destroyed by accident; but Pontoppidan tells us he made one, but was obliged to discontinue its use, because he found he could not get so clear a light from it as from the common wick. The Greenlanders use them, and so do the Labrador Esquimaux. I have seen these last using them in Labrador, in their soapstone lamps. Asbestos wicks are used in England in some of the lighthouse lanterns, and are now being arranged for more general use.

A very interesting account of the mining for and use of asbestos is given in Marco Polo's "Travels in Great Tartary" (A. D. 1280), which is too long for quotation here, but the matter is so faithfully described that the account of it might have been written yesterday.

The late Prof. Ansted, of King's College, in his little work, "Rambles in Search of Minerals," tells us that certain tribes of Indians make dresses of asbestos, which they cleanse by throwing them into fire; but, unfortunately, he says nothing as to the whereabouts of these unknown tribes. When speaking of "tribes of Indians," one's thoughts seem naturally to turn to the Red men, dwellers on the American continent, but it is absolutely certain that those spoken of could have been none of these. Even the bare supposition that any tribe of savages could have accomplished the extraordinarily difficult process of spinning and weaving this refractory mineral

*A recent address before the Society of Arts.

fibre into a cloth, is just as wildly improbable as to imagine that any human being could have dreamt of using it as a covering for his bare skin. The difficulty of doing this—that is, of spinning it—is seen by placing a single fibre under the microscopic lens, where it looks as firm and rigid as a bar of steel, and shows none of the callosities and other irregularities of silk—and none of the imbrications which make the spinning of wool so easy and natural. It is curious also that none of the old authors who speak on this subject attempt to describe the weaving process. We have, now, however, ample proof that it was managed by intermingling some organic fibre, probably flax, with the asbestos fibre, and then, with a liberal supply of oil, weaving the two together, after which they burned out both the vegetable fibre and the oil. Naturally, the cloth so made must have been but a poor skeleton of what such a cloth should have been ; and what is a little extraordinary is that this was precisely the process by which asbestos cloth was woven in modern days until, after long and repeated experiment, a more effectual way was found of accomplishing the operation by means of very ingenious and intricate machinery.

All these historical matters are very interesting, but asbestos to-day is of more importance to the human race than ever it has been before in the whole range of history.

In modern times—little more than five-and-twenty or, perhaps, thirty years ago—it was scarcely known, except in the cabinets of the curious, but now it finds its way into every workshop where steam is employed.

In recent times it was intended, in the first instance to be applied in Italy for the manufacture of a special clothing for the protection of firemen ; and afterwards, Paris set an example, which was followed by London after conclusive evidence of its feasibility. Captain Shaw says that there are certain cases in which it may be indispensable to traverse the flames in order to reach some particular spot, and it was for the purpose of preserving persons who find themselves in such circumstances that the Italian experiments were made.

In the general application of asbestos in modern times to the several branches of practical mechanics and industrial manufactures, it is to Italy that we are indebted for leading the way. Previous isolated experiments are recorded, but these do not seem to have been followed up until long afterwards. In the last century, for instance, Professor Bruckmann of Brunswick was successful in the manufacture of paper, on which he caused to be printed a natural history of the mineral, some copies of which book are said still to be preserved in the museum of Wolfenbuttel ; and early in the present century, a Madame Perpenti of Cone successfully employed asbestos, not only in the manufacture of paper, but of cloth also, and a kind of coarse lace, with many other articles of a useful character. It is specially noteworthy in regard to this cloth that in her make Madame Perpenti used no other fibrous ingredient as an admixture. Her process simply consisted in softening the asbestos in water, beating and rubbing it, and finally separating the fibres by means of a comb furnished with fine steel points.

I have only been able to refer to a few of the earliest adaptations of this mineral fibre, because it would take far too long to explain or give any attempt to enumerate them, or even give more than a general mention of some few of its uses in steam, hydraulic and electrical machinery, in which a multiplicity of packings, &c., now find a place. The various coverings also designed for the protection of boilers and pipes and for the economy of fuel are specially important and very numerous, as well as its varied applications to engineering and electrical purposes. It is also of great importance in many matters connected with warfare, and in medical and hospital practice, though in the latter it is, fortunately for us, not used as it is said to be in China, as a medicine. In regard to its use as lint, the editor of the *Engineer* remarked, some time ago, that although we may never reach the time when our undergarments shall be purified by fire, instead of by the laundress's art, yet, short of this, many uses now fulfilled by materials—the thorough cleansing of which cannot be secured without their destruction—may possibly be better served by asbestos. Of these, the cleansing of lint is one, with medical bandages, operating cloths, &c.

In these days of high pressure and liner records across the ocean, asbestos is of supreme importance to the marine engineer, to enable him to obtain jointing and packing materials upon which absolute reliance can be placed. The natural properities of the mineral admirably adapt it for such purposes as these, its native lubricity rendering it additionaly valuable; by its use a perfectly pure packing can now be produced through which the rod slides with a minimum of friction.

Its numerous uses for building purposes may also be referred to, many of which are rendered compulsory in the United States, where asbestos is far more largely used than it is here. Its usefulness in the form of drop curtains is generally understood there, and in New York and elsewhere is made compulsory, as, it is to be hoped, it will be some day so rendered here. A part of one of these curtains which withstood the fire at the Queen's Theatre, Manchester, in August, 1890, I will show you. This was made by the United Asbestos Company of London, and was given to me by the secretary and manager of that company.

For cold storage buildings and refrigerating chambers, it is simply invaluable. For the preservation of meat and other provisions, brought from distant lands, specially constructed ships containing the necessary refrigerating apparatus and chambers are now in universal use.

In beetroot sugar refineriesi n France, Germany, and Austria, fine asbestos cloth is in universal use filtering the saccharine juices. It is necessary also in chemical laboratories for straining and filtering acids and alkalies, which would quickly destroy any ordinary filtering paper ; and it is specially useful when the liquid to be filtered is of a caustic or strongly acid nature, or where it may be desirable that the filter, with the residue, should be ignited without consuming the filter, or where the residuum is to be dissolved off the filter by acids or other solvents. Asbestos filter bags are better fitted for this purpose than those made of any other material ; they last longer, retain the heat better, and are more easily purified. For filtration purposes generally, asbestos has proved to be so eminently adapted that it forms a material adjunct to the filtering media in all the more important filters now in use.

Being one of the most refractory substances known, asbestos is in use in a variety of ways for the lining of furnaces and the backing of stoves.

For insulation purposes, it is much in use by electrical engineers in the form of millboard in the construction of dynamos.

A special quality of asbestos paper is also made for wrapping battery plates in, and gloves are made of asbestos cloth for holding red-hot crucibles, and to enable the engineer to handle the wires with comparative impunity.

As already mentioned, asbestos in modern times was first brought into experimental use in Italy, and soon afterwards the United Asbestos Company, having acquired the Italian works and mines, started the manufacturing business in England.

It was not long afterwards that there appeared amongst us a totally distinct variety of the mineral, which had not long before been discovered in a wild and unpopulous part of the province of Quebec, in Lower Canada ; and though it was not very favourably received at first, its economic value could not long be ignored, and experience has shown that while the two varieties are totally and curiously unlike, each has certain special uses and advantages, and, indeed, a combination of both is occasionally to be preferred to the use of either one of them separately.

The difference between the two forms of mineral is remarkable. The asbestos of Italy is asbestos properly so called. It is a variety of hornblende, or pyroxene, while that of Canada is nothing more than serpentine, which occasionally, but only rarely, assumes a fibrous character. When it so occurs, its mineralogical name is chrysotile. In form, structure, and general appearance, the two are as strangely dissimilar as any two minerals can possibly be ; yet, in chemical composition they are remarkably alike, and in many of the uses to which they are put they may be said to be absolutely identical. Indeed, to such an extent is this the case, that by far the larger part of what is sold and used for asbestos, is in reality chrysotile, which is so used and sold with full knowledge of the fact that it is so, and without any pretence of concealment or disguise whatever. The essential difference between the two, is that Italian asbestos is anhydrous, while the Canadian chrysotile, being serpentine, is invariably hydrous, its water of composition amounting to between 13 and 14 per cent.

The first Italian mine was opened in Lombardy in 1866, and the first Canadian mine, at Thetford, in Lower Canada, in that part of the country which is known as "The Eastern Townships of Quebec," about the year 1877. Some considerable time before this date, the existence of the mineral there was known to geologists, and it was also exhibited at the International Exhibition in London as early as 1862, though, at that time, it was not much regarded, except by scientists, and by them chiefly as a mineralogical curiosity. But this first mine was no sooner opened, though its success at first was by no means promising, than others quickly followed, and prospecting for fresh finds was extensively carried on in every part of the province.

Somewhere about this time, a good many new mines were started, but in no case did the produce of any one of them come up to that of Thetford, which still maintains its old supremacy, both in regard to the quality of fibre and the quantity produced.

Among these new mines, was one which was discovered near to the pleasant village of Danville, in the township of Shipton, a good many miles from the headquarters at Thetford. This mine, from its first discovery, was worked, with a fair amount of success, by a Mr. Jeffrey ; but at no part of its career, up to the time of its closure—which happened shortly before the death of the proprietor—was it looked upon as of any particular importance, though its produce was invariably good and generally considered to be second only to Thetford, and much beyond anything to be found at Black Lake.

Mr. Jeffrey, whom I well knew, gave his name to the mine, or rather it was always known—and to this day is generally spoken of as—the "Jeffrey Mine." He was a well-known character among asbestos men, somewhat obstinate and self-willed, and strictly a man of the old school—independent in his ideas, by no means highly educated, and never much inclined to move out of the old grooves ; indeed, his style of work might be said to have been that of the "rule of thumb." As the years rolled on, he became hampered with contracts and other matters, which presently landed him in pecuniary difficulties to such an extent that at last he found himself under the necessity of assigning the whole of his property to trustees, for the benefit of his creditors ; very shortly after which the mines were closed.

Some time subsequently, proposals were made to Mr. Boas, of St. Hyacinthe, either to take over the mines or to render financial assistance, with a view to a resuscitation of the works.

Mr. Boas was a man of an entirely different calibre to that of the late owner. He was not an asbestos man, nor did he make any pretence to a knowledge of mineralogy, but all throughout the province he was highly esteemed for his uprightness, shrewdness, and sound common sense. On going over to inspect the Jeffrey mine he was soon satisfied of the character of the fibre, which, with proper management, he was assured could be made to yield valuable returns. But what struck him most of all was the apparently unusual character of the rock which carried the fibre, the texture of which was such as he had never remarked before. It was certainly quite different from the ordinary run of asbestos-bearing serpentine which he had met with anywhere else, and it then occurred to him that it might be possible to convert such a rock into many important uses, instead of allowing it to be carted away and thrown on the dumps as waste. After reflecting on the matter, he set about making a series of experimental trials, the result of which showed him that he was entirely correct in his conjectures. He therefore decided to take over the property, as soon as the necessary arrangements were completed, set about erecting such building and fitting up such improved machinery—nearly all of which was automatic in operation—as were an astonishment to the country, and then began to work the mine as it was never worked before. His efforts in this direction soon began to be crowned with the success they deserved. His untiring energy and activity brought him many visitors to see the operations carried on at the mine, while his friends and neighbours were not slow to perceive that, at the very time his predecessor was most in want of funds, a veritable gold mine lay unheeded beneath his feet. Some began to blame Mr. Jeffrey for being unaware of this, but if he were to blame, to how much greater an extent were all those numerous scientific men, geologists, mineralogists, mining engineers, and others who, in course of that time, had called purposely to inspect the mine, report upon, and write about it? Every one of these may be presumed to have had better, that is, more highly educated eyes than he could have had. The rock was precisely of the same texture as it had

always been, but no one before this time had ever remarked anything peculiar about it. The time had evidently not yet come. The extreme importance of the matter remained unknown, until it suddenly encountered the (unpractised) eye of keen intelligence, when at once the whole thing became so manifestly self-evident that, as was the case with the famous egg problem solution, the spectators could only wonder where their eyes had previously been.

