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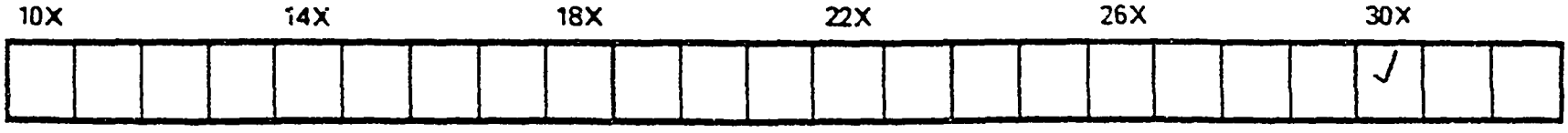

SEVENTEENTH YEAR OF PUBLICATION

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Established 1882

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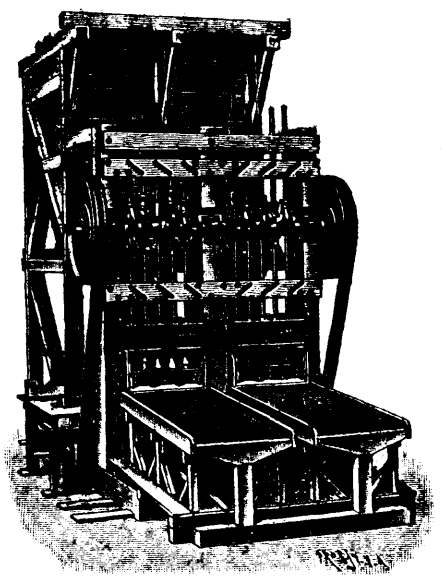

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Licenses are issued to owners of quarts crushing mills who are required to pay Royalty on all the Gold they extract at the rate of two per cent. on smelted Gold valued at $19 an ounce, and on smelted gold valued at $18 an ounce.

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

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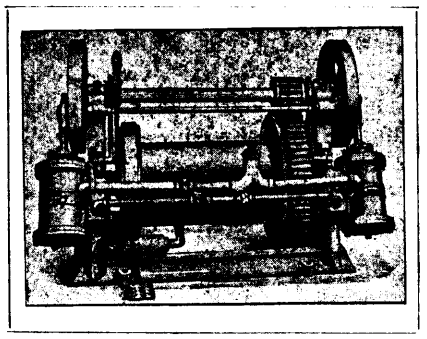

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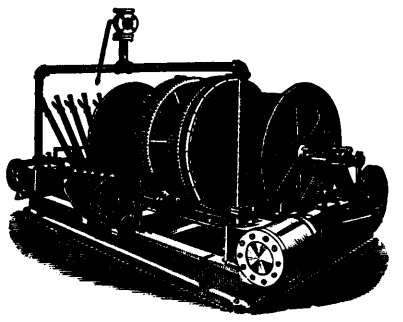

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The Iron Industry.

The condition of the iron industry at present is nothing short of extraordinary. In all the leading iron and steel producing countries of the world, furnaces are being taxed to their utmost capacity, old ones are being blown in, and new ones built, yet with production going on at an unprecedented rate, there is a positive dearth of pig iron, steel billets and raw material generally. In the United States, now the largest producer of iron, the trade papers are filled with accounts of the scramble machinery makers are engaged in for iron and steel. For instance, the Philadelphia market, under date of 5th September, is thus described:

"Efforts to place orders for October and November deliveries were met with a demand for $3 to $5 advance on billets, and about the same on plates and shapes, and even then the mills, after taking a few orders for the last-mentioned articles, had to stop, as they were soon filled to their extreme capacity. Buyers are here in person from nearly every point of the compass, and take whatever they can lay their hands on for shipment, especially to the west and north-west, etc."

In Pittsburg we are told:—

"It is admitted by everybody, both buyer and seller, that prices are entirely too high, but with the exorbitent demand for material there does not seem to be any way from keeping them from advancing. It is a sellers' market, and has been for months, and with a shortage in supply in nearly everything, it is a question of getting the material, and not one of price."

At the Alabama furnaces "prices were advanced without lessening the demand, and the sales were liberal and very well distributed among the buyers all over the country." The English engineering trade was never so good, and large orders for locomotives wanted by the Midland Railway Company for immediate delivery have had to be filled in the United States, because Eeglish makers could not furnish them until months after they were wanted. For a wonder, strikes and labor troubles in England are at the moment almost unknown. The ship builders of the Clyde, the Tyne and the Tees, have orders on hand to employ the full capacity of their works for at least six months. Such immense concerns as the Armstrong Whitworth Company at Elswick, employing 25,000 men, are running night and day. In Germany, a similar state of things prevails. Pig iron is being imported from England and other countries, notwithstanding the fact that for the seven months ending July 31st last, the output of German furnaces was 4,685,858 tons, or 11 per cent. more than for the corresponding period of last year. Germany, in fact, is rapidly over-hauling England in the production of pig iron, and appears likely soon to take second place

The inevitable result of all this activity has been a decided rise in prices. The following figures taken from *The Iron Age*, New York, of the 14th inst., show how great the increase has been during the past year:—

	Sept. 14th, 1898.	Sept. 13th, 1899.
Pig Iron, Fcundry No. 2, standard, per ton	$10 75	$22 25
" " southern "	9 50	20 00
" Bessemer, per ton	10 50	23 75
" Charcoal, "	11 50	23 50
Steel Billets, per ton	16 00	38 50
Wire Rods, "	22 00	45 00
Steel Rails. "	18 00	32 00

So far, this doubling of values has not had the effect either of lessening the demand or checking the output, though the natural tendency to both of these results is bound sooner or later to make itself felt.

To keep the blast furnaces going, extraordinary demands have been made on the iron mines New deposits have been opened, operating mines extended, and abandoned ones un-watered and re-worked. The stock piles at the Michigan and Minnesota mines have completely disappeared, and yet the demand for vessels to carry the ore to the furnaces at Cleveland and other lower lake ports has been so great as to send freights on ore up to $2 per ton—an unheard of figure. In the month of August alone the tremendous total of 3,000,000 tons of iron ore was brought down the lakes.

There are vast deposits of iron ore in Canada, and it is not creditable that in such a period of general and unprecedented demand they should play so small a part. Many are remote from transportation facilities, and others are in the hands of those unable to work them. The recent discovery of large bodies of good hematite in the Michipicoten district and the opening up of the Atik-okan and Mattawin Ranges, by the Ontario and Rainy River Railway, should bring about a state of things resembling, on a smaller scale, the great iron mining and shipping business on the American side, and should make the Ontario furnaces less dependent on American ores than they now are. A notable development of the iron industry in Canada is that recently decided on by the Dominion Iron and Steel Co. at Sydney, C.B., where proximity to coke supplies and the great deposits of iron ores of Bell Island, Newfoundland, combine to give unusual facilities for the business. Four furnaces are to be built, with a capacity of 250 to 350 tons each per day, and contracts have been let for the erection of a complete modern plant, which will include a 38-inch blooming mill and ten 50-ton electric travelling cranes. The whole contract, including that for the blast furnaces, is one of the largest ever awarded in America, and will amount to nearly $5,000,000. With the nine existing furnaces in Canada and the six additional ones that are in course of construction this country should be able to do a good deal towards at least supplying her own requirements, and perhaps, spare a little for English and foreign markets.

The reserves of iron ore in England and Germany are not great, and the prospect of exhaustion of home supplies, especially in the former country, is anything but re-assuring to ironmasters there. Even in the United States, where nature has been lavish of this raw material, more valuable for the upbuilding of a nation than gold, the rate of production is so great and increasing at such a pace, that sooner or later the supply will fail to meet the demand. In 1898 the world raised about 70,000,000 tons of iron ore, of which 22,000,000 tons came from mines in the United States, 16,000,000 tons from Germany, and 14,000,000 tons from Great Britain. The Canadian production was insignificant, but in view of higher prices for ore and iron, of the undoubted abundance of supplies, and of the substantial bonus offered by Provincial and Dominion Governments—if any such additional inducement is now required—there can be little doubt that the near future will see a large increase in the output, both of Canadian iron mines and blast furnaces.

Modern Practice in Gold Mining.*

By JOHN HAYS HAMMOND.

Problems in mining may be classified as those relating to —(1) mining geology; (2) mining engineering; (3) metallurgy; (4) mechanical engineering.

1. Mining geology deals with the determination of the geological character, with especial reference to their genesis and magnitude, of ore deposits and co-relatively their commercial values. This is the most important province of the mining engineer, but, unfortunately, one in which but few are proficient.