Before the time of the publication of my book on asbestos and its uses, I had more than once visited and inspected every mine in the eastern townships of Quebec, and was well acquainted with their different peculiarities and capabilities, with the single exception of this particular one at Danville. Why I neglected this I cannot tell; but so it was. Mr. Jeffrey several times invited me to go over there, but never once, in my many visits to that part of the country, did I ever avail myself of the opportunity of doing so. It was a long way from the other mines, and no doubt I was under the impression that this was mainly like all the rest, and scarcely worth the time and trouble of a special journey. At the same time, I would emphatically disclaim all idea that, had I done so, I should have discovered anything special about it, any more than Mr. Jeffrey himself had done, or anyone of the numerous scientific or professional men who had already inspected and written about the mine. As an asbestos man, it is quite conceivable that my attention would at once have been attracted to the important consideration of the number, extent, and quality of the veins and seams of asbestos, to the neglect of any special peculiarity, altogether undreamed of before, in the texture of the surrounding rock. On the other hand, Mr. Boas was, as I have said, not a mineralogist or an asbestos expert, and was, therefore, untroubled with any preconceived notions. He simply looked on the matter with the keen eye of unprejudiced common sense. When I was told first of the discovery, I remembered that something like it had often occurred to my mind, but my thoughts were always directed to the question of the possibility of so crushing the rock, as to see a way to the extraction of the numerous small veins and stringers, which are commmonly seen in asbestos mines, but which I afterwards found are by no means prevalent in that of Danville. This seemed to be scarcely worth the expense which would have had to be incurred, as it could have been only accomplished by the aid of special machinery; and when the description of what Mr. Boas had done was first reported to me, I could only regard the story as the effect of a too vivid or sanguine imagination. But when at length I reached Danville I was strangely undeceived. On going down into the pit to examine the result of a blast, before any of the *debris* was touched, I was literally astounded. Instead of, as I had expected, finding the result to be as 1 in 50, or even 1 in 100, I could plainly see that, regarding the mass of rock as a whole, it was undoubtedly and at the very least 90 per cent. of pure asbestos, or asbestos-like material, the like of which I had never seen before. And when I subsequently saw this very rock, after it had passed through the crushers and sifters, falling automatically, without any handling whatever, from the cyclones as pure asbestos fibre, white as the driven snow, I thought the sight of that well worth the journey from London to Canada.

I have here for your inspection a sample of the most useful of the Italian ores, with a specimen or two of Canadian ore from Thetford and East Broughton, so that you may see the strange mineralogical difference between the two species, also a sample of the Danville ore and fibre, with a lump of asbestic, which is the rock which carries the latter, and also a sample of the cleansed material, just as it falls from the cyclone, ready for use by the manufacturers. To these I would presently call your special attention in order that you may see in particular the wonderful nature of the rock itself, which is found at Danville. No lens is required, its very peculiar character being sufficiently obvious to the unaided eye.

In the Italian deposits, one often finds minute crystals of green coloured garnet, which the miners call the asbestos seeds (*semenze dell' amianto*). None of these are ever seen in the Canadian mines, but at Danville I have frequently found remarkable specimens of clear light-coloured translucent serpentine. I will show you a specimen of this, being part of a vein of pure silky fibre covered or protected by a rich delicate skin of a charming tint of light green as lovely as that of a newly expanded willow leaf in spring, yet this is in itself as clearly and compactly fibrous as that which is held compressed in the vein.

I suppose few things are better understood than this trade fact, that when any valuable or unusual commodity remains for a long time at an almost prohibitive price, on account of the difficulty of its production, so that manufacturers have been continually driven to the use of substitutes in place of the real thing; when this material happens to be, by any fresh discovery, suddenly brought down to a price within the reach of all the world, one invariable result follows. Such an impetus is given to the use of that commodity, and such an effective spur is applied to the inventive faculty, that an incredible number of uses for it are at once found, and the trade in it quickly advances by "leaps and bounds," just as is already the case with this.

One remarkable fact in connection with the discovery of asbestic is that the firm which stands at the head of the trade—that is, which is the largest dealer in, and manufacturer of, asbestos and asbestos goods in the whole world—I mean the consolidated firm of the H. W. Johns Manufacturing Company of New York, after a full investigation of all the facts connected with this matter, proceeded to make contracts of such an extent that the immediate duplication of the whole of the Danville machinery was necessitated, although it was then by far the most extensive and effective in Canada.

With regard to this machinery, I will only say that it is unique, and well worth the inspection of any one to whom the opportunity of seeing it is afforded. The building in which it is housed is a substantial five-storey structure, so arranged by the hillside that the laden wagons can drive straight through the doorways and along the passages, to deliver and take up their loads at the required points, on four out of the five stories of the building, which is admirably ventilated and lighted in every part by electricity. The roof is covered with asbestos, and considerably more attention has been given to external appearance than I have ever seen before in mining buildings. Another building stands close alongside as an annexe, the lower part of which is utilised by the engine and boiler house.

At the front entrance to the fourth floor are seen the huge lips and jaws of the mighty crusher, which lies recumbent beneath. These lips and jaws are ever moving and at work, as one might almost imagine them to be those of a cow peacefully and slowly chewing the cud. As the masses of rock are hauled from the bottom of the pit, they are placed on cars and moved onward over the rails to the front of the crusher, where they are dumped on to the iron platform, near to the working jaws, towards which they slide and into which they gradually enter and disappear, a lump of a ton weight being drawn in with apparent ease and quietly masticated by the huge monster, which weighs 48 tons. The mastication consists of so carefully crushing the rock as in no way to injure the fibre.

There are four other crushers, two of which are duplex, making seven in all, the least powerful of which weighs seven tons. These are situate in various parts of the machine's anatomy; the machine itself being apparently so far a sentient animal, that it requires no assistance whatever in the digestion of its food, but hour after hour and day after day its process of digestion goes continuously on, working gradually, smoothly and automatically, until after the rock has left the crushers and passed through several sets of Cornish rolls, over a gigantic picking table, and has undergone the ordeal of no less than twelve cyclone pulverisers with a whole series of fans, exhaust blowers, revolving, shaking and jigging screens, with the rest of the complicated apparatus, the spectator, as he proceeds onward, presently finds himself standing at the foot of a long gently sloping table. To this there is imparted a constant jigging motion, so that everything which touches it is irresistibly impelled to join in the dance, and slides slowly along jigging, jolting and jumping, onwards and downwards, until it reaches the lower end of the table; by which time the fluffy fibre is entirely separated from all gritty particles, when, as these last approach the edge they are gradually jerked over to be dealt with further on; while the fibre is acted upon by a strong upward current, by which it is drawn, or sucked, into a pendent receiver, after the fashion of pieces of paper carried by a draught up the chimney, where it disappears from view. Now, if we leave the concluding process and proceed to the lower floor, we shall see the result exuding from the orifice of a pipe, and falling in flakes of immaculate whiteness into bags placed there to receive it, in which it is firmly compressed and fastened up. The bags which hold 100 lbs. each, are then loaded into waggons waiting in readiness to receive them, for conveyance by the Grand Trunk Railway on the road to their ultimate destination.

Thus, from the time that the rock is drawn from the pit, until the fibre reaches the manufacturer, no handling or interference of any kind is needed, but everything is carried on systematically and automatically, the sole exception being the employment of a single lad, whose duty is to watch the cyclones and see that they do not become clogged by reason of the fluffiness of the fibre.

Another very important and remarkable matter for consideration is that a majority of the more clear-sighted owners of the other mines, seeing at once the impossibility of any competition with Danville at anything like present or recent prices, determined for the present at any rate, without burning their ships, to close their works and await the progress of events. Their wisdom in following this course is at once apparent, when we see at what a heavy cost we arrive at the value of the crude asbestos, and its expensive character, both in labour and the extent of land required for dumping ground. The removal and disposal of *debris* of the mines, which is incessantly increasing, is far and away the most expensive and troublesome part of the whole system of asbestos mining. In this regard, it may be worth mentioning what a well-known mining engineer says on the subject. Mr. Klein, the manager of the American Company's mine (formerly Werthеim's) who is an experienced and thoroughly reliable man, recently delivered a lecture at the Asbestos Club at Black Lake, the members of which are no inexperienced novices, but all mine owners, managers or engineers—men who would quickly have contradicted his statements, had contradiction been possible. In this lecture, while dealing with this very important part of the subject, which had necessarily to be referred to, the lecturer stated that in almost every case he had found the amount of waste in the mine to be understated in the returns and reports; that in the very best mines it could not be put at less than fifty tons of waste for every single ton of asbestos produced. And here I can well imagine a smile rippling over faces of the audience, for the lecturer immediately began to qualify this statement by saying that, in his own belief, a hundred tons would often be much nearer the mark, and that even a hundred and fifty was by no means unknown. But even this is not all; the enormously-increasing mounds of waste, piled up around the various mines, have generally become intolerable to such an extent that in two cases extraordinary measures have had to be taken to get rid of them at any cost.

In the case of the United Asbestos Company, the form of their land at Black Lake is of so inconvenient a character that, in the course of time, it was found they could dump no more without trespassing on their neighbour's land; so, in order to prevent a stoppage of their work, the company was under the necessity of building an inclined tramway, 3,800 yards in length, by means of which cars could be drawn up the mountain side as far as the shores of Cariboo Lake, where for the present, they could find room for dumping,

In another case, the extent of the company's holding was seriously curtailed by the decisions of the local and superior courts in the actions brought against them by their neighbours for encroachment. This was of more far-reaching importance to them than the very heavy pecuniary compensation they were compelled to pay for the quantity of abestoes they were alleged to have taken from their neighbonr's land. At any rate, these decisions of the courts left them but one way out of the difficulty, and that was to purchase land on the far side of the track of the Central Quebec Railway, across which they had to build a line of their own, and over which their dumpIng cars are now drawn by means of an overhead bridge. By the adoption of this costly expedient alone have they at last been enabled to get rid of their waste rock, the constant accumulation of which was shutting them out in every other direction.

This is one of the ordinary expenses incident to asbestos mining which so greatly tends to keep it at such a high price. It can therefore readily be seen that if once this enormous expense was swept away, how effectually the

prime cost of the mineral could be reduced, more especially if that waste were waste no longer, but actually a substance convertible into money. This is precisely the effect of the discovery of Danville.

Now, after what has been said, two main questions will occur to the mind of every one. First, why cannot the waste of other mines be utilized in the same way as that at Danville? And secondly, if there be any special reason why it cannot, then for how long a time is it likely that this particular mine will remain unexhausted? To the last question I reply, without any hesitation, that unless some entirely new discovery be made, the Danville mine cannot possibly be exhausted by any imaginable process of working for very considerably beyond the period of one hundred years. In fact, the mine to all intents and purposes, is practically inexhaustible. And as to the other point, none of the mines elsewhere produce asbestic, the nature of the rock being entirely different from that of Danville. I have already shown why the various mines differ in the quality of their fibre, and have no doubt that in one or two of them something approaching to this may be produced, but to what extent is as yet unknown, and whether or no it will return a profit also remains to be seen. At one mine the process was tried with somewhat similar machinery, though only on a small scale. In the first place about two-thirds of the rock was found to be so manifestly inapplicable that it was at once rejected. The remainder of the dumping ground was then picked over, and a good part of the rock passed through the crushers, sifters and cyclone, with the result that from this portion of selected rock some bags of "float" were obtained which was not much like that of Danville. No sale could be found for it, and the mine is now closed.

Well, what after all is asbestic? A dictionary will tell us that the word is an adjective, meaning something "of or belonging to asbestos;" but, as used here, it is substantive, applying to that part of the rock which remains after the richer veins of asbestos have been extracted from it. This remainder is purely a fibrous material, which clearly shows its serpentinous origin. And here a very remarkable fact may be mentioned. The knoll-like mound in which the Danville mine is situate, is one only of a series of similar mounds which run a long distance through the country—all through the townships of Melbourne, Cleveland and Tingwick, and, after all these knolls had been carefully inspected, no single one of them was found to carry any fibrous material but this Danville one alone, in which all the fibre found in this part of the country would seem to be concentrated.

On the question of its production, as we have already stated, asbestos is nothing more than serpentine, that is serpentine in its peculiar fibrous form, which it assumes much less frqeuently than is generally supposed; and, when it does occur, has many pecularities. Most minerals, as we well know, are sensitively affected by the nature of their surroundings, and especially by their more intimate associates. Even gold is no exception to this rule, as witness the effect of its association with bismuth; but I know of no mineral which is so readily affected by its associates as serpentine. This is sensitive to such an extreme degree that it might almost be called a sentient rock. From this point of view, nothing like sufficient attention has been paid to it by asbestos men, though everyone can see its alterations in every asbestos mine in the country. As a matter of fact, so many, so various, and so supreme are the changes brought about by its variable associates, that, although in some form or other asbestos, can be found in nearly every part of the world, there are, as already remarked, in no two countries, any two mines which produce exactly the same class of fibre; and this is true not only of any two countries, but of any two parts of the same country, and even of any two parts of the same district. In reality, it is never and nowhere the same. The difference may be slight, and may be either in colour, form, or texture. Doubtless, either the colour of the rock or the fibre itself is so regulated that the one affects, or is affected by, the other; but to show the fact of the existence of this peculiarity, one has only to compare the fibre and its containing rock—such, for instance, as it is at Thetford—with that which is produced at Black Lake, and either of these with the produce of Broughton, Lake Nicolet, Brompton Lake, the Ottawa Valley, or, over and above all, with the special material which occurs at Danville, and which, at present, stands alone.

Before this time—provided the veins were long enough or wide enough, and the fibre in them sufficiently silky—no one paid any regard to minutiæ. Asbestos was simply asbestos, just as serpentine is serpentine. But in future much more attention must be given to this vital matter, for upon it will depend the existence and utility of many mines. In fact, the day is rapidly approaching when far more attention must be given to the study of mineralogy generally by mine owners and their superior *employees*, as well as to the special qualifications of the local serpentine. It is to the neglect of these important matters that the new discovery has fallen in their midst with the suddenness of a thunder clap.