2 Mining Engineering.—In this class are the problems relating to the methods of the exploitation of the mine.

3. Metallurgy.—Under this catagory are included the methods of reduction of ores. This branch of mining engineering is rapidly becoming specialised. The importance of the problems presented to the metallurgists is obvious, as they relate to the adoption of appropriate processes upon which depend the highest percentage of extraction of the metals from their ores with the least possible reduction charges.

4. Mechanical Engineering.—In this class are the problems pertaining to the installation of mining machinery.

The problem of deep mining likewise belongs to this class, and the author would point out the salient factors of this problem. The great importance of deep mining—i.e. of obtaining maximum depths—may be gauged by taking the special case of deep-level mining upon the Witwatersrand. As is well known, this formation is unique as regards its reliability, both in respect of the continuity of the ore-bearing formation and of the payable grade of the ore. There are many miles of reef along the Witwatersrand banked formation, but estimate here is confined to the central, which has been more thoroughly explored than the other sections of the Rand. The author has estimated the value of the gold contents per lineal mile, along the direction of the outcrop of the reef, worked down to a vertical depth of 1,000 feet, to be £9,000,000 sterling The central section embraces upwards of ten miles, to which the above estimates apply. These figures are obviousiy sufficient to stimulate the ingenuity of the engineer to increase the limits of deep mining. The factors determining the limit to which deep mining may be carried are—(1) Depths *per se—i.e.*, costs of deep shafts and of haulage; (2) ventilation; (3) drainage.

1. Depths *per se*—From an engnieering point of view mining could be carried on at depths which considerations of an economic nature would preclude. With the existing types of hauling engines, wire cables, etc., there is no difficulty in hauling through vertical shafts from depths of 6,000 feet. An improvement in types of engines and appurtenant machinery, which is undoubtedly within the power of the engineer, would enable this depth to be considerably increased. From the bottom of the vertical shaft an incline shaft, or a second vertical shaft, could be sunk to a vertical depth of, say 4,000 feet, thus giving a total depth of 10,000 feet. Such depths increase greatly the first cost of operations, in that they involve a corresponding increase in the size of the plant required for short sinking, for hauling, mining material, miners and ore, in addition to the cost of the shaft itself. The actual extra cost per ton of ore, etc, hauled would not be excessive, and would not greatly militate against profitable mining, unless the margin between profit and loss had already been a narrow one in the shallow levels

2 Ventilation.—One of the great obstacles to deep mining is the difficulty of securing the requisite efficiency of ventilation. This is due to the increase of heat in the workings as depth is attained. The heat encountered in mine workings may be due to one or a combination of two or more of the following causes:—(1) The increasing secular heat as the interior of the earth is approached; (2) proximity of the mine workings to regions of heated volcanic rocks, solfataras hot springs, etc., (3) chemical decomposition of certain constituents of the ores, or of the enclosing wall rocks, confined to deposits of comparatively rare occurrence; (4) animal heat and heat due to use illuminants and explosives, all of subordinate importance. Geologists estimate as the result of deep boreholes and other tests, that the average increment of temperature due to internal heat of the earth is 1 degree Fahr. for about 60 feet vertical depth. The rate of increase in different localities is by no means uniform, sometimes being as low as 1 degree Fahr. in upwards of 250 feet vertical depth. Indeed, in the same mine, the increment of temperature is not invariable, though generally it is fairly constant in some mines —indeed, remarkably so. The isogeotherms are chiefly affected by the proximity of regions of solfataric action or other volcanic phenomena, and by the conductivity of the rocks in which they lie. If 1 degree in 60 feet be accepted as the average increment of temperature, there will be an increase of 16 degrees per 1,000 feet vertical, equivalent to 80 degrees at a depth of a mile. Assuming the normal surface temperature to be 60 degrees Fahr., this would give a temperature of 140 degrees Fahr., one by no means insuperable, but at the same time not economical. To counteract the effects of this undue temperature, artificial ventilation is requisite. Under very favorable conditions the cost of the necessary artificial ventilation in metal mines, especially where inflammable and noxious gases are of rare occurrence, would not preclude mining to depths of 10,000 feet. Nevertheless, high temperatures, even when not intolerable, entail extra expense, due to the fact that the miners are thereby more or less incapacitated. Under these conditions short shifts are adopted, and not only artificial ventilation, but also the frequent use of iced drinks, cold baths, etc., are necessary.

(3) Drainage.—The is one of the least determinable factors. The water pumped from mines is sometimes almost exclusively limited, even in workings of considerable depths, to the upper levels of the mines. On the contrary, however, there is sometimes a progressive increase in the water as depth is attained. The increase is by no means constant, and generally varies considerably from level to level, depending upon the character of the ground drained by underground developments. Where there is an abnormal influx in depth, the expense of pumping becomes a menace to profitable mining operations, though under normal conditions this increased cost may not prove an insuperable factor.

The extra cost of deep mining as has been indicated, is chiefly due to longer haulage, etc., to increased cost of drainage and of ventilation. In the working costs of shallow mines, or of those of moderate depths, these items are small compared with the total cost, in which are included general expenses, cost of development, stoping, metallurgical treatment, etc. Therefore the additional cost of mining in depth entailed by these factors could be considerably increased before reaching a sum which would make deeper mining unprofitable. The factors, then, which determine the limit of deep mining, and by deep mining depths of 4,000 feet and upwards are referred to are—(1) The discontinuance, or, what is tantamount, the impoverishment of the ore deposit. This, irrespective of other considerations, is the cause of cessation of deep mining operations in the majority of cases; (2) the excessive costs of first plant, of ventilation and drainage under unfavorable conditions. This applies especially to the exploitations of ore deposits, where the margin between profit and loss is close: (3) difficulties of a purely engineering nature.

From the foregoing considerations it will be seen that the difficulties included in this category will not be insuperable until long after the question of deep mining has become one of academic interest alone.

*A paper read before the Engineering Conference.

Mine Accounts.

A METHOD OF COST ACCOUNTING, WITH SPECIAL REFERENCE TO MINES.

*By MR. JOHN E. HARDMAN, S.B., Ma.E., Montreal.

Definition.—In this paper the term "Mine Accounts" will be interpreted in the restricted sense of applying only to those accounts with which the mine manager is directly concerned, and not as applying to or dealing with the books and accounts which it is more particularly the province of the head office to keep.

The ultimate work to be done about a mine is the getting of mineral, to effect which is the object of all the organization both of men and materials. Therefore, any system of cost accounts which may be adopted at the mine should show accurately the various items of expenditure which enter into the cost of the production of one unit, whether that unit is an ounce of gold, a pound of base bullion or matte, or a ton of shipping ore. Furthermore, it should enable the manager to know *what* work is going on, *where* it is going on, what such work is *costing*, whether more or less than yesterday, last week, last month or last year, and whether the work is doing at a profit or at a loss, and should enable him to answer these questions at any time by spending a few moments with the cost books.

Desirability.—While to the average shareholder in a mining company the main point of interest is the dividend earned upon the investment, (which is really the difference between the total cost, and total value of production) nevertheless, to the man who is superintending that production, the different items which enter into that total cost are of the first importance, and it goes without saying, that no mine is too small or too insignificant to keep such books, and few are so small that it is not a direct economy to have an employee whose first duty it is to write up these books daily. In accordance with the limitation of the term as given in the paragraph above, the matters of share registers, dividend and call ledgers, and generally, the accounts kept by the head office, will not be referred to in this paper, and only those books and accounts which it is necessary to keep from the standpoint of costs will be dealt with. The only merit claimed for the method which follows is that the manager of a mine or smelting plant will be enabled by its use to know each day what each and every man on the time sheet has done and is doing, the relative value of the different men, what advance each heading or winning is making and at what cost, and to detect leaks and wastage and take steps to remedy them, to note where additional saving is possible and additioal expense is inevitable and must be provided for in estimates, and in this way to be able to employ the rest of his day in personal supervision of the business of the company to very much better advantage than is otherwise possible.

The paper is offered only as a skeleton, to be expanded or simplified to meet each case, and as a suggestion for the skilled accountants often employed.

Primarily, the accounts at a mine are very simple, being but a form of single entry bookkeeping.

Debit Accounts.—The debit items are few, being in the form of proceeds from drafts, remittances from the head office, and credits from sales of ore or bullion, and in some cases the minor items of rents received, supplies sold and interest earned locally. Money, afterwards to be expended for labor and supplies, is received by concerns not yet on a self-sustaining basis, usually in the form of a remittance from head office direct, or as a credit in the local bank.