Now, a few words on the particular uses of asbestic as apart from asbestos. The first idea which occurred to the discoverer was to pulverise it, and to convert it in its pulverised state into a cement or plaster. A few bags were sent to the manufacturing firm of H. W. Johns and Company for trial, when they found it to be so admirably adapted for this special purpose, and so unique from many points of view, that it was at once named "the king of wall plasters." In its manufacture it requires the use of neither hair nor sand, its own fibres furnishing a perfect substitute for the former, and the pulverised rock supplying all that may be required of the latter. During the short time since its introduction, although the number of men employed in procuring it is unusually large, and the machinery employed in its preparation entirely automatic, the supply is found to be unable to meet the demand. This plaster, being composed exclusively of asbestos, is both fireproof and a non-conductor of heat, so that a room plastered with it is not only protected from fire, but at the same time is kept warmer and more comfortable than if dressed with any other known plaster. It also effect a saving of something like 25 per cent. in the fuel employed; and being also a non-conductor of sound, bedrooms may be relied upon, if the spaces beneath the floors and over the ceilings be filled with rough asbestic, to be free from overhead or internal noises. Its use also is invaluable, for the same reason, in hospitals and sick rooms, as well as in music and concert rooms. It is moreover odourless and vermin proof, and being a natural filter, if a pail be upset in the room above so that the underneath ceiling be wetted, it dries again as before and leaves and leaves no mark or stain. It is also as elastic as fibrous, so that there is no fear of any crumbling, chipping, fracture or displacement. Even if a nail be driven into it, it will enter as readily as into a deal board. Neither the heat from any stove or furnaces, nor even the "settling" of a building, will have any effect upon the asbestic. It will adhere to metal or glass, and I have seen it applied as a covering to a tin pipe, its adhesive nature preventing any crack or split when bent round the pipe; and when walls are papered or painted with it, all danger from fire from that source is entirely avoided. When walls are plastered with it, no sooner does it become dry than all danger of having to do it again after the settlement of the building is entirely done away with.

I called at many of the huge buildings now rising about New York and Montreal, following the example of Chicago, and saw its practical use while building was going on. A coating of rough asbestic was first applied with a trowel, just as it would be with any other plaster, it might be on brick, laths, or plain boards; and, when this is dry, it forms a coating very much like the asbestos felt-board now so much in use in America and Canada. This rough coating is then surfaced over with a superior quality of asbestic called "Finish," which dries with a fine appearance not unlike marble, and with a good palish. Its cost is about the same as that of good sand and lime plaster, which its covering capacity greatly exceeds, while its mixing is so simple, and its application so easy, that it is fonnd to be practically cheaper.

There is a peculiar danger to be feared in all these lofty buildings, which are now so much the fashion over yonder, which specially arises from their framework. Both iron and steel are so much affected by heat that, if a conflagration should occur near to one of these Babel-like buildings, the girders would become so affected that they would be likely to bend downwards, in doing which they would assuredly draw the uprights towards them, and cause a general collapse of the whole structure. I saw the action of this immediately after the destruction of the Tuileries and large buildings in Paris in the time of the Commune. The plan adopted was to pile the furniture, and such other combustible matter as was at hand, in the center of the principal room, pour petroleum over it, and then set fire to the heap The great heat soon caused the girders to sag downwards, drawing the sustaining walls inward, so as to cause speedy and irretrievable ruin. In the case of the monster buildings alluded to, if the metal skeleton were protected by brick, and the brick plastered with asbestic, all danger from the source indicated would be avoided. This is the plan adopted at the Waldorf Hotel in the Fifth Avenue, and many of the modern buildings in New York.

Asbestic is also applied, by the manufacturers already mentioned, to the making of a special roofing material of a perfectly light and cool character, which is effectually proof against burning sparks and cinders that, in every case of exposure to fire it has proved to be a complete protection. It is specially applied to the steep or flat roofs of factories, foundries, warehouses, railway buildings, cars, &c. It is suitable for all climates, has been used in every part of the States, and in parts of South America and Europe, for a sufficient length of of time to show its superiority over corrugated iron wherever used.

In 1861, the roofs of Kingsford's Oswego starch factory were covered with the original asbestos roof coating, which is still in good condition. This is now vastly improved in strength and durability by the use of asbestic, and specially improved asbestic roofing has now become so important, and in such rapidly increasing demand, that it is manufactured at the enormous rate of *over two miles per day*.

For paper making, asbestic is so admirably adapted that it has now taken the lead in the United States of any other commodity used for the purpose, whether of wood, straw, or any kind of pulp. Wherever it has been tried, it is found to carry everything before it, and there can be little doubt that as it becomes more generally known its use will become universal. The demand for it is already so great that in the course of last year the H. W. Johns Manufacturing Company had to put up an immense new building adjoining their other manufacturing premises at Brooklyn, for the special purpose of producing asbestic paper, more especially for building purposes. Here I saw in operation a new machine capable of producing it of a very superior quality at the rate of from 30 to 50 tons per day, and of a width of 130 inches. This new building was specially erected in consequence of the vast discovery of asbetic fibre at Danville, which enables the manufacturers to enter into competition with any kind of wood or straw pulp paper now used in the trade.

There can be no doubt that, properly prepared by careful working, the shortest Danville fibre will before long become an important factor into the paper trade generally, it being of a pure white colour and of remarkable fineness, while the trade can buy it at a price much below that of any other material now in use by them. During the last year the increased consumption of asbestos by this firm was, notwithstanding the depression in prices and trade generally, nearly four times that of any former period, and this was entirely attributable to the Danville discovery.

When any of these revolutionary changes occur in any particular line of business, as is now taking place in the asbestos industry, matters are always disorganized, and many people seem to be involved in ruin, but things very soon right themselves. The new discovery has given such an impetus to the trade that no day passes without new applications of asbestos being brought to the notice of manufacturers, and very shortly more asbestos will be required and used than ever before; and when things have quieted themselves a little, and old practices have become discarded, means will be found for utilising the now standing properties and (as I believe) making them more flourishing than ever.

Perhaps no one who seriously regards the subject-matter of the paper read before them this evening will fail to see the great importance of it, and how extensive a field is now laid open to the discoveries of scientific men. The present discovery was not due to scienee at all, but to the unaided intelligence of keen common sense. Its extraordinary value is shown by the fact of the promptness with which the entire capital of the company recently formed was secured by the manufacturers and the few capitalists who had looked into the matter, rather than by the general iuvesting public, to the great majority of whom asbestos—and all that relates to it—is, in a great measure even now, practically a sealed book.

SPECIAL MEETING

OF

The Federated Canadian Mining Institute.

The Tariff on Mining Machinery.

A Special General Meeting of the members of the Federated Canadian Mining Institute was held in the Windsor Hotel, Montreal, on Friday Evening, 7th May. There was a good attendance. Among others:—

MR. GEORGE E. DRUMMOND, (Canada Iron Furnace Co.), Montreal.
MR. John J. PENHALE, (United Asbestos Co.), Black Lake.
MR. JAS. S. MITCHELL, (Beaver Abestos Co.), Sherbrooke.
MR. CLARENCE DIMOCK, (Central Rawdon Gold Co.), Windsor, N. S.
MR. JOHN F. STAIRS, (Nova Scotia P. & M. Co.), Halifax.
MR. HARVEY GRAHAM, (Nova Scotia Steel Co.), New Glasgow.
MR. T. P. BACON, (New Rockland State Co.), Montreal.
MR. JOHN E. HARDMAN, S.B., M.E., (Oldham Gold Co.), Montreal.
MR. JAS. F. LEWIS, (Can. Rand Drill Co.), Chicago.
MR. S. J. SIMPSON, (Ingersoll Rock Drill Co.), Montreal.
MR. LIONEL SHIRLEY, M.E., Montreal.
MR. DWIGHT BRAINERD, (Hamilton Powder Co.), Montreal.
MR R T HOPPER, (Anglo-Can Asbestos Co.), Montreal.
MR GEORGE MACDOUGALL, (Montreal Quarry Co.), Montreal.
MR. WM. HAMILTON, (Hamilton Manf'g Co.), Peterborough.
MR. J. M. JENCKES, (Jenckes Machine Co.), Sherbrooke.
MR. F. H. HOPKINS, (Dom. Wire Rope Co.), Montreal.
MR. H. W. DE COURTENEY, Montreal.
MR. JAS. D. SWORD, M.E., Rossland, B. C.
MR. A. W. STEVENSON, C.A., Montreal.
MR. J. STEVENSON BROWN, Montreal.
MR. W. F. DEAN, (Can. Gen. Electric Co.), Montreal.
MR. JAS. W. PYKE, Montreal.
MR. J. P. NELSON, (Intercolonial Coal Co.), Montreal.
MR. E. W. GILMAN, (Canadian Rand Drill Co.), Montreal.
MR. B. T. A. BELL, (Editor Canadian Mining Review), Ottawa.

MR. GEORGE E. DRUMMOND, President, occupied the chair.

THE SECRETARY having read the notice convening the meeting, submitted the following telegram from Major Leckie, President of the Mining Society of Nova Scotia:—"Am strongly opposed to admitting Mining Machinery free. Mining industry has not greater claims than others to exemption. Entirely unjust to Canadian miners to admit American coke and ore free, and in addition, pay two dollars bounty on their product. Export duty unjustifiable; should be opposed most strenuously."

MR. HARDMAN referred to the ambiguity in the phrasecology of the old law and pointed out that the new item was quite as liable to misinterpretation.

THE SECRETARY: It is evident from the wording of the item "Machinery of a class exclusively used and required for mining," that it was the intention of the government to give protection to the home manufacturers, as a large quantity of machinery used in mining was also applied to other industries such as drills, compressors, hoisting engines, blowers, pumps, etc. It would prevent a repetition of friction and misunderstanding if the dutiable articles were clearly specified and everthing else admitted free.

MR. JAS. F. LEWIS stated that a representative meeting of Canadian manufacturers had been held that afternoon, when a resolution was adopted asking the government to specify for duty the following articles: Ore and rock crushers, stamp mills, Cornish and belted rolls, rock drills, air compressors, and percussion coal cutters. The list was an exceedingly modest one, and it was hoped it would receive the support of the Institute. If all mining machinery were admitted free, his company would simply shut down their Canadian Works and ship their drills and compressors from the other side.

MR. WM. HAMILTON (of the Hamilton Manufacturing Co.), stated that during the past year his company had gone to considerable expense in fitting up their works at Peterborough for the construction of special lines of mining machinery under the E. P. Allis Company's patents The introduction of free mining machinery would entail serious loss to his company.

After further discussion

MR. JOHN E. HARDMAN, S.B., M.E., moved:

Whereas the items relating to mining machinery in the tariff just superseded were suceptible of misinterpretation by the different collectors of customs, thereby creating occasional annoyance and delay in passing entries and whereas the language of item 535 of the present tariff is likewise susceptible of misinterpretation; be it resolved that the Federated Canadian Mining Institute respectfully suggests to the Federal Government the advisability of re-constructing this item to read as follows:

(*a*) That ore and rock crushers, stamp mills, Cornish and belted rolls, rock drills, air compressors and precussion coal cutters be specially enumerated as dutiable:

(*b*) All tools, machines or appurtenances to be used exclusively for mining, milling, smelting, reducing or refining, or materials used in the construction of the same, n. e. s. Free.

MR. JOHN F. STAIRS, seconded

The motion was carried unanimously.

The question of the provision in the tariff for an export duty on iron and steel made from Canadian ore was next considered, and after discussion

MR. A. W. STEVENSON moved, seconded by MR. JAS. S. MITCHELL: Resolved—That the members of the Institute respectfully urge upon the Federal Government the necessity of cancelling the clause relating to the imposition of an export duty on iron and steel made from Canadian ore and fuel, fully believing that such an export tax would prevent the full development of our iron mines and industries which the proposed bounties are meant to encourage.

The motion was carried unanimously.

THE SECRETARY having intimated that the Minister of Finance and the Controller of Customs would receive a deputation from the Institute on Saturday, it was decided to send a deputation to Ottawa on this date.

DEPUTATION AT OTTAWA—MINISTERS ASK FOR A FREE LIST.

A large deputation from the Institute visited Ottawa on Saturday, 8th May, a special coach being attached for their convenience to the morning train, Canada Atlantic Railway.

THE HON. MR. PATERSON, Controller of Customs, granted a hearing to the deputation at three o'clock in the Russell House, after which the party was received by the Hon. W. S. Fielding, Hon. Wm. Mulock, and the Hon. Mr. Paterson in the office of Finance Minister. The views of the Institute were clearly and forcibly presented by the Secretary, who submitted the resolutions adopted by the Institute. Mr. Jas F. Lewis respresenting the manufacturers, also addressed the Ministers. At the request of the Finance Minister, a list of machinery and appliances to be admitted free of duty when for use in mining was prepared and submitted, as follows:

FREE LIST.