Credit Accounts.—The credit items are more numerous and will vary with the size and importance of the mine, but the chief item is always *Labor*, followed by *Supplies* and *Expense*, and these three main headings may be subdivided by the manager to such limits and in such form as the needs of the case or his personal idiosyncracies may suggest.

For the outside business done by a mining company a simple cash account suffices. A daily cash book itemized in a suitable form will enable the cash items to be posted directly to the various accounts in the ledger without the intervention of a journal, which is rarely needed and takes some time to write up. It is not necessary here to describe the forms and manner of keeping this account, as any text-book on bookkeeping will give ample information for the simple work to be done.

For the sake of making this paper more symmetrical, however, I insert the following forms from actual experience: Form 1 illustrates a simple form of cash book, and form 2 shows a voucher which it has been my practice to use

As will be seen, this form is filled out according to the different items in any account or tradesman's bill which is sent in, and the distribution of the various items to the different ledger headings is marked on the back of the folded sheet. It has been found to be as easy to post from these slips as from a journal, and to involve less clerical labor.

From the Cash Account thus kept it is a simple matter to draw up a "Monthly Statement" for transmission to the head office, which will show the condition of the cash at the mine office.

Labor.—The largest and most important item of costs is labor, and the various methods of engaging men and keeping their time is one of the matters to which reference is frequently made in the occasional publications which appear on the subject matter of this paper.

According to the size of the mine and the number of its employees it is customary either to have regular timekeepers or have the time kept by the different foremen or shift bosses employed. The latter method is much to be preferred, inasmuch as the foremen are more constantly with the men (or should be), know them more intimately than the timekeeper, and the time kept by them should, therefore, be more correct.

The value of the labor items in cost accounts depends upon their being correctly charged; no man's labor should be lumped, he has been doing *something*, and that something has cost his wages, which must be charged to the proper account.

Each of you who has had personal experience in handling men knows that there is always a certain number of roustabouts who may to-day be employed on surface work and to-morrow on underground work:—John Smith, for example, may be helping to lay a surface track until 10.30 a.m., when he is suddenly taken off to help to do the same work underground, or to help on the sorting floor, or, if he is a good hammersman or drill runner, to work out the shift of some miner who has been taken ill or has been injured The subdivision of such men's time should be by the hour, and with a capable foreman such man's time can be divided accurately enough to turn in such subdivision to to the office each night or at the end of every shift.

The necessity for such subdivision and for arriving at correct labor costs for many different departments and working places led me in my own practice, about ten years ago, to use what I have called a "Detail Labor Book," one form of which is shown in Form 3. The data from which this book is written up can be obtained in various ways, but I have preferred to obtain it directly from the foremen's timebook by requiring each of the foremen to turn his timebook into the office when he comes off duty, that is at the end of his shift. The clerk's instructions are to enter the time from the foremen's timebook as soon as it is received, so that each foreman may again get his timebook when he goes on duty at the beginning of his next shift. Other good and various ways may be devised by the manager to suit his own convenience and ideas.

*Paper read before the Nelson Meeting of the Canadian Mining Institute, September, 1899.

The form given (Form 3) shows that the left hand column designates the *place* where the man or men were employed, which is also the heading of a particular page in the cost minute book hereafte. referred to. The second column gives the names of the workmen employed. Where many men are employed their respective numbers instead of names may be used to lessen the clerical labor involved. In this column a fraction after the name or number of a man means that that portion of the whole shift was worked by this man in this particular place; search below will show the remaining fraction if the man worked his full shift, and reference to the foremen's timebook will confirm the record of a full or fractional shift. The third column shows the amount of the wages of all the names or numbers on that line, and the fourth column gives the total of the labor or wages for that day in each place worked, and this amount is the amount which is posted directly to the page in the "Cost Minute" book, which is headed by the name of the place worked. This "Cost Minute" book will be explained later. At the end of any day the total at the foot of the fifth column gives the total sum expended for labor during the month to the end of that particular day, the sum total of the preceding days being carried forward in red ink to the top of each succeeding page.

At the end of the pay period, whether weekly, fortnightly or monthly, the total of this column shows the total amount of the pay roll, and should agree exactly with the total of the foremen's timebook. The fractions arising from the subdivision of time must be carried out decimally, or there may be a possible disagreement of a few cents in the money total.

The foremen's books are also copied into one large book in the office, which is the original voucher for the pay sheet; in this large time book the names of the men may be classified according to the department in which they work.

Where a mill, or concentrating works, is an adjunct to the mine, the same method should be used, and in fact in all departments whether surface or underground.

In my personal experience this record of detailed labor has been found most useful and well worth the time required from the accountant.

In regard to the matter of pay rolls or pay sheets, they are perhaps necessary where a company store is kept and where the workmen are supplied with goods furnished them by the company, in which case I need not enlarge upon the form, as it is well known to all of you. It must show the total time of each man with the rate per day, and total amount due said man, together with all the items with which he has been debited such as fines, goods supplied, advances made, rentals due, &c., &c., the total of which, deducted from the total amount due, shows in the final column the net amount required to be paid him in a cash envelope or by cheque. In my own experience I have avoided these pay sheets as being cumbersome and usually presenting a soiled and tattered appearance by the time the last name is signed and they are ready for filing away. As an alternative I submit the form of a due bill, Form 4, which I have used with great satisfaction. This due bill is drawn from a stub book after the manner of a bank cheque, full particulars being entered upon the stub as they are entered upon the due bill. This due bill is given to the employee some hours before the pay is ready, and the employee has a chance to compare it with his own record of his time, and debits and credits, and to see the foreman (or the clerk) if any of such matters are incorrect, for rectification. He signs this due bill upon the back, and at the hour of pay he hands it in through the wicket and receives in return an envelope (Form 4A) containing his cheque or the amount of his wages; upon which envelope is printed, as upon the due bill, his time, total wages, deductions and net wages. From these due bills or from the stubs of the same, the accounts can be rendered just as satisfactorily as from the time sheet, and the only objection that has ever been made to this system is the entanglement which sometimes arises when an employee loses his due bill.

The above method provides a satisfactory system of recording labor costs, embracing the three necessary factors of (1) keeping full time by the time books, (2) aggregating and dividing that time so that correct proportions can be properly charged to the respective accounts by means of the detail labor book, and (3) paying the individual for that labor, by segregating each man's debits and credits on a due bill or pay roll sheet.

Supplies.—Next to Labour in importance comes Supplies, under which heading material of every sort which is used in the operation of the property should be included.

To keep a correct account of the receipt and re-distribution of supplies it is advisable and almost necessary to have a building or general storehouse where everything purchased must be received and receipted for, and from which all deliveries for consumption must be made. Articles in bulk such as pit timber, lumber boards and fuel can not, of course, go into the storehouse, but their receipt and delivery should be noted in the books kept in the storehouse by the storekeeper.

Timbermen and carpenters should turn in an account of material used every 24 hours.

Every supply when it comes in should be debited to a "General Stores" account, and a receipt for it given by the store-keeper, if required; everything going out from the storehouse is credited to "General Stores" account, and charged against the particular account or cost heading by which it is used, or requisitioned. Nothing of any kind is too small to permit it to be taken from the storehouse without charging it against some particular account.

In the best practice nothing can be obtained from the store-keeper without a requisition (Form 5); these requisition forms are supplied from the office in the convenient form of a pad to the different foremen or heads of departments. The store-keeper keeps these requisitions when presented and turns them into the office daily, having previously entered upon his "Stores Delivery Book" the name and amount of the supply issued and the account to which it is charged.

The store-keeper may keep a "Stores Received" and "Stores Delivered" book, or he may make a daily report, on slips, to the office. In the latter case the account of stores received and delivered is kept in the mine office, and is perhaps to be preferred.

It is not necessary that the store-keeper should know the price at which supplies are bought or charged, his duty is concerned only with amounts received and again delivered, but a general stores book should be kept in the office, in which should be entered not only the *invoice* cost price of all goods received, but also all freight and transportation charges upon them, together with the amounts paid for handling and distribution of the same, and also the *pro rata* cost of the store-keepers wages, &c. The total of these items determines the actual cost price of each article, which is the figure at which each article should be charged against the various accounts in the cost minute book. There should be no additions for profit, as the results would be misleading. Contractors may be charged an increased price for their supplies if the manager choses, but such an increase does not in the long run lead to any benefit or cheaper results. Company stores kept for supplying the workman with food, clothing, etc., are of course entirely separate from these supply accounts.