All pipes of wrought iron above 2 inches (butt or lapp-welded) and used exclusively in mining.
Pressure or exhaust fans for ventilating mines, exclusive of power,
All coal cutting machines, except percussion coal cutters.
All machinery for coking ovens.
Stanley and other coal-heading machines.
Miners' safety lamps.
Coal augers and rotary coal drills.
Diamond and all other core drills.
Machinery used in the washing and dressing of coal.
All electric or magnetic machines for the separation or concentration of iron ore.
Drying and ore roasting machinery.
Blast furnace blowing engines and all rotary pressure blowers.
Blast furnace water jackets.
Jigs, classifiers, separators, buddles.
Slime tables, vanners.
Amalgamating and settling pans, used for ore dressing.
Ball grinding machines.
Machinery for the extraction of the precious metals by the chlorination or the cyanide processes, excepting power.
Copper plates, electroplated or otherwise, for use in reduction works.
Automatic samplers for ores containing precious metals, excepting power.
Amalgam safes.
Retorts.
Automatic feeders.
Amalgam cleaners.
Mercury pumps.
Bullion furnaces.
Bessemer and other convertors for iron and copper ores.
Briquette making machines for fuel and ore.
Sheet-iron pipes, monitors, giants, and elevators used in hydraulic mining.
Pyrometers, gauges (spring and mercury) used in furnace work.
All safety appliances for mining.
All materials imported for the manufacture of the above machinery.

(Signed), GEO. E. DRUMMOND, President,
Federated Canadian Mining Institute.

B. T. A. BELL, Secretary,
Federated Canadian Mining Institute.

JAMES COOPER, Chairman,
Committee of Canadian Mining Machinery Manufacturers.

J. M. JENCKES, Secretary,
Committee of Canadian Mining Machinery Manufacturers.

J. E. HARDMAN,
JNO. J. PENHALE,
Members Mining Committee.

J. F. LEWIS,
WM. HAMILTON, JR.,
Members Manufacturers Committee.

A GRANT TO THE INSTITUTE.

THE SECRETARY then submitted for the consideration of the Government an application for an annual grant of $2,500 towards the work of the Institute. The publications embraced a variety of subjects relating to the resources and mineral development of the country, and were of great value in directing attention to the Dominion as a field for investment. Similar grants had been made to the Royal Society of Canada and the Canadian Art Association and the Institute, representing, as it did, the best talent in the mining profession of Canada, was no less worthy of their recognition. If the grant was made, a portion of it would be applied towards the equipment of the Commercial Mining Museum in Montreal.

The Ministers have promised consideration to the views of the Institute. The deputation withdrew well pleased with their reception.

Government Adopts the Tariff Amendments Suggested by the Institute.

In the Amended Tariff resolutions submitted to Parliament on 26th instant the views of the Institute are incorporated in the following items relating to mining machinery:—

Item 305—Steam engines, boilers, ore crushers, stamp mills, Cornish and belted rolls, rock drills, air compressors, cranes, derricks, percussion coal cutters, pumps, n.e.s., windmills, horse-powers, portable engines, treshers, separators, fodder or feed cutters, potato diggers, grain crushers, fanning mills, hay tedders, farm wagons, slot machines and type writers, and all machinery composed wholly or in part of iron or steel, n.o.p., twenty-five per cent *ad valorem*.

Item 535.—Mining, smelting and reducing machinery, viz.:—Pressure or exhaust fans, rotary pressure blowers, coal cutting machines except percussion coal cutters, coal heading machines, coal augers and rotary coal drills, core drills, miners' safety lamps, coal washing machinery, coke-making machinery, ore drying machinery, ore roasting machinery, electric or magnetic machines for separating or concentrating iron ores, blast furnace water jackets, converters for metallurgical processes in iron or copper, briquette making machines, ball grinding machines, copper plates, plated or not, machinery for extraction of precious metals by the chlorination or cyanide processes, monitors, giants and elevators for hydraulic mining, amalgam safes, automatic ore samplers, automatic feeders, jigs, classifiers, separators, retorts, buddles, vanners, mercury pumps, pyrometers, bullion furnaces, amalgam cleaners, slime tables, blast furnace, blowing engines, wrought iron tubing, butt or lap welded, threaded or coupled or not, not less than 2½ inches diameter, when imported for use exclusively in mining, smelting, reducing or refining.

MINING NOTES.

Nova Scotia.

Mr. W. A. Saunders has sold his mine at Caribou to an American Syndicate, who propose putting in more machinery and working on a more extensive scale.

The Touquoy mine which was recently purchased by a Truro Syndicate produced 99 ounces as the result of the first month's work under the new owners. Mr. Touquoy is spending the summer prospecting areas he owns near Chester Basin, and on which very rich boulders have been found.

The returns from the Elk mine last month amounted to 100 ounces. One of the employees, a man named Fraser, was tried for stealing gold ore from the mine and committed to four years imprisonment. An interesting feature in the case was that one of the owners and the manager stated that it was possible to distinguish ore as coming from a certain mine and they picked out the sample stolen by Fraser as coming from the Elk mine, this being the feature in the evidence on which Fraser was convicted.

The Brookfield mine continues its very handsome returns. Last month the yield was 365 ounces.

The returns from the Richardson mine, last month, show a very material increase, and amounted to 355 ounces from 2000 tons of ore, which includes both slate and quartz. This company have persevered diligently in working a large low grade belt of ore, and are reaping a just reward. They now propose to add either blankets or concentrators and a chlorination plant. Mr. F. H. Mason, F. C. S., of Halifax has been instructed to prepare plans and estimations for the latter.

The new plant at the Central Rawdon mine is nearly completed, it consists of a ten stamp mill with three frue vanners, one Morse belt and two plain belts. The mine in the past has produced 4,693 ounces of gold from 3,244 tons of ore. As this mine has very many interesting features we propose giving an account of it in our next issue. The property has recently been examined and reported upon by Messrs. J. E. Hardman, R. G. E. Leckie and F. H. Mason. In the bottom level the Cope and West veins have united and form a big body of ore from 4 to 6 feet in width, showing gold right through it. The prospects at Central Rawdon were never more rosey than at the present time.

The old Antimony mines at Central Rawdon have been bonded by an English syndicate. An expert has spent some time at the property, carrying out a series of tests on the ore, and recently returned to England with a bond of the property.

A new find of gold is reported from the famous Oldham district and a large number of areas have been taken up, mainly by Halifax people.

We were shewn a piece of solid galena, weighing in the neighbourhood of 50 lbs., taken from Cheticamp. It is estimated that the vein carries about 30 per cent. of lead, and from 30 to 40 ounces of silver per ton. The vein is said to be about 8 feet.

Major R. G. Leckie *et al* have started development operations both at the Dufferin and at the Goldenville. It is proposed, we understand, to put in 60 stamp mills at both places. So there is likely to be a boom in low grade mining.

We understand that the New Egerton Mining Company propose putting in a chlorination plant to deal with half of their tailings and that the Cassell Gold Extraction Co., will put in a cyanide plant to treat the other half on royalty.

The new company who purchased the Thompson Hill mines at Cow Bay, produced 52 ounces from 50 tons as the result of the first month's work.

Mr. Shaugnessey, who has recently been in charge of the Tudor property, at Waverley, is making a test of the ore at the Barachois mine at Wine Harbour, and if it proves satisfactory, he will take over the management of the property.

Three new finds are reported from Cow Bay, one being a 20 inch lead showing considerable gold.

A new find is also reported from Forrest Hill, showing heavy gold.

There has been a find of auriferous galena in limestone at Gay's River, and hundreds of areas have been taken up. The lead or deposit is said to be 100 feet wide. There has been a big rush for areas here, and at any rate the Mines Department is reaping a harvest.

It is generally understood that this season may witness important developments in another direction. During the winter several coal areas have been acquired by a local solicitor, acting on behalf of an English firm, and when these and others, now being negotiated for, are consolidated in one ownership, steps will at once be taken to open a valuable seam which has already been proved. The special feature of this seam is its comparative freedom from sulphur, which is the one unfavorable incident in C. B. coals. If, as the owners claim, they have secured a first-class steam coal with rather less than 1 per cent. of sulphur in the raw coal, and about 65 per cent. in a sample of 50 hour coke, we congratulate them, and have no doubt they will find a ready market. This is just the coal that is being asked for.

The G. M. A., have placed an order for a new pair of hoisting engines with Messrs. I. Matheson & Co., of New Glasgow, who are also busy on an extensive order for screens and picking tables for the Dominion Coal Co.

Quite a number of C. B., miners have caught the gold fever and have rushed—not to B. C., which seems for the moment to be the golden hub of the Universe, but to Cheticamp, where there is every reason to believe that gold will be found in paying quantities. There are, undoubtedly, alluvial deposits as well as rich quartz in this district, but to what extent is the problem.

The Dominion Coal Co. shipped in April 22,000 tons. This is 8,000 tons less than last year and is accounted for by the falling off in the trade with the States. It is, however, largely in excess of the figures for 1894 and 5, respectively, when the tonnage was 1,664 and 5,854. Taking the first two months of the fiscal year, March and April, the totals are upwards of 56,000 tons, against 39,486 last year.

There are two additions to the Petersen Tate line of turrets, plying between Sydney and Montreal, this season, viz.: the turret "Chief," and the turret "Court," each of 4,000 tons register. This fleet now consists of seven vessels with an aggregate tonnage of 23,000.

It has been decided in order to concentrate the whole of the shipping at one point—the International Pier—to discontinue entirely the loading of crafts at Cow Bay and Glace Bay. Even small schooners will be accommodated at Louisburg or Sydney, where the company guarantee prompt despatch.

The new shaking screens and picking belts, which are now in full operation at Dominion, Caledonia, and Reserve Mills, are giving great satisfaction, and two well known experts, who visited the mines recently, pronounced the handling and condition of the coal under this system, "Equal to anything on the Continent."

Preparations are in progress at the Old Sydney mines to commence the sinking of another shaft, and as soon as the machinery, which is now being delivered, is set up, work will be begun.

British Columbia.

WEST KOOTENAY.

The present rush of people into the Kootenays comes very nearly surprising the prophets who claim some foresight in the matter of our mineral development. For that large class of people who are abandoning the well worn paths of older places, to start with no particular aim or connection in this new field, there is, at present, the resource of turning prospector. There are great regions yet unexplored for mineral, and the present producing camps have still a good deal of ground vacant which needs care and time to prospect. Most of the Kootenay towns have a full supply of miners and professional representatives. In fact, the towns are quite far enough advanced for the state of the mining development.

Vancouver, Victoria, and other British Columbia places supply many of the new comers into the Slocan. Rossland still attracts hundreds of people who for the most part afterwards scatter abroad to the newer camps, such as those of Quartz Creek, Wild Horse Creek, and Salmon River, along the line of the Nelson and Fort Shephard Railway. The ores of these places are fairly rich in gold, silver and copper, and have the great advantage of being along the line of a railway which has been in operation for several years. At present there is not much talk of the Waterloo camp which attracted a good deal of attention during last summer.

As far as can be seen at present, the greatest development work will be done during the coming summer in Slocan and Rossland, with the addition of the newer camps of the Southern Slocan, along the range between Slocan Lake and the Kootenay Lake, also the camps of the southern portion of Nelson mining division, such as Salmon River, Wild Horse Creek, and Quartz Creek.

The somewhat neglected Lardeau country shows signs of coming to the front. This district, formerly a placer camp, was prospected for vein mining shortly before the last fall in silver, in 1893. The slump in silver caused it to remain undeveloped, whilst Rossland and the more accessible Slocan drew all the attention.

Many properties have meanwhile been bonded to strong people with plenty of encouragement in the matter of developing large ore bodies, but very little shipment can be made until some railway service taps this country.

The Horne Payne people have large interests along the upper branches of the Lardeau River; at present they are moving in the matter of railway construction into this district. One of the projected lines is to run from Galena Bay on the N. E. arm of Arrow Lake to Trout Lake, and the other is to follow the Fish River northwards from the extremity of the N. E. arm.

Most of the Lardeau ores carry gold and copper as well as silver The ore bodies follow the general strike of the schists and slates in a north-westerly direction, and these ore bodies appear to have great continuity upon the surface, judging by the general arrangement of the locations which lie in single file for miles in some cases, more especially along the contact of what is called the great "Lime Dyke," a highly crystalline band of limestone some 500 feet thick, upon which there are nearly a hundred locations, and groups such as the Glengarry, Badshot, Black Prince, Wagner, and Abbott groups.

Concerning the most favorite prospecting grounds of the coming summer, it is probable that East Kootenay will attract the most attention. It is a comparatively unprospected district, although it has many old locations and some mines. Compared with the divisions of West Kootenay the field is larger. A great many Americans are going in from Spokane by way of Jennings and up the Kootenay River, as well as a large number of old timers of the Slocan who will go in by way of Golden, or over the divide to St. Mary's River from Kootenay Lake. The ores are copper, silver, lead and gold, and have been well spoken of by competent mining men.

There are still large tracts to be prospected in the Slocan, Ainsworth and Nelson divisions, and many men are now going up into the Lardeau-Duncan River country by way of Hauser Lake. The records of locations for the first week of May, last year, in Slocan mining division were 5, for the same week of this year they are 49, chiefly in Slocan Lake district. This shows that the Slocan is not yet all staked, and the snow is not off more than half way up the mountains yet.

The total shipments of ore and matte from West Kootenay for the first four months of this year, up to May 1st, are valued at $2,502,679. For the same period last year they were $1,200,000; during January, February and March of this year the average monthly value was about $750,000; in April it was $350,000. The falling off in April is due to the stafe of the roads and snowslides, and is usual.