It is usually necessary to keep the storehouse open only at specified times during the day, say from 6 to 8 a.m., 12 to 2, and 6 to 7 p.m.

To prevent waste or petty pilferings it is advisable to take periodical stock takings, and to facilitate this the following form of a general ticket to be kept on the bin or rack in the store-room, or on

file in the store-room office is often used (Form 6). This ticket must be checked or audited every week by the clerk in the office from the stores account book. It is unnecessary to say that these stores should embrace every kind of article or material used about the works.

Expense.—The third factor in costs I have called "Expense," and under this heading may be aggregated a lot of petty items which are usually charged to a "General Expense" account, but which have a certain, though varying, ratio to the output or amount of work done.

Expense includes—Postage, telegrams and cables, subsistence and transportation of Manager (or one of the staff) when on company business, stationery, umpire assays, advertising, express and mint charges on bullion, insurance, taxes and legal expense at the mine, &c., &c.

These items are often considered to be head office matters, but to take, for an example, the case of a disputed value of an ore shipment, the cost of letters, telegrams, umpire assays and (possibly) travelling expenses of the assayer, should be charged against that particular shipment or lot of ore. Likewise expense incurred in hurrying a delayed hoist or compressor should be charged against that particular machine. I am not going to urge this point, as the whole object of this paper is to suggest, provoke discussion, and arouse interest in a subject which is altogether too much neglected by Canadian mines and managers. But those of you who will attempt this subdivision of an account usually lumped, will, I am sure, never abandon it.

Having obtained, by the methods above indicated, an accurate account of what labor has been employed, what amount of supplies has been used, and what expense has been incurred, in any one day, and where it has been so employed, used, or incurred, it is a comparatively simple matter to collect the various items under such accounts or headings as will give you the cost desired.

For this purpose I have made use of two books, one of which has been referred to above as the "Cost Minute" book, the other is a cost ledger.

Cost Minute Book.—The Cost Minute book (as its name implies) is simply a book in which is entered daily, minutes of all the work done that day; the labor items coming from the detail labor book, the supply items from the requisitions sent to the store-keeper and by him returned to the office, the expense items from the regular office books.

This book may be arranged as the taste of the accountant wishes; I give as a sample, some pages from the actual working of a company operating a free milling gold mine.

It will be noticed that each day of the month has a separate line. The first column on the left contains the date, and there follow numerous columns headed by the names of the different supplies used in the place or department indicated by the heading entered at the top of the page.

In mine work there is a column each for "Dynamite," "Fuse" and "Caps," "Electric Fuses," "Sharps," "Drill Parts," "Short Steel," "Shovels," "Pick Handles," "Hammer Handles," "Candles," &c., &c.

In surface accounts, such as Power or the Engine Room, these columns are headed with the names of the supplies used, such as "Cylinder Oil," "Black Oil," "Cotton Waste," "Tallow," "Hemp Packing," "Rubber Packing," &c., &c.

After these columns for supplies there will be noticed the one headed "Labor" which is ruled as for dollars and cents, and it is to this column that the amount obtained by classification in the detail labor book is posted

In mining work, as in sinking or driving, there are two more columns following the labor column in which are noted the total number of tons hoisted that day from that particular heading. The first column is headed "Waste" and includes all rock which is not sent to the mill or ore bins for further treatment; the second column is headed "Ore" and requires no explanation I have sometimes added another column to represent the amount of waste or seconds picked from ore when it has been necessary to resort to hand picking.

The figures of these respective columns are obtained from tally boards kept by the lander at the mouth of the shaft, and checked by duplicate tally boards kept at the various station plats underground by the trammers, or by tally boards, near or at the working faces, or mill passes of the various stopes. The figures from the surface and underground tally boards must correspond. The underground tally is taken off and brought to surface by the head trammer or by the foreman at the end of each shift. The surface tally board is noted by the lander or by any office employee designated for that purpose.

It will readily be seen that from this book, in the space of a few minutes, can be ascertained the amount of any one supply or article which has been issued for any number of days in the month, the total amount of labor which has been expended in any one heading for those days, and also what has been the production in tons, of both waste and ore, for such period.

At the foot of each column there is put in, in red ink, the actual cost price of each of the supplies used as obtained from the general stores book; and at the end of the month the amounts and prices are multiplied to give the cost in dollars and cents, which is put in the space reserved for it. The total of these amounts is the total cost of supplies for this particular account or heading for the month; the total of the labor column is the total labor cost of that account; the addition of whatever expense account is chargeable gives you the total cost of your piece of work, which can be reduced to cost per unit (foot, fathom or ton) by simple division by the number of feet driven or tons broken.

To make this cost *actual* and *accurate* there remains a sum to be added for management, and for power (if air drills are used). There is also the cost of pumping and hoisting to be divided *pro rata*, though these accounts should also be kept by themselves.

It is on these points that there is the largest room for personal equation and for differences of opinion, and also where the various publications on the subject maintain a discreet silence.

As I have said before, this paper is merely a suggestion, hence I feel free to describe how I have attempted these difficulties in my own practice.

In the first place the wages of the shift bosses or foremen underground are apportioned to the respective places of work in proportion to the number of men at work in each heading or stope: *e. g.* if there are 22 men in No. 6 Stope, 18 in No. 7, 12 in No. 9; 4 men in No. 4 level West, 4 in No. 4 level East, 4 in No. 5 West, 4 in No. 5 East, 6 in Winze K, and 9 in the main shaft, there are 83 men in the various workings, if the foreman's wages equal $225.00 per month, there will be 22.83 of $225.00 to charge to No. 6 Stope, 18.83 to No. 7, 12.83 to No. 9 and so on.

The same plan is followed as regards management expenses, the sum total of the salaries paid the manager, accountant, assayer, and all the office staff is divided *pro rata*, according to the number of accounts amongst which they can be properly charged, and this sum is added to the cost of labor, supplies and expenses.

Another plan is (1) to determine the total number of hours (or shifts) worked on the property according to the detailed labor book, and (2) to determine total salaries paid, from the manager to the foreman or shift boss; and then to divide (2) by (1) giving a factor or constant per shift (or per hour) which is multiplied by the hours (or shifts) worked in each account, both surface and underground. The sum attained by this multiplication approximates very closely the cost of superintendance for each particular account.

It is not denied that this is an arbitrary method and that the management may have spent much more time upon one department

than upon another, but it is as good a subdivision as any other and is independent of any personal equation; and as the item is, or always should be, an exceedingly small one, it does not effect materially the accuracy of the ultimate cost.

In the case of air drills and the amount to be charged for them, I have been in the habit of keeping a "Power" account; to this account is charged all fuel, water, oil and other supplies used, and all repairs to boilers or machinery plant, and all labor of firemen and engine-drivers (excepting in certain cases the man at the hoisting engine and mill engine). The total of the Power account is then subdivided into "Hoisting," "Pumping," "Compressed Air," "Lighting," and other accounts where power is used such as "Repair Shop," "Sampling Mill, &c., &c. This subdivision should be in the ratio of the power used by the different accounts, and to get at this approximately it is well to have each engine indicated properly, and to use recording gauges, revolution counters and such other devices as will make the measurement of the power more accurate.

For large engines running continuously, like mill engines, revolution counters are not necessary, but for large air compressors operating under variable loads I have found a counter of the greatest service in making up the power consumed by the machine. In the case of hoisting engines the number of buckets, skips, or cages hoisted furnishes the necessary factor for determining a proportion. For pumps or pumping engines a card near by, upon which is noted time of starting and stopping, and the number of strokes made, gives the required information.

The data from these revolution counters, cards, etc., is of course sent daily to the office.

In this subdivision of the Power Account much will depend upon aggregation of the plant in one spot, or upon having it scattered over the property; whether all the boilers are in one house and make steam for the whole plant, or whether there are separate boiler plants for the hoist, the mill and the air compressor; the method of keeping this account and its subdivisions must, therefore, be arrived at by the manager himself. If this account is accurately kept it is a source of great gratification (and of many surprises) to the manager to know just what it is costing him for power to pump the mine water, to hoist a ton of rock or to mill a ton of quartz, and in my own experience has made economies (previously unsuspected) possible and profitable.

I have been particularly struck in one or two cases which have come under my notice recently in British Columbia, with the laxity with which blacksmith shop accounts are kept. I give herewith a page from a company keeping a smithy account in a very good fashion.