"The Orphan Boy," in the Big Bend country, 65 miles north of Revelstoke, has been in trouble for some time past. The late secretary, F. C. Whitney, caused an issue of 4000 fraudulent shares. Then the president of the company auctioned off the property upon a judgment of $3,249. The property brought $6,200 at this sale and now the shareholders are proceeding against the principals of the sale. It is a gold ore-body; some of the gold is free and the rest is base in arsenical pyrites, so it is said.

The Kansas City Smelter Co., are supposed to be about building a 300 ton smelter at 5 mile point on Kootenay Lake. 5 mile point is the point where the Nelson and Fort Shepard Railway touches Kootenay Lake; it is 5 miles north of Nelson, and it receives fully two-thirds of the Slocan-Kaslo ore for shipment to U. S. smelters at present.

The mining agent, Mr. Morrish, of the New Gold fields of British Columbia, has lately been in the Slocan; also Mr. Callahan, the Galena Mines engineer. No one seems to think of calling companies by the name of 'Silver Fields,' yet it is not inappropriate to some of those carrying the name of the rarer metal.

The agents of the Colorado Sampling Works have stated their intention of placing sampling works at Nakusp. Nakusp occupies much the same position on Arrow Lake that Kaslo does on Kootenay Lake. It is a lake port for shipment of Slocan ore. At Kaslo, the lately built sampling works have done well. About one-third of the Slocan ore goes out via Nakusp.

The Reco Mining Company of Sandon, announces the payment of another dividend of $50,000 on April 30th. This, with $100,000 on Feb. 15th, and several thousands prior to incorporation, should place this property in the first rank. Only development work will be done during the summer as the ore all comes down by pack or rawhide. A concentrattor will probably be built by this company soon.

Kaslo, in company with other towns in West Kootenay, is building up a little. A good many recent locations are made about this place. Heretofore Kaslo has not been a mining camp, although doing a large trade with somewhat removed mines and the Slocan.

Some mining machinery is making its appearance in the Slocan Lake country. The Galena Mines have a hoist and will soon put in a compressor plant and Burleigh drills; also the Arlington Mines, of which Frank Watson is manager, will put in a hoist very soon. This mine will be worked by 20 men. The Fisher Maiden on 4 Mile Creek, under the s me management, will continue working with 15 men.

A group of 7 properties within a short distance of Slocan City is to be opened up shortly. These prospects have very rich surface showings, and are the usual ores of argentite and pyrites in a quartz gangue. Considering the number of this type of ore bodies now being opened up on Springer and Lemon Creeks, it will not be long before it is known what they are worth. Experts are hopeful but non-committal. The value of this section in gold ores becomes more apparent as development goes on, and it is an increasing one.

The C. P. R. steamer will be ready for service on Slocan Lake, about the 20th of May. The three wharves being built at Roseberry, New Denver and Slocan City are well under way. The railroad terminals will be at Slocan City and Roseberry; tracks will be laid down to the wharves and transfer barges to carry four barges will be built; meanwhile the Slocan River Railway hangs fire, but considering the fact that squatters have been served notice to get off the right of way, it is probable that in a few days Slocan City will be a lively railway camp. It is the destination of a great many new comers as it is, and the town is expanding quite fast enough for the state of mining development.

The government is to put up $4,000 each for building of roads on 4 Mile Creek and Springer Creek. This will be about half the cost for 6 or 8 miles up each creek. The mine owners contribute the rest.

The L. H. property, upon 8 Mile Creek, is to be worked by Tacoma people. This ore body is somewhat peculiar in the Slocan. It has large bodies of a silicious pyritic character, carrying gold, and small bunches of arsenical silver along the foot-wall.

Everything points to a much increased exploration and development of British Columbia during this season, operations having begun so early in the year. Though stock certificates are finding a dull market, there is no lack of activity, except in those cases where a few second-class companies have run hort of funds from their treasury stock and have no shipping ore in sight. New sections are opening up and sales are ready.

J. C. GWILLIM.

SLOCUM CITY, 21st May, 1897.

BOUNDARY CREEK.

The drift on the Jewel at the 120 foot level is being continued with good results.

A contract for a 50-foot shaft on the Crown Point has been let by Leslie Hill of the British Columbia Prospecting Syndicate.

Work is progressing on the Last Chance owned by the Republic Mining Company.

Prospecting promises to be even more active than last season here, but a wider area is being explored. A considerable number have gone into the West Fork and main Upper Kettle River districts, and are already reporting good discoveries.

In the last issue, with reference to the "D. A.," owned by the Boundary Creek M. & M. Co., the statement—"average width 10 inches," referred to the later work—the average width for the length of the adit being somewhat less. This adit is being continued and a shaft has also been started on the "S. H. B.," on a vein of copper pyrites carrying good values in gold and silver.

The Brandon and Golden Crown Mining Co., are driving a cross-cut tunnel to prospect the series of veins outcropping on the Golden Crown.

Work has been started on the Anchor-Enterprise vein, Long Lake camp, the controlling interest in which has, it is understood, been acquired by Messrs. Cameron & McKenzie. The intention is to sink 150 feet and connect with a tunnel from the base of the hill. It was from the Enterprise vein that the first specimens of petyite ever found in Boundary Creek were taken.

A rather interesting mineral came under the writer's notice for determination recently. It proved to be tetradymite, containing in addition to bismuth and tellurium, small quantities of lead, sulphur, and selenium. This is the first bismuth mineral ever found in the district.

The Cariboo M. & M. Co., have moved their hoisting works some 200 feet east to the new shaft; the compressor plant has also been set up there.

Work is progressing rapidly on the "Minnehaha" shaft at Camp McKinney, with apparently good results.

At Fairview the Smuggler Mining Co. have leased the Strathyre 10-stamp mill for six months. The mill, other than as regards the power, is a fairly good one, and is equipped with six Frue vanners.

It is stated that a 20-stamp mill is about to be put up at the Tin Horn. The Tin Horn Company have a fairly good looking vein of dark blue colored quartz sparsely sprinkled with sulphides, which is said to give good average values.

H. G.

GREENWOOD, B. C., May 14, 1897.

NEW DENVER.

With the advent of Spring and consequent inrush of people of every description, the usual annual building operations have now begun in earnest. Each year witnesses a large increase in the size and population of almost every town in Kootenay, and at present, for lack of building material, it is utterly impossible to obtain a house or tenement at any price in many places. The hotel capacity is taxed to the utmost, and new ones are springing up like mushrooms in every direction, which augurs well for a busy summer.

The new C. P. R. boat for Slocan Lake will make her trial trip this week week, and according to anticipations should prove an immense boon to the travelling public.

Owing to highly favorable weather, prospecting this season is rendered possible much earlier than usual, and great activity is being shown on all the mountains around Slocan Lake.

The streets of Slocan City are almost impassable and hundreds are still making for that direction in the hope of quickly making a fortune. The district will no doubt afford employment for a large number of men this year, as the Howard Fraction, Arlington, Two Friends, Skylark and Ranger, Cameronian, Exchange, Crusader and Lily B., will in all probability work large forces and add to the general prosperity. The Howard Fraction is expected to ship again in a few days, and a boiler and engine destined for the Arlington are now on their way to the mine.

It is a regretable fact that everything does not appear to have been conducted on open lines in reference to the Two Friends. After stocking the company, and taking out over ten car-loads of high grade ore, the bonders decline to make the last payment of $37,500, so that the mine reverts again to the original owners.

Twelve-mile properties are well to the fore this season, the Bachelor and Get There-Eli groups being already in process of thorough exploitation by the bonders. The ore carries considerable gold as well as silver and is of a general high grade nature.

Slocan City now boasts telegraphic communication with the outside world for the first time, and it is announced that the government have made definite arrangements to provide half the cost of a wagon road up Springer Creek, the Bank of Montreal kindly offering to advance the money until the appropriation is made.

Ten-mile promises to be as busy as ever this summer, the locations on Kilsance Creek not yet accessible, are simply fabulous in value from all authentic reports, and I can personally vouch for the statement that specimens of the ore beat anything in the country for richness. The Bondholder is closed temporarily, but the Enterprise will employ an increased force all summer. The bond on the Dalhousie has been relinquished by A. G. Ferguson of Vancouver, but was immediately retaken by another party at the same figures. The Edmonton & Hyderabad groups situated nearer the lake are also under bond and developing satisfactorily.

The Silver Nugget, bonded last fall to Hugh Sutherland, is at present lying idle, but other claims on that creek soon to be operated include the L. H. and Little Daisy.

The Galena Farm continues to progress under able management, the main shaft is now down close to 200 feet, and everything reported up to expectation.

The Thompson Group, Fisher Maiden, Wakefield, Vancouver and others on Four Mile, are all being developed and should contribute largely to the Slocan output by next fall.

The concentrator at the Washington mine, the oldest in the country, is now being reoperated, with plenty of ore to insure continuous working for at least a couple of years.

Another $50,000 dividend by the Reco Company swells the total so far paid to $187,500, and from now on regular distributions will take place.

Report has it that a complete sampling works are soon to be erected at Nakusp by the Colorado Sampling Co. Considering the benefit a similar institution has proved to Kaslo it is sincerely to be hoped that the rumor has substantial backing.

The question of Sunday labour in mines is receiving considerable attention in some quarters; it is very unlikely, however, that the practice of taking a day off will become general, as many of the mines are located away up in the mountains where a day's rest is appreciated but little in comparison with a day's pay.

The narrow margin by which the Alien Law Amendment was defeated shows conclusively the patriotic trend of public opinion. While on general principles it is as well that the amendment was defeated, it is not at all improbable that some of those who voted against it will, as a result, lose their seats at the next election.

HOWARD WEST.

NEW DENVER, May 18, 1897.

Quebec.

Mr. T. J. Watters, Manager of the new Mica Manufacturing Co. Ltd., has returned from London and has commenced work on the Templeton properties of th ecompany.

Mr. Lewis McLaurin is exploiting several new deposits of mica in the same district.

Blackburn mine is being worked double shifts, and continues to produce a satisfactory output.

On the Dugas property, Manchester and Baumgarten are working on a very promising deposit of mica.

The election of Mr. George R. Smith, General Manager of Bell's Asbestos Company's mines at Thetford, gives to the General Mining Association an energetic representative of the mining industry in the Local Legislature. Mr. Smith defeated Mr. Mooney, another representative of the asbestos industry, by a substantial majority. Megantic County, which Mr. Smith represents, has hitherto been ably represented in the Quebec Legislature by the late Hon. Geo. Irvine, Q.C., and Mr. James King, both of whom, like Mr. Smith, were officers of the Association.

At the annual meeting of the Asbestos Club held at Black Lake on the 29th ult., the following officers were elected:—

President—A. M. Evans, M.E., Glasgow & Montreal Asbestos Co., Black Lake Mines; 1st Vice President, P. P. Hall, Quebec; 2nd Vice-President, B. J. Bennett, King Bros. Asbestos, Mines, Thetford Mines; Sec.-Treasurer, R. Stather, Black Lake Mines; Asst.-Secretary, T. H. Crabtree, American Asbestos Co., Wertheim Mines.

Council:—James King, Lyster; Dr. C. E. Morin, Thetford Mines; Geo. R. Smith, M.L.A., Bell's Asbestos Co., Thetford Mines; L. A. Klein, (late) American Asbestos Co., Wertheim Mines; W. J. Smythe, Inverness; J. J. Penhale, United Asbestos Co., Black Lake Mines; R. T. Hopper, Anglo-Canadian Asbestos Co., Black Lake Mines.

An interesting paper on the subject of "Legitimate v. Boom Mining," was read by Mr. A. M. Evans, M.E.

Ontario.

Messrs. Æmilius Jarvis & Co., report for last month as follows:—The Mining Companies' Bill, passed during the month, is singularly weak and unsatisfactory. The public were given to understand that their interests were to be protected by fixing upon the promoters and directors personal responsibility for statements contained in advertisement or prospectus issued inviting persons to subscribe for the shares or stock of a company. We search in vain for any attempt upon the part of the framers of the bill to efficiently guard the investing public. If the Imperial "Directors' Liability Act, 1890," is not an ideal piece of legislation, there is no question but that it has deterred many from exploiting the public, and we cannot admit that Canadians are so thoroughly educated in mining matters that they are always competent to judge between true and false representations.