All fuel sent to the shop is weighed and charged to it; all iron, steel and other material is requisitioned for to the storehouse; after shaping and working it is credited to the shop when sent out and debited to the account for which it is used. In addition to this, the smith is obliged to keep tally of every pick that is sharpened, of every hand drill sharpened, or every air drill sharpened, and the nippers or steel men are obliged to keep tally of all the sharpened steel and picks delivered into the mine. Wherever possible the steel is rounded up and weighed, once a month in the east usually, but in some western mines it is frequently impossible to do this more than once or twice a year. From the total cost of the blacksmith shop for labor and supplies, is determined the actual cost of each pick sharpened or steeled, for each hand drill sharpened, and so on; furthermore, a special account is kept in the smithy of the time and material used in repairs to old work, and material for new work. In this way a smithy account is not entered directly into the cost sheet, but is closed by being charged in the right proportions to the different cost headings underground and on the surface. I may say here that in my own practice I have found the blacksmith shop one of the first places in which a saving can be effected.

The surface accounts are simple; in case the ore is trammed from the mouth of the shaft or tunnel to ore bins or direct to the mill, such tramming charge is figured on the basis of total number of tons trammed. In the case of a free milling proposition, this tramming charge is considered as part of the milling expense, and not as part of the mining cost; in the case of shipping ore it may be reckoned as part of the mining cost. Similarly, all men on the surface employed in keeping the yard straight or in good shape are charged under any convenient heading that the manager may desire, say, "surface work," and the final closing in of this account depends to a great extent upon what these men have been doing during the period involved.

A carpenter shop account in large mines is as necessary as the blacksmith shop account, and should be closed in a similar fashion—that is, directly to the various cost headings in the mine or underground, for which the work may have been done; or, directly to the buildings on the surface, at which supplies and labor may have been used.

Cost Ledger.—At the end of each month the various pages or accounts in the Cost Minute book are closed as indicated above on page , the cost per unit being noted in red ink on the page. These accounts are then closed or posted into the Cost Ledger, which is simply an ordinary ledger, in which the items on the debit side of each account are the totals for labor, supplies, expense and superintendence as obtained from the minute book, and the credit items are the number of feet sunk, raised, driven, etc., and the number of tons won.

In my own practice I have endeavored to have the credit side also show, in dollars and cents, the value of the ore won and credited to the account, a matter which is comparatively simple in the case of shipping ore, if correct sampling and assaying is done, and in the case of milling ore, equally simple, if a sufficient provision of ore bins has been made to enable lots from different headings to be kept separate.

From this ledger it is easy at any time to make out a very complete and satisfactory cost sheet for any number of weeks, months or years.

From the books in which are kept the account of stores received and delivered, one can check the "stock-takings" which should be made periodically

As regards cost books for smelting or milling accounts, they should be arranged on identical principles, the labor, supply and expense items being classified to the different accounts, and power being subdivided as necessary.

The furnace or mill is debited with all ore received, and credited with bullion produced. The assay value of the slag or tailings must be taken account of, if they are saved (or banked) for further treatment, as must of course all concentrates, speiss or other intermediate products which are not thrown over the dump.

In the case of a mine having its own furnace or mill, care must be taken that the unit used in the mine is the same as that in the reduction works, a ton of 2,000 lbs. in one place must be of the same number of pounds in all other places.

Checking with Home Office Accounts.—While this system of accounts is one which is most desirable for the manager of a mine, it is not usually intelligent to the shareholder, nor, I might say, to the Directors, and therefore, to obviate the trouble and expense of keeping two sets of books it is desirable to be able to close these various cost accounts into the accounts usually kept by the home office: the average manager will find little difficulty in doing this. In this connection I desire to bring to your notice the admirable analysis of costs to be found in the reports of some of the South African mining companies, notably, the Crown Reef, Henry Nourse, Simmer & Jack, and

Robinsón Companies, whose annual reports will be found well worth perusal by those of you to whom the subject of this paper may especially appeal.

The main divisions into which the head office accounts are divided are *Expenditure* and *Revenue*, of which we need only concern ourselves with the former.

At the outset, we are met with the question of "Capital" account, which usually occupies (especially with English companies) a very prominent position on the balance sheet; this, however, is not in the province of the manager, but of head office, and nothing need be said about it further than that the capital of a mine decreases each day that it is worked, since each day it contains less and less of the mineral for which it is wrought, and hence, each day its actual value is diminished.

All expenditure properly comes under one of the following headings, viz: Construction, Maintenance, and Operation; in some of the Lake Superior mines, construction is charged to operating expense, and the Alaska Treadwell Company (whose accounts are models) charge both construction and maintenance directly to operating, *i.e.*, all expenses are charged directly against the unit of one ton produced, which is unquestionably the soundest way. The number of expense accounts to be kept is a matter that must vary with the character of the mine, and the requirements of the directors.

In the case of milling ores, the South African companies referred to, have the following classification.

MINE COSTS.

(1) Stoping,
(2) Tramming,
(3) Hoisting,
(4) Pumping,
(5) Development,
(6) Timbering,
(7) Tracklaying.

SURFACE COSTS.

(1) Tramming,
(2) Crushing,
(3) Sorting.

MILL COSTS.

(1) Milling,
(2) Power,
(3) Concentration,
(4) Cyaniding,

with general charges, amongst which are put stationery, rents, hospital fees, directors' and audit fees, sundry expenditures, additions to plant, machinery and buildings, and road or surface improvements.

For general use I would suggest the following list, which can be added to or modified according to wants and conditions:

(1.) *Prospecting or Exploration*—which should include all expense incurred in surface prospecting, exploration by means of diamond drills, or men sent out to test new or undeveloped claims.

(2.) *Construction.*—This account covers the first cost of all roads, tramways, buildings, foundations, machinery, ditches, pipe-lines, &c., &c., necessary to put the property on a producing basis. Each road, building or machine should have its own account, to be closed in to construction account at proper intervals. In building itemize grading, dry wall, mortar wall, lumber, plank, boards, hardware, glass, paint, etc.; and in Plant, the excavation, concrete or rock foundation, invoice cost of machine, freight and duty on same, with all attachments of piping, belting, etc., etc. The labor and supplies used in construction are obtained as previously indicated.

When the work is finished and closed into construction its connection with this account ceases, all repairs or renewals should be directly charged against operation. In many cases it is possible to charge off a certain amount each month, for example, in the case of a wire rope which previous experience has shown you will only hoist a certain number of tons before renewal, an amount corresponding to the number of tons hoisted can be charged off each month.

(3.) *Development.*—This account covers the cost of all shafts, winzes, levels, cross-cuts and raises, and is easily made up from the cost ledger.

(4.) *Output*—Into this account is closed all stope accounts.

(5) Pumping.

(6.) Hoisting.

(7.) Tramming. These accounts are easily gotten from the cost ledger.

(8.) Timbering is an account which need not be kept separate unless the width of ore body, softness of walls and other conditions make the account a large and important one In ordinary mines the timbering necessary is charged directly to the stope account, or, (in development) to the shaft, level or heading requiring it; its cost price is the first cost, plus the cutting and preparation, plus the labor of putting it in place, etc., etc.

(9.) Transport may be a separate account under the head of Surface Expense as will also be—

(10.) Sorting, and

(11.) Crushing, in the case of mines selling their product or sending it to public sampling works. The labor involved in making stock piles of ore, for which a higher than a market price is sought, may be charged to separate account or included in 9. Transport should also include whatever labor is expended in loading ore wagons or cars.

(12.) Milling, in the case of gold ores or concentrating propositions, is but a copy of the cost account.

If, as is customary with English companies, there is a Salaries, or office account, it presents no difficulty.

There remain two other points to which I desire to call attention before closing, the first of these is what I might call "Management Cost per Ton" in which all salaries paid both at the Mine office and at Home office, including directors, auditors, and consulting engineer's fees and percentages, are divided by the unit of product. Such a cost item is most instructive to shareholders, but rarely desired by boards of directors.

The other point is a "Shift" record, in which one arrives at the production per single shift, or per man at work. The production of any one day, week or month is divided by the total number of single shifts in that period, including in this shift all the office staff and non-productive labor as well as the productive.

Finally let me draw your attention to a subject which is perhaps not germain to this paper, but which involves a cardinal point in the subject of Costs, and that is the ratio between Producers and Consumers, as I have been in the habit of designating them for many years.