In the "Act to further approve the Mining Laws," which passed its third reading on April 10th, the Government have shown a willingness to amend some of the most glaring weaknesses of the very unsatisfactory Mining Act of 1892. The encouragement of the first discoverer is a step in the right direction. He is now entitled to a free grant of 40 acres if the deposit found is not less than 10 miles from nearest known ore body. The conditions of application have been made more workable: Now, instead of having to procure two affidavits from independent parties, it is only necessary for the discoverer to file his own affidavit that he "has never heard of any adverse claim by reason of prior discovery or otherwise." "Blocking" Applications are now somewhat checked, for a rental of 25 per cent. of the purchase price must be paid to the Government within 60 days, and the whole within three months, time to be reckoned from date on which application is filed. Another move in the right direction is in limiting amount of applications: "No application shall be entertained in any one year from any person, for more than 320 acres, nor from any firm, partnership, syndicate or incorporated company for more than 640 acres, within a radius of 15 miles in any one district." The Commissioner for Crown Lands may, however, curtail even this quantity if he deems it advisable in the interests of the Province. Sec. 8 gives the Lieut.-Governor in Council power to withdraw territory pending exploration, and also gives him power to increase the price or rent rate of such explored land. The working conditions, both under purchase and lease, will now necessitate *bona fide* early expenditure upon properties instead of allowing a lapse of seven years. Work must begin within two years of filing, and this work has to be "actual mining operations, exclusive of houses, roads, and all like improvements. With regard to licenses, a claim is limited to 990 feet square (22½ acres), and "ground included in each claim shall be deemed to be bounded under the surface by lines vertical to the horizon." Only one claim may be staked by each licensee, unless the discovery is distant at least three miles from the nearest known mine or discovery on the same reef. Sec. 24 makes provisions for monthly and quarterly returns to be made to the Bureau of Mines.

Whilst the modifications introduced are undoubtedly, as far as they go, in the interest of the public, the prospector, and the investor, it is a distinct omission that some attempt has not been made to change the present cumbersome, slow, and inadequate centralized system to one calculated to deal effectively with the altered conditions that have been brought about by the great activity in mining so noticeable throughout the province. We should like to see the Australian "Warden" system, which has been found to work so well under all the varying conditions of the different colonies, adopted. It is evident that decentralization is absolutely necessary to give the flexibility and rapidity that it is necessary in the face of the vast amount of business that has now to be handled by the department, and it is a matter of regret that adequate provision to this end has not been made.

The warm weather in the middle of the month removed the snow rapidly, and already a large number of men, prospecting for and developing locations, are at work than ever before. The Thunder Bay district is especially active. Near Schrieber, a dyke of exceptional richness has been discovered, and the Empress Vein, already proved to run through six locations, has been further traced on for for another mile, and samples sent in are very satisfactory. At White River, gold has been discovered in several places, and reports from the district are encouraging.

Shares in working companies closed for the month as follows:—Cornucopia, $7.50, nominal; Mikado, $7.00 to $7.50, nominal; Gold Exploration, $5.00, nominal; Foley, $3.00 to $3.10; Hawk Bay, $0.90 to $1.00; Saw Bill, $2.85 to $2.95; Empress, 15c. to 20c.

Locations, with only prospectors' reports and samples, have been changing hands briskly at figures ranging from $200 and chargas up to, in one instance, for an exceptionally promising property in the Thunder Bay district, $10,000.

Locations, with pit and crosscut demonstrations. or reports by reliable mining engineers, have ranged up to $15,000 in the case of H. P. 300, and $30.000 for a block adjacent to the Ferguson.

On H. P. 301 the shaft is down over 60 feet and shows a good body of quartz carrying visible gold. The Grimsby Co'y have the shaft down 25 feet on their "Eagle Lake" property, the reef assaying $18. On the "Golden Goblin" the shaft is down over 22 feet with a well defined widening reef which it is reported shows visible gold every shot. On the "Ferguson," which has been temporarily stopped owing to the death of Mr. Ferguson, they now have their mill erected. On the "Sultana" the width of the reef at 300 feet is said to be 50 feet, and it is continuing to put out a weekly gold brick of from $2,000 to $3,000. The "Neepawa" is opening up well, and its shaft is down to a depth of 50 feet. A 20 stamp battery is going up this summer. On the "Saw Bill," development is progressing most satisfactorily. The ore from the bottom of the shafts and drift faces is as rich as ever, and about 300 feet of drifting is now done. The second shaft near the intersection of the Hammond reef and Saw Bill vein, is progressing rapidly. On the "Hawk Bay," No. 2 shaft is down about 30 feet, and the timbering of No. 1 is nearly complete. For the future both shafts are going to be sunk by compressors. The vein in No. 2, now four feet wide, is showing the same gradual increase in width as found in No. 1, and continues to give good returns. The "Foley" is giving great satisfaction. It is proposed to put in a new compressor plant and other labor saving machinery which will enable the mine to dispense with twenty-five to thirty hands, and will give a great saving in fuel as well as labor. The vein in the 200 foot level has widened to seven feet three inches, and average samples taken across the vein give $38 per ton. The clean up for the first half of the month gave $7,500, a large increase upon March, and, even with the present stamp power, a return of $200,000 per annum appears reasonably probable.

On the "Empress" the 400 foot tunnel has been completed, and a splendid body of ore has been shown up, 100 feet in width, with an additional 15 foot reef beyond, all highly mineralized. The tunnel has therefore demonstrated an ore body double the size of what was expected from the surface showings, and the Board recognizes that a mass of this magnitude can only be handled in a miner-like way by a large battery of from 100 to 120 stamps. The "Empress" vein is traced through eight locations, and shows on the surface from about 10 to 40 feet in width. That it should widen to such a very large body in depth evidences the existence of a continuous deposit rarely equalled in magnitude. The first gold brick for the year was a $3,000 one. The regular clean-up this spring will take place immediately upon the manager's return. Work on the "Golden Goblin," "Norway," "Trojan," and "Yum Yum" is continuing steadily and satisfactorily. The "Regina" continues producing regularly. It is reported that a controlling interest in the "Pine Portage" mine, which has a 10 stamp mill, has been sold to American capitalists and that the property will soon be opened up again.

During the month letters-patent have been issued in the Province incorporating the following companies:

"The Mineral Exploration & Development Co'y, of Ontario"; capital, $2,000,000, in $1 shares.

The "Gold Brick Mining & Development Co'y," of Saw Bill Lake; capital, $500,000, in $1 shares.

The "Megatherium Gold Mining Co'y," of Jackfish; capital, $100,000, in $1,000 shares.

The "Keewatin Gold Mining, Prospecting & Development Co'y; capital, $750,000, in $1 shares.

The "Scramble Gold Mining Co'y, of Ontario"; capital, $1,000,000, in $1 shares.

COMPANIES.

New Vancouver Gold Mining and Land Co., Ltd.—The annual general meeting of this company was held in the head offices of the company in London, (Eng.) this month.

The Chairman, moving the adoption of the report and accounts, said: I am very glad to be able to make a different statement to that which I made this time last year. At that time I told you that we had made a loss for the year of about £8,600, but on this occasion I have to report that we have made a profit of within £100 of £8,000; so that the difference between the two years is very considerable. (Hear, hear). At that time I expressed my opinion that, as we had passed through vicissitudes before, we should emerge from that which seemed to be pressing upon us. That has been so, and the result we have to show you to-day has been obtained notwithstanding a great depression in prices in San Francisco, which is our principal market, and some difficulties in our coalfield, which as you know, is a very broken one. At the same time, by a series of small economies the result we present to you to-day has been effected. That result enables us to pay a small dividend of 2 per cent., and, taking into account the previous interim dividend, it amounts to 3 per cent. for the year. This is small enough, but it takes us out of the long non-dividend-paying list, and I hope that now we have started paying dividends again we shall continue to do so, and that on an increasing scale. You will notice in the report that the sales for 1896 amounted to 272,000 tons, against 287,000 tons the year before; so that they were really less than they were in the previous year. The net profit which appears in the accounts, of £5,210, is after all depreciation has been written off and all bad debts accounted for. With regard to the mines, they are pretty much in the same position as the year before. We still meet with difficulties, but, upon the whole, they present the same aspect as they did in previous years. Turning to the balance-sheet, you will find that the principal item on the credit side has been reduced from £310,000 last year to £306,000 this year; so that that item, the most important we have, is gradually being reduced. On the other hand, the debenture capital, which in 1895 was £67,000, is now reduced to £65,500, and I think, in this present year, when a large amount of debentures become due, which we have no difficulty in meeting, that item will be still more reduced; so that the security for the debenture capital is gradually increasing, and I have no hesitation in saying that at the present momemt the security is—I was going to say a perfect one, but I will content myself with saying as perfect as any security of that character can be.

Mr. Frederick Tendron seconded the motion, and in doing so said that the Company had been a fairly successful one, for the average dividend for the whole period was something over 4 per cent. The property was being

gradually improved, and the shareholders were in a much better position than those possessed of ordinary mines which were gradually being worked out.

The Chairman, in reply to Mr. Strange, said that the Canadian Pacific did not take coal from them, but got it from the Comox Mine, where it was cheaper. In China and Japan there was much competition and underselling. The McKinley tariff would not affect them, as their contracts were all made.

The motion for the adoption of the report was put to the meeting and unanimously agreed to.

Tier Cove Copper Co., Ltd—The annual meeting of this company was held in London on 25th instant. The accounts showed that the mines of the company made a gross profit of £15,189.11s. 3d., leaving, after charging the account with the interest and discount payable to the Cape Copper Co., and the rent representing the interest on the company's debentures, a net profit of £5,235 6s. 7d. This sum has been applied to a reduction of the debt due to the Cape Copper Company.

The East Mine, Costs and Returns Account, shows:

	£	s	d
Dr.			
To Mining costs	16,444	2	6
Smelting costs	9,490	4	5
Freight, insurance and Swansea charges.	27,863	10	5
Balance—Profit	15,189	11	3
Total	£68,987	8	7
Cr.			
By Ores and Regulus	£68,987	8	7

New Over-head Tramway at the Noble-Five Silver Mine, B.C—The new Finlayson Tramway built by the Colorado Iron Works, of Denver, Col., has been installed at the Noble-Five Silver Mine, Cody, B.C., and is working very satisfactorily.

It consists of two standing or stationary steel ropes one inch in diameter on the unloaded side and one and one-eighth inch rope on the loaded side, laid upon towers from 100 to 300 feet apart. In the case of the one under discussion the towers are from 30 to 900 feet apart and vary in height from forty to eighty feet. On this rope run the bucket trucks. These buckets in this case number fifty-two. Below the standing rope is an endless rope three-fourths inch in diameter, to which the buckets are attached by patent detachable clips 244 feet apart. This is known as the traction or hauling cable, The weight of the loaded cars pulls the empty ones up, the cable being controlled by powerful brakes at the two terminals. The clips referred to above are stationary on the rope and it is the automatic action at the terminals which attaches and detaches the clips to the buckets, dumping the latter at the lower station, which excites the wonder and admiration of all beholders. Space forbids a minute description of this action, but briefly, there are two buckets, one at the upper terminal being loaded and one at the lower terminal being dumped and waiting for the arrival of the next bucket, which are always detached—the moving bucket on arriving at the station is detached, the cable with its stationary clip moves along a few feet engages a dog on the waiting bucket, never stopping, and moves with it around the station; before beginning its upward climb it engages a projecting arm, which action dumps the waiting bucket on the other side. The same operation is continued, the bucket arriving every 75 seconds. The same automatic action obtains at the upper end with the exception that, instead of being dumped, the waiting bucket is loaded. The buckets are now being loaded with 350 pounds of ore but will carry 700 pounds.

The Noble Five tram is 6,100 feet in length and has a drop in that distance of 2,100 feet. At one place it crosses the famous Noble Five slide with a 900 foot span at a height of 443 feet.

A leading feature of the Finlayson tram is the cheapness of operation, a trifling cost compared with other systems. Another feature is its great convenience as an up-carrier; supplies for the mine, timbers, rails, etc., can be placed in the up-going buckets and taken up without cost. The capacity of the tram now in operation is about 400 tons in twenty-four hours.

Counter for Winding-Engines.*

The methods used in many mines for counting how many times the cages are brought to bank are very primitive, and being mostly manipulated by workmen above ground, it may be doubted whether the counting is always correct. There are various apparatus for registering the uumber of windings automatically, but none are satisfactory, all requiring too much personal attention. The author describes an instrument invented by him which, in his opinion, combines simplicity and ease in working, registers automatically and accurately the number of times the cages are wound up in a double shaft, and requires no adjustment by hand. To procure this result, the action of the winding engine is indicated in such a way that one cage has reached the pit's mouth, and the other is nearly at the top, before their positions are registered. Once fixed on the engine, this apparatus always indicates from whatever level in the pit the cages are wound. It has been working successfully for three years at the mines at Pribram, in Bohemia.

The instrument consists of a small prolongation, fixed centrally on the shaft of the winding-engine, rotating at the same speed as the shaft working the cages. A projection attached to it terminates in a helical wheel, which drives in opposite directions two vertical screws by means of worm-wheels set at right angles to the motor-shaft. Two nuts, resting against a central scale, work up and down two screws, and represent in miniatnre the two cages in the shaft. Each nut carries a projection, and every time they pass a pawl in the middle of the scale connected to a counter the pawl pushes the counter round a quarter of a revolution; the pawl is so adjusted that not nntil both cages have reached the bank is a complete number marked on the dial-face. As the two cages must have reached the pitmouth before the counter moves on, the engineman cannot make the counter work by winding the empty cages up and down the shaft. Of course, the windings are thus counted in sets of two, and the number entered in the book must be doubled.