Classify as Producers only that labor which is *directly* producing material from which revenue or income is derived, such as the men stoping or developing; classify as Consumers all others who simply handle the valuable material produced without increasing its amount, such as nippers, trammers, and all surface men. The smaller the proportion of consumers the more profitable the mine, the larger this proportion gets the less the profit becomes.

Machine Mining at Lethbridge, N.W.T.

By W. D. L. Hardie.*

The Galt coal-field is situated in Alberta, Canada, about 800 miles west of Winnipeg, 110 miles west of Dunmore on the Canadian Pacific Railway, and 66 miles north of the international boundary-line (49 degrees north latitude) between the Dominion of Canada and the United States of America. It is reached by a branch line of the

*Paper read before the Mining Institute of Scotland.

Canadian Pacific Railway, which runs from Dunmore to Lethbridge and is now being extended into British Columbia *via* Crow's Nest Pass. There is also a narrow-gauge railroad, 200 miles long, from Great Falls in Montana to Lethbridge in Canada.

The colliery of Lethbridge, as well as the town of Lethbridge with a population of about 2,000, are situated in the south-eastern corner of the Galt coal-field. The extent of this coal-field is not yet well defined, but it is known to be of immense area and belongs to Cretaceous or later times; and with many breaks stretches from Coahuila in the republic of Mexico to Athabasca in Canada.

The coal is a high-grade lignite, and by some engineers is classed as semi-bituminous. It is a free-burning coal and, all its qualities considered, is the best coal yet found in the North-West Territories for domestic and steam uses. It does not coke.

The Galt coal-field has a general northerly dip, but is so broken by faults running in all directions, with a throw of from 1 to 9 feet, that the general dip has but little bearing on the mining operations, further than the cost of cutting these faults.

When the Lethbridge colliery was opened, several years ago, the coal was got through the drifts opened near the bed of the Belly River (which lies about 300 feet below the prairie), and raised to the prairie-level over an incline plane 2,500 feet long. Some years ago, the drifts in the out-crop above high-water mark were worked out and recourse to sinking was the result. Four shafts were sunk on the prairie:—No. 1 shaft is worked out; No. 2 shaft was sunk on a very inferior piece of the coal-field; and Nos. 3 and 4 shafts were sunk into the very best body of the coal, in the neighbourhood of Lethbridge. No. 3 shaft is now producing most of the coal sold by the Alberta Railway and Coal Company. About 800 tons of lump coal is raised per day, and from 150 to 200 tons of fine coal, which is passed over different screens making nut coal, pea-coal, and slack. The amount of fine coals from machine-running is about 10 per cent. less than from pick-mining.

The seam at No. 3 shaft lies 350 feet below the prairie, and has an average thickness of 52 inches of good coal. However, the section detailed in the Appendix shows that the thickness varies. The roof is a friable shale from 20 to 60 feet thick, and the strata above it are gravel, blue clay, yellow, clay, and surface loam, in the order mentioned. The bottom is an impure fire-clay, and where there is any water on it very large pillars of coal have to be left, to prevent squeezing on haulage-ways. The face and butt-cleats of the coal are well defined, and extend into the shale above, on the same parallels. The butt-entries run east and west, and face-entries run north and south. The main-face cleats are about 9 inches apart. Coal is worked on the face in rooms 20 feet wide, and mined 4 to 4½ feet deep, it makes very large lumps. The texture of the coal is fairly strong, but it disintegrates when exposed long to atmospheric influences.

About 2 years ago, the management decided to change from pick-mining to machine-mining. After some investigation as to the most suitable machine for this seam, a plant of Sergeant coal-cutting machines was purchased. The writer has had 15 years' experience with Legg, Harrison and Sergeant coal-cutting machines, and consequently knew precisely where to get the best machine-men to start work, and how to put the plant into condition for production of coal In less than 6 months pick-mining was suspended altogether without reducing the output. The mechanism of the Sergeant machine has been described in several papers published in Great Britain.

As a direct means of comparison, the tonnage from entry-driving by pick-mining was carefully observed for a period of 6 months, which showed that the average production was 2 tons per running yard. Taking this tonnage, and using the prices paid for pick-work, we obtain the following figures of the cost per ton for driving entries by pick-work:—

2 tons at 2s. 9·15d. per ton		5s. 6·31d.*
1 yard at 7s. 7·55d.	"	7s. 7·55d.
		13s. 1·86d.

And 2 tons at 13s. 1 86d. equals 6. 6·93d. per top of lump coal

A careful record of the amount of lump coal taken from 1,000 feet of entry driven by machines showed that 3 tons per running yard were produced. No yardage is paid for machine-work. The dead work is all included in the tonnage price. The cost is therefore:—

3 tons at 1s. 2·84d. per ton paid to machine-men and helpers.		3s. 8·52d.
3 tons at 2s. 10·64d.	" " loaders and shooters	8s. 7·92d.
		12s. 4·44d.

And 3 tons at 12s 4.44d., equals 4s. 1·48d. per ton of lump coal. In the above estimate, only entry-work is compared, to show what the result would be if machines were used for entry-driving alone.

In pick-work, there were four classes of narrow work, namely, entry-driving, cross-cut driving, room-neck driving, and room-turning. In machine-work, there are three classes of narrow work, namely, entry-driving, room neck driving, and room-turning. For the purpose of comparing the cost per ton of general development, a plan has been made showing the mode of working before the machines were introduced (Fig. 1, Plate II.), and another plan (Fig. 2, Plate II.) has been made showing the mode of working after their introduction. In both cases, a length of 1,320 feet by a width equal to the amount of ground developed by four parallel entries has been selected.

PICK-WORK.—OLD SYSTEM (FIG. 1, PLATE II.).

Class of work.	Feet.	No.	Feet.	Yards.	Tons.	Tons.		Cost. s.	d.	£	s.	d.
Entries	1,320	× 4	=5,280	=1,760	× 2	=3,520	at	2	9·15	=486	4	0
				1,760			at	7	7·55	=671	7	4
Entry cross-cuts	35	× 44	=1,540	=513⅓	× 1	=513	at	2	9·15	=70	17	2
				513⅓			at	5	1·86	=132	4	6
Room-necks ...	30	× 176	=520	=1,760	× 2	=3,520	at	3	1·11	=544	5	7
				1,760			at	5	1·86	=453	12	9
Room-turnings.	..	176	..	..		..	at	24	8·92	=217	14	10
				4,033⅓		7,553				2,576	6	2

And 7,553 tons at £2,576 6s. 2d., equals 6s. 9·6d. per ton of lump coal.

MACHINE-WORK.—OLD SYSTEM (FIG. 1, PLATE II.).

Class of work.	Feet.	No.	Feet.	Yards.	Tons.	Tons.		Cost. s.	d.	£	s.	d.
Entries	1,320		4=5,280	=1,760	× 3	=5,280	at	4	1·48	=1,088	11	2
Entry cross-cuts	35	× 44	=1,540	=513	× 2·7	=1,385	at	4	1·48	=285	10	9
Rooms-necks ..	30	× 176	=5,280	=1,760	× 2 7	=4,752	at	4	1·48	=979	14	0
Room-turnings.	..	176	....	....		....	at	16	5·94	=146	3	4
				4,033		11,417				2,498	19	3

The above system had always given trouble, inasmuch as it did not give the requisite size in entry-stumps to maintain the haulage-ways in good condition, and it was abandoned for the system shown in Fig. 2 (Plate II.).

MACHINE-WORK.—NEW SYSTEM (FIG. 2, PLATE II.).

Class of work.	Feet.	No.	Feet.	Yards.	Tons.	Tons.		Cost. s.	d.	£	s.	d.
Entries	1,320	× 4	=5,280	=1,760	× 3	=5,280	at	4	1·48	=1,088	11	2
Entry cross-cuts	50	× 20	=1,000	=333⅓	× 2·7	=900	at	4	1·48	=185	11	0
Crosscut necks.	15	× 80	=1,200	=400	× 2·7	=1,080	at	4	1·48	=222	13	2
Room-necks ...	15	× 84	=1,260	=420	× 2·7	=1,134	at	4	1·48	=233	15	10
Room-turnings.	..	124..		(regular)								
Room-turnings	..	76..		(splitting pillars)			at	16	5·95	=164	19	2
				2,913⅓		8,394				1,895	10	4

And 8,394 tons at £1,895 10s. 4d., equals 4s 6·19d. per ton of lump coal. But the old system develops an area the width of which is 1,080 feet, against a width of 982 feet in the new system; therefore 1,080 feet: 982 feet = 4s. 6·19d. : 4s. 11·88d. per ton of lump coal.