To make the apparatus work automatically, it must be easily and quickly thrown in or out of gear, and allowance made for winding up the coal from different levels. The instrument is coupled by turning a screw which adjusts the lower projection to the helical wheel in any given position. Sometimes the position of one cage in the shaft is altered, while the other is stationary at the pit's mouth. To avoid altering by hand the position of the corresponding nut, it is adjusted on the screw to a height agreeing with the highest level in the mine from which coal is wound. When it reaches the pawl it indicates this height, when it exceeds it, it marks the position of a cage wound from the lowest level. It is adjusted by bringing the nuts into positions on the screws corresponding to the cages in the shaft, the left-hand nut representing the left-hand cage, and so on. The screws and pawl are protected by glass, and the apparatus, once fixed, is permanently adjusted, and needs no further attention. It is made in one size, and indicates for drums from 6½ to 26 feet in diameter, and shafts from 1,370 feet to 5,200 feet in depth. However high the cage may be lifted in the pulley-frame, the indicator is not thrown out of gear. It is said to work well and easily, and to require little lubrication. Drawings of the apparatus are given in the original paper.

B. D.

Plain Talk on Ore Testing.

There are men in every line of business who differ greatly upon the principles underlying their special branch and the methods under which it should be conducted. Some are honest in their differences, while others are willing to sacrifice their real opinions to any matter of expediency which promises more ready and full returns of cash to their coffers. There are assayers who believe that the prospector shoutd be "encouraged" by overstating the value of his ore and who habitually give small returns, from a "trace" to a few dollars per ton, upon ore which they know to be totally barren, thinking by this fraud to keep the miner at work for days, or perhaps months, upon a prospect which will yield nothing, spending valuable time and money to no purpose, save that of giving a few dollars worth of work to the assayer. Perhaps the prospector sends samples to two different assayers, and one returns him "no trace" while the other gives him a value of a few dollars per ton. The biggest return is almost invariably accepted as correct, and the "no trace" man is charged with a failure. Some assayers say it makes no difference whether they return "no trace" or a dollar or two a ton, because in neither case is the ore of any value. I claim the contrary and assert that the accuracy of an assay ot ore of very low grade is much more important than that of an ore carrying a hundred dollars per ton, for the reason that in the first case a difference between "no trace" and a dollar or two may decide the expenditure of hundreds or perhaps thousands of dollars in development; while in the latter, the ore will be shipped anyway; and we have all learned that the smelters will pay for nothing but the actual contents of the ore. Then, too, these returns of value from valueless ore are often the result of accident or carelessness in the hands of an assayer who has every intention of being honest. A particle of rich ore in the grinder left from the last sample, a salted crucible, a loaded cleaning brush, a dirty mixing cloth, flukes containing a little precious metal, these and other matters of carelessness, uncleanliness or disorder about the laboratory are continually making the difference between reliability and worthlessness in the result of assaying. The general public is not competent to judge of the qualifications of an assayer any more than those of a physician. Any man may buy an outfit for a hundred dollars and stick out his shingle "Chemist and Assayer," when in reality he knows no more about the correct application of the principles underlying the trade he professes than the man in the moon. Such instances are more common than many would believe, and sometimes people of intelligence who would at once realize the foolishness of hunting out the cheapest lawyer or doctor will give their patronage to such an assayer just because they can get his services a little cheaper than those of a man who is competent in his profession and who realizes the importance of taking pains.

A good assayer is often charged with failure because his customer is ignorant of the first principles of sampling ore. Sometimes a piece of rock is broken in two, the halves sent to different assayers, widely varying results are obtained, and one of the operators is charged with an error, when in fact both are correct, and the results are chargeable to the fact that the metal was unevenly disseminated through the sample. It is well to remember that like results can only be reasonably expected when the sample is finely crushed, thoroughly mixed and carefully divided. The careful miner will treat his sample in this way, grinding as fine as his circumstances will permit, mixing and dividing carefully, and in every case reserving a portion of the sample so that a check assay can be made if desired. As the best men are liable to an occasional mistake, no conservative miner will expend any large amount of labour or money upon the result of a single assay, but will base his future work upon the concurring results of two or more reliable assayers.

The best practical test of the qualifications of a assayer is his ability to check with the smelters on their shipment pulps, and if you are in doubt with whom to trust your work go to our friends who are ore shippers and get them to tell you who they patronize. No man can be honest in this business without making many enemies among those customers who have had higher assays elsewhere than he can give them and who had rather believe their assayer dishonest or incompetent than that their ore is less valuable than they hoped. Remember that good men as a rule can get a fair price for their work. I have in mind an assayer in Colorado who probably does more business than any man in the West and who charges $2 for a gold and silver assay while others in the same town charge 50 cents, and the chances are that, considering the real value of the results turned out, the two-dollar man comes the nearer to earning his fee. If there is any trade in which "cheap and nasty" work is utterly valueless it is in that of the assayer.

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*Der Aufnubzahler fur Fordermaschinen. By V. Mayer. Oesterreichische Zeitschrift fur Berg-und Huttenwesen, 1895, vol. xliii., page 651 and plate.

SUCCESSFUL CANADIAN MINES.

The following is a partial list of Canadian Mining Companies worked at a profit and paying dividends:—(More complete information will be given in the seventh edition of our *Canadian Mining Iron and Steel Companies Manual*, to be issued to subscribers on 1st July.)

PROVINCE OF NOVA SCOTIA.

Coal areas estimated to cover 97,200 sq. miles; coal sold in 1896, 2,047,133 tons. Area of Gold measures from 5,000 to 7,000 sq. miles; total gold won to 30th September, 1896, (from 1862) 638,322 ozs. 12 dwt. 19 grs. of a value of $12,116,203.38.

Company.	District.	Mineral.	Capital.	Par Value of Shares.	Remarks.
Blockhouse Gold Mining Co.	Lunenburg Co.	Gold	$8,000	$10 00	Initial working in 1896 gave 360 ozs. from 220 tons rock milled. Mill and other plant being erected.
Bluenose Gold Mining Co	Goldenville	do	50,000	100 00	Work started 1896, three months' milling yielding 423 oz.
Brookfield Mining Co.	Queens Co.	do	500,000	50 00	Gold yield in 1896, 4,667 oz. 10 dwt. from 5,351 tons milled. Equipped with new milling and chlorinaton plant (at a cost of $80,000) in 1897 whereby profits will be largely increased.
Cumberland Railway & Coal Co.	Cumberland Co	Coal	2,000,000	....	Coal sales average about 400,000 tons per annum.
Dominion Coal Co.	Cape Breton	do	18,000,000	....	Coal disposals, 1895, 855,152 tons; 1896, 1,133,331 tons.
General Mining Association Ltd.	do	do	£151,079 stg	£5 10s fully paid	Dividends since 1877. Amount paid 1895, 12s.
Golden Lode Mining Co	Halifax Co	Gold	$30,000	$100 00	In 1895-6 paid regular monthly dividends of 5 p.c.; the profits in 1896 were equivalent to 65 p.c. of the entire capital.
Intercolonial Coal Co.	Pictou County	Coal	1,000,000	....	Disposals in 1895, 204,244 tons; 1896, 180,410 tons.
Modstock Gold Mining Co.	Stormont District	Gold	300,000	$100 00	Produced 1854 oz. from 3580 tons rock milled in 1896.
New Egerton Gold Mining Co.	15 Mile Stream.	do	200,000	....	Gold yield 1895, 2956 oz. from 5239 tons milled; 1896, 2624 oz. from 5200 tons milled.
New Glasgow Gold Mining Co.	Goldenvilla	do	20,000	....	Gold yield 1896, 1734 oz. 5 dwt. from 3,791 tons rock milled.
Nova Scotia Steel Co.	Pictou County	Iron & Steel	5,000,000	$100 00	Half yearly dvidends of 4 p.c. each on pref. stock, paid 10th Sept., 1895, and 10th March, 1896, amounting to $82,400. Gross profits for year ended 30th June, $111,960.61.
Pictou Charcoal Iron Co.	do	Iron	200,000	100 00	Output of hematite for year 1896, about 13,000 tons.
Richardson Gold Mining Co.	Stormont District	Gold	100,000	....	Successfully operates low grade; cost of mining and milling with 40 stamps, being about $1.65 per ton; yield in 1895, 1674 ozs. 10 dwt. 10 grs.; 1896, 2550 ozs.
Torbrook Iron Co.	Annapolis Co.	Iron	100,000	$10 00	Output 1895, 35,073; 1896, (four months only) 8,797 tons.
Tudor Gold Mining Co.	Waverley	Gold	150,000	10 00	Works successfully low grade ore; yield in 1895, 989 ozs.
Wentworth Gypsum Co	Hants Co.	Gypsum	200,000	100 00	Annual output 100,000 tons.

PROVINCE OF QUEBEC.

Asbestos produced in 1896, $429,856. Mica, $100,000. Chromite, $25,982. Graphite, $10,000. Pyrites, $101,155. Slate, $53,370.

Bell's Asbestos Co.	Thetford	Asbestos	£200,000 stg	£1	Dividends since 1888; paid in 1896 5 p.c.
Blackburn Estate	Templeton	Mica	Private.	....	Doing a profitable business in the extraction of Mica.
Canada Iron Furnace Co.	Radnor	Iron.	$300,000	....	Output of charcoal pig averages 25,000 tons per annum.
Eustis Mining Co	Capelton	Pyrites	Private.	....	Mine has produced about 400,000 tons Copper Pyrites; annual output about 30,000 tons.
Johnsons's Asbestos Co	Thetford	Asbestos	$250,000	$500	Has paid handsomely since mine opened.
King Bros	Thetford	do	Private.	....	Produces annually about 600 tons; mainly high grade.
New Rockland Slate Co.	Richmond	Slate	$150,000	....	Yearly product averages 6,500 tons.
Nichols Chemical Co.	Capelton	Pyrites	$2,500,000	....	Output of ore averages 40,000 tons.
Wallingford Bros.	Templeton	Mica	Private.	....	Have mined at a good profit for several years.

PROVINCE OF ONTARIO.

Gold yield 1896 about $150,000. Petroleum, $1,155,646. Natural Gas, $276,301. Salt, $169,677. Nickel, $1,155,000. (During 1896 24 mining companies were incorporated and a large number of gold locations were taken up, many of which are expected to yield profits during the present year.)

Canadian Copper Co.	Sudbury	Copper Nickel	$2,500,000	....	Up to Dec. 1895 had won 475,000 tons of smelting ore and 52,100 tons of matte, equivalent to 11,710 tons of copper, and 10,680 tons of nickel.
Sultana Gold Mine	Near Rat Portage	Gold	Private.	....	Has and is yielding a handsome return to its owner, Mr. Caldwell.

The following companies, among others, are expected to pay dividends this season.

Crystal Gold Mining Co.	Lake Wahnapitae	Gold	$1,000,000	$100.00
Foley Mines Co. of Ontario	Rainy River	do	1,000,000	$5.00
Saw Bill Lake.	"	do	125,000	1.00
Mikado Gold Mining Co	Lake of the Woods	do	....	....
Canadian Gold Fields Ltd.	Marmora	do	....	....
Seine River Gold Mines	Rainy River	do	£100,000	£1
Regina (Canada) Gold Mine.	Lake of the Woods	do	£150,000	£1

Successful Canadian Mines—Continued.

NORTH-WEST TERRITORIES.

Company.	District.	Mineral.	Capital.	Par Value of Shares.	Remarks.
Alberta Railway Coal Co	Lethbridge	Coal	£1,125,000	....	Accounts for year ended 30th June, 1896, show a next profit of £2,671.
H. W. McNeill Co., Ltd	Anthracite	Coal	$50,000	$1.00	Production averages 65,000 tons per annum.

PROVINCE OF BRITISH COLUMBIA.

Coal output 1897, 846,235 tons of $2,327,145. Gold produced of a value of $1,788,206. Silver $2,100,689. Lead $721,384.

..e Roi	Trail	Gold	$2,500,000	$5.00	Total dividends to date $400,000.
War Eagle	do	do	2,000,000	....	Dividends paid by old company up to October 1896, $187,000.
Reco M. & M. Co.	Slocan	Silver	1,000,000	$1.00	Dividends paid to May 1897, $150,000.
Bryon N. White Co.	do	do	500,000	....	do March 1897, $350,000.
Rambler-Cariboo	do	do	1,000,000	$1.00	do March 1897, $40,000.
Two Friends	do	do	240,000	.30	do March 1897, $29,000.
Cariboo M. & M. S. and Co	Camp McKinny	Gold	800,000	$1.00	do March 1897, $141,410.
New Vancouver Coal Co	Nanaimo	Coal	£215,000	£1	Dividends average 2 per cent. per annum.