*The prices in dollars and cents have been transposed into British money at 4·85 dollars to the pound sterling.

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PICK-WORK.—NEW SYSTEM FIG. 2, PLATE II.).

Class of work.	Feet.	No.	Feet.	Yards.	Tons.	Tons.		Cost. £	s.	d.
Entries.....	1,320 ×	4 =	5,280 =	1,760 × 2	=	3,520 at	2 9·15 =	486	4	0
				1,760		at	7 7·55 =	671	7	4
Entry cross-cuts	50 ×	20 =	1,000 =	333 × 1	=	333 at	2 9·15 =	45	19	11
				333		at	5 1·86 =	85	16	7
Crosscut necks.	15 ×	80 =	1,200 =	400 × 2	=	800 at	3 1·11 =	123	14	0
				400		at	5 1·86 =	103	2	0
Room-necks...	15 ×	84 =	1,260 =	420 × 2	=	840 at	3 1·11 =	129	17	9
				420		at	5 1·86 =	108	5	6
Room-turnings.	..	200	....	...		... at	24 8·92 =	247	8	8
				2,913		5,493		2,001	15	9

And 5,493 tons at £2,001 15s. 9d., equals 7s. 3·46d. per ton of lump coal.

Machine-work as shown in Fig 1 (Plate II.) has not been put into practice, nor has pick-work in Fig. 2 ever been put into practice; and the actual comparison is really between pick-work as shown in Fig. 1 and machine-work as shown in Fig. 2 (Plate II).

It is worth while to notice that very little mining (holing) was done in the narrow work driven by pick-work. The coal was smashed out of the solid by powder, hence the very small tonnage of lump coal per yard of entry-work. The machines hole in the fire-clay under the coal to a depth of 4½ feet, and two rib-shots bring the whole down in very large lumps.

Up to this point, it must be borne in mind that we have only been comparing narrow work. A comparison of wide work will now be given.

PICK-WORK (WIDE PLACES).

A careful record kept over a long period shows that a cut 15 feet by 4 feet gave a little less than 8 tons of lump coal. We will here assume 8 tons:

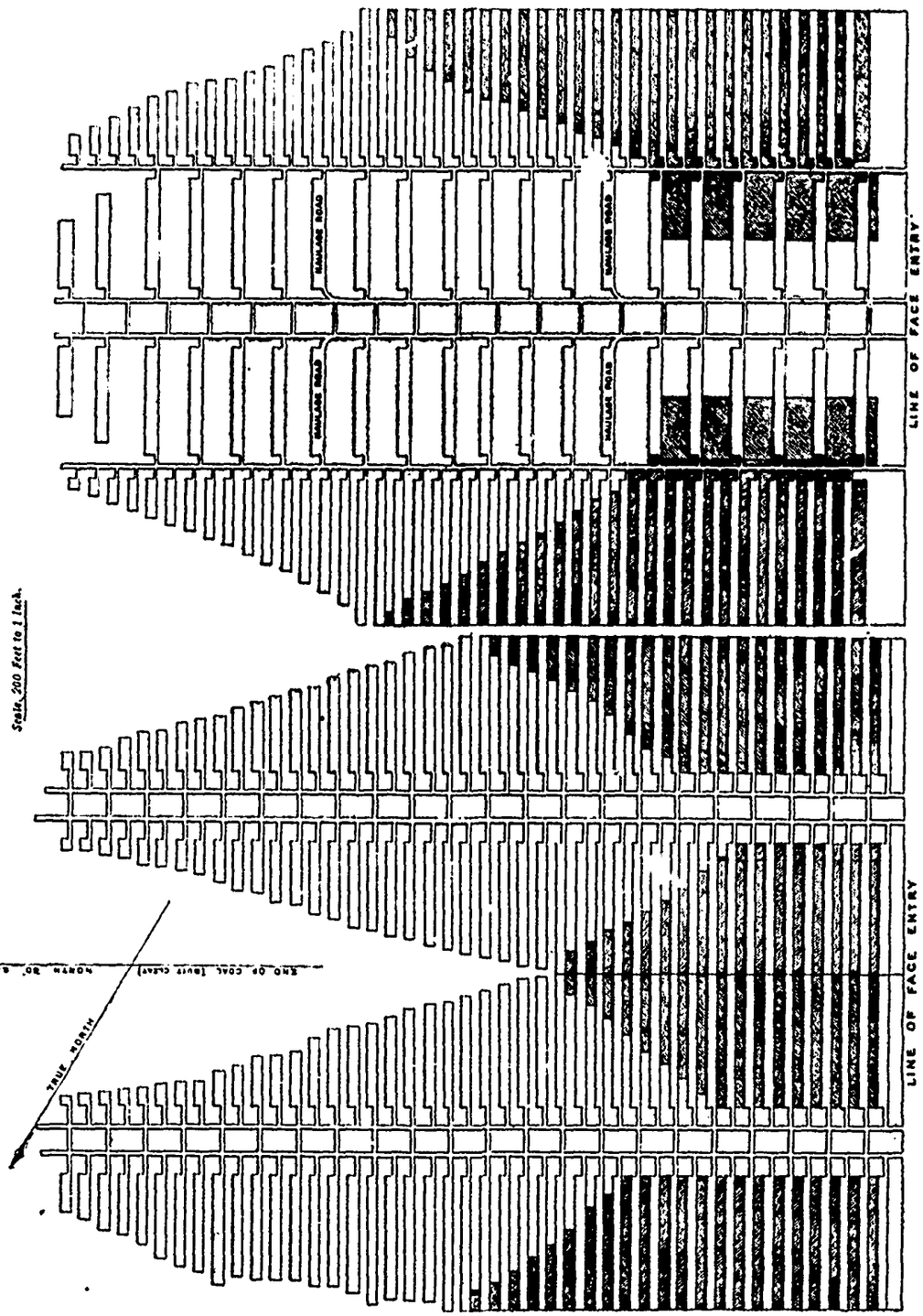

FIG. 1.- OLD SYSTEM.
FIG. 2.-NEW SYSTEM.

Plate illustrating Mr. Hardie's Paper on "Machine Mining at Lethbridge, N.W.T."

8 tons at 3s. 1·11d. paid to miners	£1	4s.	8·8d.
1⅓ yards at 1s. 8·78d. paid to miners	0	2s.	3·7d.
	£1	7s.	0·5d.

And 8 tons at £1 7s. 0·5d., equals 3s. 4·6d. per ton of lump coal.

MACHINE-WORK (WIDE PLACES).

As before, assume that a cut 15 feet by 4 feet gives 8 tons of lump coal :—

8 tons at 0s. 9·9d. paid machine-men and helpers	£0	7s.	7·1d.
8 tons at 1s. 7·8d. paid coal loaders and shooters	1	3s.	2·4d.
	19s.	9·6d.	

And 8 tons at 19s. 9·6d., equals 2s. 5·69d. per ton of lump coal.

Although pick-work turns out about the same amount of coal as machine-work in wide places, that is, places over 8 feet wide, pick-work coal does not look so well on railroad cars as machine-coal, and the lumps from pick-work are smaller. If a 1¼ inches mesh were used in the screens instead of a ⅝ inch mesh, the percentage of lump coal from pick-work would fall short of that due to machine-work.

In the Appendix, it will be noticed that there is a band of fire-clay between the upper and lower bench of the coal-seam, and this sometimes turns into bone-coal. Where the clay-band was present, the miners holed in it, but when absent the coal was blasted out of the solid. The machines mine under the coal, in the bone-coal and fire-clay, in rooms as well as in entries.

Costs.—The following statement shows the amount invested in the plant which is capable of mining 720 tons of lump coal per day. The average capacity of a machine is about 30 tons in a working day of 9 hours. The machines are worked double-turn, and as some machines will always be off for repair or other causes the work of 24 machines may be reckoned upon.