The following mines are owned by private individuals and have returned profits. The exact amounts are not obtainable, but are estimated below:

Mine.	District.	Estimated Profits.
Payne, s. l	Slocan, B.C.	$250,000.00
Idaho, s. l	do	172,000.00
Poorman, g	Nelson, B.C.	50,000.00
Deer Trail No. 2	Cedar Canyon	100,000.00
Ruth, s. l	Slocan, B.C.	50,000.00
Whitewater, s. l	do	40,000.00
Washington, s. l	do	20,000.00
Slocan Boy, s. l	do	25,000.00
Goodenough, s. l	do	35,000.00
Noble Five	do	50,000.00
Jackson Mines, s, l	do	20,000.00
Antoine, s. l	do	10,000.00
Surprise, s. l	do	20,000.00
Monitor, s. l	do	15,000.00
Last Chance, s, l	do	50,000.00

The following among others are expected to pay dividends this year:—

Company.	District.	Mineral.	Capital.	P. Val. Shares.	Remarks.
Cariboo Hydraulic Mining Co	Quesnelle	Gold	$500,000	$5.00	Gold produced for 1894-5-6, $194,052.
Hall Mines Ltd	Nelson	Silver, etc.	£300,000	....	Last balance sheet showed a profit of income over expenditure of £28,067.6s.

Mine.	District.	Capital Stock.	Par Value of Shares.
Jumbo	Trail	$500,000	$ 1.00
Trail Mining Co	do	250,000	100.00
Josie	Trail	$700,000	$1.00
Iron Mask	do	500,000	1.00
O. K.	do	1,000,000	1.00
Ivanhoe	Okanagan	1,000,000	1.00
Wonderful	Slocan	1,000,000	1.00

Cinnibar Mining in British Columbia.

Among our illustrations this month we show a number of views of the property of the Cinnibar Mining Co., at Savonas, Kamloops, Division of Yale, Province of British Columbia. The occurrence of this rare and valuable mineral has been described by Dr. Dawson to be: "In irregular sparry veins, consisting chiefly of calcite and quartz, with some dolomite, traversing zones of a gray felspathic and dolomitic rock which readily weathers to a yellowish colour. Both these zones and the contained veins, as a rule, run nearly magnetic north and south through the main rock of the hills, which is a dark greenish-black, Tertiary eruptive, containing pyroxene and olivine—bnt much decomposed. A considerable quantity of rich ore has been taken from the wider portions of the main vein opened on the 'Rosebush.'"

The claims owned by this company comprise the "Rosebush," "Blue Bird," "Hill Side," "Lake View" and "Yellow Jacket." The principal development so far has been done on the "Rosebush," and consists of a tunnel driven in about 400 feet, cross cuts aggregating 300 feet, an upraise to the surface with drifts at different levels, and a stope of considerable size from which most of the ore has been won.

On other parts of this claim several small drifts and surface excavations have been made; the workings known as the Big Dyke and No. 8 tunnel are also on this claim, or at least in part. and here a tunnel has been run 120 feet, with two cross-cuts just commenced, an npraise to the surface 80 feet in height. Here there are also comparatively extensive surface excavations, and present operations are confined to this part of the mine. On the "Yellow Jacket" there have been run two tunnels, one 90 feet in length, the other 260 feet, with four cross-cuts, aggregating 330 feet in length; two connections with the surface, 80 and 100 feet respectively, the latter having two levels, with drifts amounting to 220 feet in length. In the face of this tunnel and beneath the level of it more than 1,200 feet in all have been drilled with a Sullivan diamond drill, while there has also been a considerable amount of surface exploring done in the same vicinity, and on the remaining claims a small amount of surface work.

A Granza (coarse ore) furnace of a capacity of between 25 and 30 tons per day has been constructed and was first charged on 10 inst.

It is expected that the ore under treatment now will yield not less than one-half of 1 per cent. in quicksilver; and as 35 tons are treated daily, the yield per diem in quicksilver will be 350 pounds, which would be worth $175. This is, of course, using only the low-grade ore of the Rosebush claim, and the yield should be doubled when the Yellow Jacket ore is put through the furnace. This is a conservative estimate. Superintendent Veatch expects as the furnace is worked longer that better results will be obtained. As the total cost of operating the Cinnibar mine at present is only about $1,700 per month, the profit on the qnicksilver after this month, even if no better ore is used, should be about $3,500 per month. As several of the 23 men now working are doing exploration and development work only, the real cost per month on the ore going through the furnace is less than $1,700.

BOUNDARY CREEK MINING AND MILLING CO.

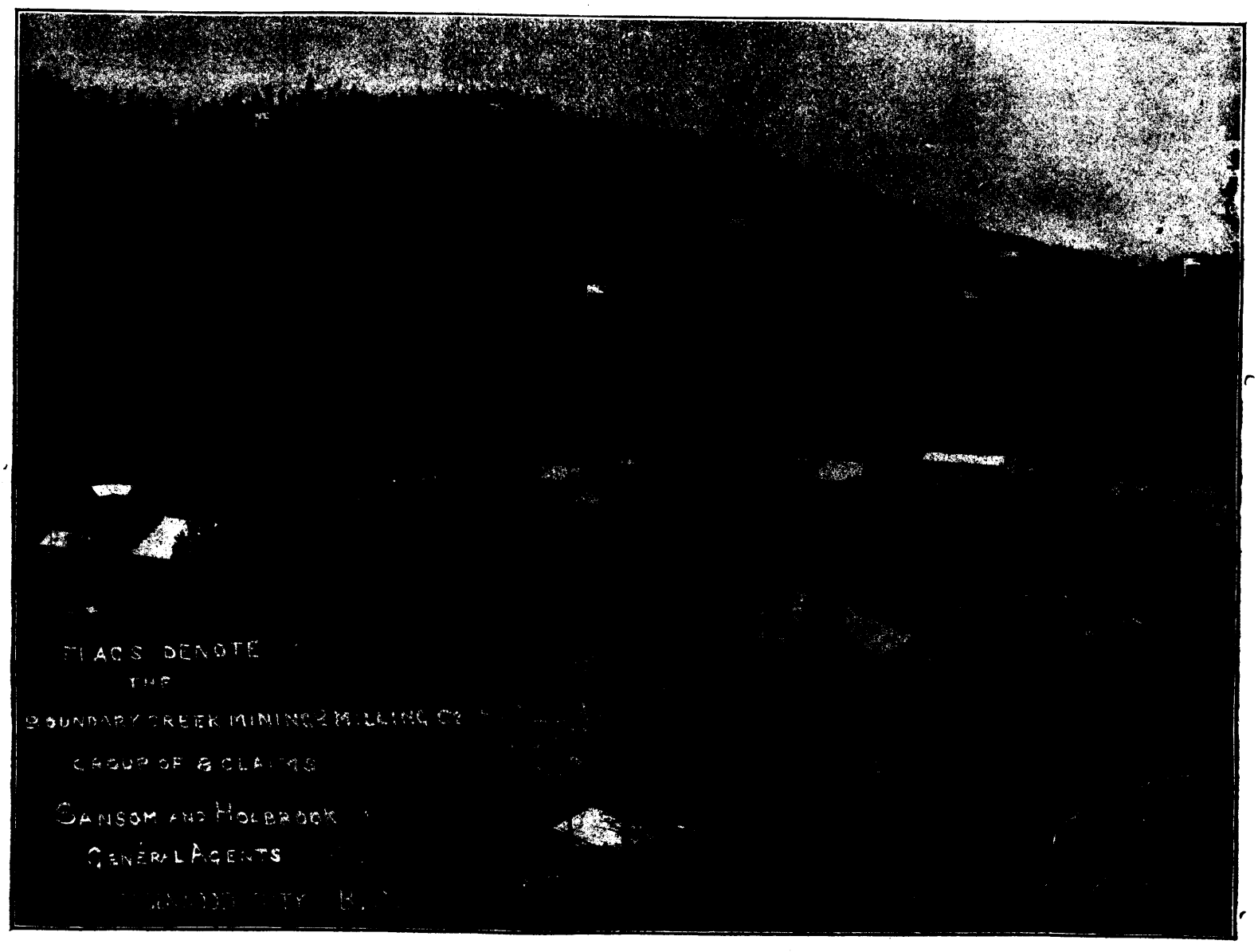
INCORPORATED OCTOBER 21st, 1896.

CAPITAL, $1,500,000. **1,500,000 SHARES AT $1.00 PER SHARE.**

700,000 Shares in the Treasury for Development.

This Company owns and operates a group of the highest grade in Gold, Silver and Copper properties in Boundry Creek.

CLAIMS—The G. A. R., D.A., O.B., S. H. B., J. A. C., FRED D., S. F., C.S. & H., D.H. and BIG LEDGE, constitute the group, which is the most compact and advantageously situated of any under one ownership in Boundary Creek. The proposed Columbia and Western R.R. being surveyed to pass right through Greenwood City and along the base of the hill.



From the above photograph it will be readily seen that, lying as they do on a steep sloping hill, the properties offer unusually good facilities for drainage and rapid and economical development, by main working tunnels driven in from the base of the hill.

The veins lie in the Granite Area—which occupies the upper part of Boundary Creek basin—along the line of contact with the more basic eruptures, and are among the oldest locations in the camp.

A small shipment of 8,653 lbs. was made to the Everett smelter in 1894, yielding per ton, Gold, $103.15; Silver, 74-7-10 ozs.; Lead, two per cent., and a considerable amount of shipping ore is at present on the dumps of the different claims.

Careful investigation is earnestly invited by the Company, as their properties are being developed with a view to making mines and not to booming stock.

Attention is drawn to the large amount of stock (700,000 shares) put into the Treasury, and to the fact that the properties are all fully paid for.

150,000 Treasury shares fully paid up and non-assessable, have been put on the market at 10 cents, and most of the stock so far sold has been taken up locally. A large proportion of the miners now working are also taking stock in payment. For further particulars address

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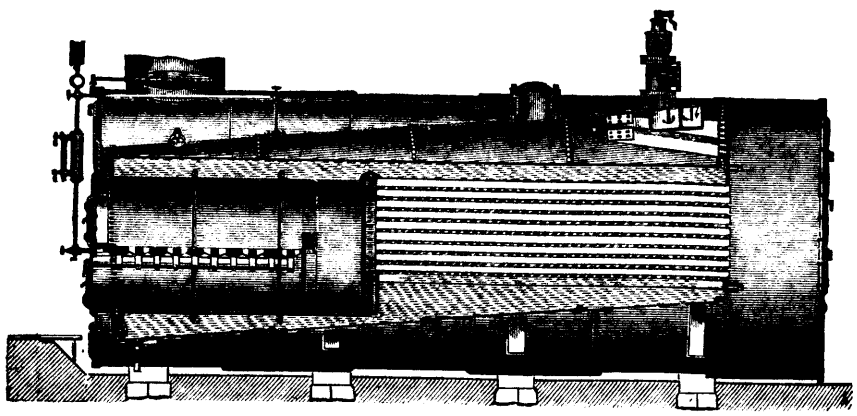

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Saves Fuel — Some tests show a saving of 30 per cent. over a common brick-set boiler. We guarantee at least 10 per cent.

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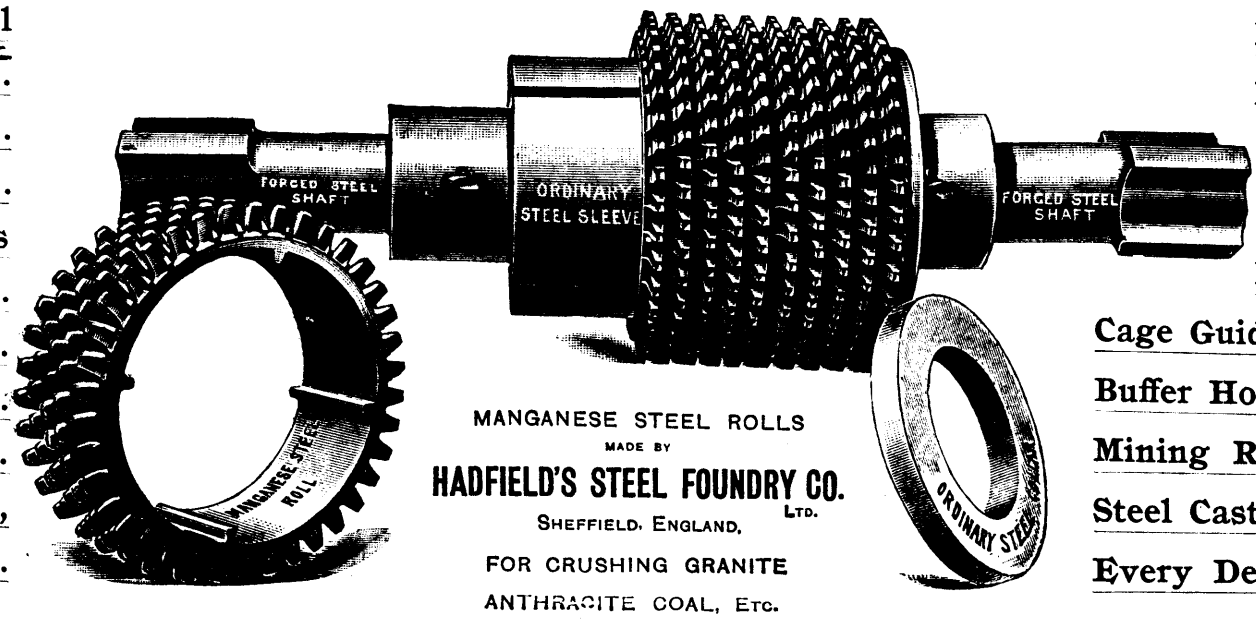

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