	£	s.	d.
1 Air-compressor, Norwalk compound, cylinders 20 inches in diameter by 24 inches stroke	721	14	0
1 Air-compressor, Ingersoll-Sergeant, cylinders 24 inches in diameter by 30 inches stroke	1,009	16	0
2 Tubular boilers, each of 100 horse-power	404	19	7
5 Air-receivers, of different sizes	112	3	5
14 Sergeant mining machines	933	17	7
Foundation for air-compressors	206	4	0
6,000 feet of 5 inches pipe	395	18	1
10,000 feet of 2½ inches pipe	371	3	2
30,000 feet of 1¼ inches pipe	510	6	10
150 Key-valves	54	0	5
General pipe fittings	206	4	0
15 lengths of machine-hose	123	14	5
Labour connected with plant, material for erecting boiler-walls, houses, etc.	1,134	2	0
	6,244	4	3

In addition to the value of the plant, there is an operating expense in excess of the operating cost by pick-work: it is estimated as follows:—

	Per Month. £	s.	d.
Repair of machines	14	8	2
3 firemen	38	7	2
1 blacksmith	15	9	3
1 machinist	15	9	3
1 pipe-man and boy	18	11	2
1 pick-boy	4	2	6
400 feet of 5 inches pipe	26	7	10
1,000 feet of 2½ inches pipe	37	2	4
25 new machine-picks	10	6	2
Extra pipe-laying	10	6	2
Interest on £6,244 4s. 3d. at 10 per cent.	62	8	10
Depreciation on £6,244 4s. 3d. at 8⅓ per cent	52	0	9
Pea-coal	39	8	3
Total working expenses	344	7	10

Everything considered, it is not safe to reckon on more than 24 working-days in each calendar month which would be equal to 17,280 tons per month, therefore 17,280 tons at £344 7s. 10d., equals 4·78d. per ton of lump coal

Narrow-work coal will represent about ⅛ of the total output, therefore:—

	£	s.	d.
863 tons, ⅛ of 17,280 tons of entry coal, at 4s. 11·88d.	215	11	4
16,416 tons of room coal at 2s. 5·69d.	2,030	15	11
17,280	2,246	7	3

And 17,280 tons at £2,246 7s. 3 d. equals 2s. 7·2d. per ton, and if the working expenses be added of 4 78d. per ton, the cost of lump coal from machines is 2s. 11 98d. per ton.

Taking the same proportions of tonnage for pick-work we have

	£	s.	d.
863 tons of entry coal at 6s. 9·6d.	293	15	3
16,416 tons of room coal at 3s. 4·6d.	2,777	0	9
17,280	3,070	16	0

And 17,280 tons at £3,070 16s. equals 3s. 6·6d. per ton of lump coal by pick-work.

The saving is (3s. 6·6d. — 2s. 11·98d. =) 6·62d. per ton of lump coal, in favour of machines.

In many instances in America, the elasticity of the system is a greater consideration than the saving per ton over pick-work. When trade fluctuates, with pick-work the facilities underground must always be equal to the largest possible demand, which often entails expense that is a drag in slack seasons. The machine system is very elastic.

The average earnings of all men connected directly with coal-getting are considerably greater in machine-mining than in pick-mining. During the 15 years that the writer has been connected with machine-mining he has never known of one instance where a miner who had become a good machine-runner vountarily went back to pick-work. There are two good reasons for this, namely, the work is not so arduous, and wages are higher. It must be borne in mind that machine-running is considered skilled labour, and the wages are always higher for this class of work than for coal-loading, shooting, etc.

Although machine-running is classed as skilled labour it is scarcely entitled to this classification because the knack of running a machine can be acquired by any intelligent miner within 6 months, that is, a man may begin as a scraper (machine-runner's helper), and by only taking turns at running may become proficient in 6 months.

Of the 30 available machine-men, only 8 of them ever operated machines before coming here. The weight of the man does not count for much, and many a man weighing less than 150 pounds do as good work and as much of it as men weighing 225 pounds. We hear a good deal about machines shaking runners to pieces, but there is no foundation for such statements. When a man becomes proficient, a light loose grip of the machine and a small pressure on the foot-block enable the runner to handle the machine at will, where the cutting is not exceedingly hard.

There is one factor that enters largely into the question of the introduction of machines and that is "labour." Any man can shovel coal: consequently, to get tonnage, only skilled runners and a few experienced men to do the shooting, propping, etc., are required, while the bulk of the work can be done by unskilled labour. Many men in America make a living in coal-mines, who never dreamt of entering one until they were middle-aged.

Air-compressors.—It is a common practice in America to multiply the area of air piston by the distance it travels per minute, and state the result as the free-air capacity of the air-compressor. The free-air capacity of the compressor divided by the number of atmospheres will give the amount of air after compression, and this amount must be reduced by allowances for altitude above sea-level, dead-space, piston valve leakages, etc.

An air-compressing cylinder, 24 inches in diameter by 30 inches stroke, at 80 revolutions per minute, will inhale 1,256 cubic feet of free air per minute, from which 9 per cent. should be allowed for altitude, as the machine is about 3,000 feet above sea-level and 15 per cent. for dead-space, valve-leakage, etc., leaving 972 cubic feet as the free-air capacity of the compressor. The quantity of compressed air delivered into the air-receiver at 75 pounds per square inch will be (972 cubic feet of free-air ÷ 6 atmospheres =) 162 cubic feet of air compressed to 75 pounds per square inch.

An Ingersoll-Seargeant coal-mining machine, with a 4 inches cylinder of 11 inches stroke, running at 200 strokes per minute will use 16 cubic feet of air per minute. Consequently, the air-compressor is capable of running only 10 machines, provided that they are planted close up to it and that there is no reduction of volume due to fall of temperature between the air-receiver and the points at which the machines use the air With large main-pipes, and judiciously selected branch-pipes, the reduction of pressure will not be very considerable. In the present case it has at no time exceeded 10 pounds per square inch with the machine running on 500 feet of 1¼ inches pipe connected with 500 feet of 2½ inches pipe connected on 1,500 feet of 5 inches pipe. There are many elbows on to the line.

The reduction of volume of compressed air due to fall of temperature between the air-receiver and the point where the machines use the air is a very important factor. The Ingersoll air-compressor delivers the compressed air into its receiver at a temperature of 228° Fahr, which falls to about 50° Fahr. in the mine near the point where the machines use the air.

After-coolers are being put in, not with the view of increasing the capacity of the machine, but of reducing the temperature in the pipes, for avoiding ignition of oil in receiver, and possibly avoiding an explosion. The receiver has been filled with flame at least once. So far as the writer's experience goes, the Ingersoll-Sergeant compressor delivers the air into its receiver at a higher temperature than does the Norwalk compound compressor.

The following statement shows the effect of using the after-cooler:

	Before the After-cooler was erected.	After the After-cooler was erected.
Air-compressor running at, revolutions per minute	100	106
Barometrical pressure in inches.....	28.2	28·2
Pressure in air-pressure at compressor, pounds per square inch	67	66
Temperature of compressed air in air-receiver at compressor, degrees Fahr.....	228	104
Temperature of free air at piston-inlet, degrees Fahr.....	47	55
" compressed air in mine, at end of pipe, degrees Fahr.	50	55·4
Pressure of compressed air in mine, at end of pipe, pounds per square inch.	58	58
Temperature of the working-places in the mine, degrees Fahr.	68	68

The writer is aware that comparisons based on the high prices paid in the Far West will not be of much advantage to those who are dealing with lower prices and wages generally. Nevertheless, the writer hopes that his paper will at least prove interesting, that it may lead to a further discussion of the subject and may bring out something of decided advantage to all the members.

APPENDIX.—SECTIONS OF COAL-SEAM.

Districts.	North. Ft. Ins.	East. Ft. Ins.	South. Ft. Ins.	West. Ft. Ins.
Following shale	0 6	0 8	0 8	0 6
COAL, *Upper Coal Bench*	1 5	1 8	1 4	1 9
Fire-clay.....	0 2	—	—	0 3
COAL, *Bone Coal*	—	0 4	0 6	—
COAL, *Bottom Coal Bench*.....	2 10	2 4	2 0	2 3
COAL, *Bone Coal*.....	0 6	0 8	0 9	0 9
Bottom clay.....	0 8	0 6	0 9	0 7
Totals.....	6 1	6 2	6 0	6 1

Notes on the Ymir Mine and its Mill Practice.

By S. S. FOWLER, S. B., Nelson.

(Paper read before the September meeting of the Canadian Mining Institute.)

Lying north of the International Boundary, west of Kootenay lake, east of Columbia river and south of Nelson, and the outlet of Kootenay lake, is a roughly quadrangular mountainous country covering about 1,450 square miles.

Occupying the central portion of this quadrangle is the drainage area of the Salmon river, a considerable stream which has its source within a few miles of Nelson, and flowing south joins the Pend D'Oreille near the Boundary.

This Salmon river country, covering about 900 square miles, was practically inaccessible until the construction of the Nelson & Fort Sheppard railway in 1893, and it was not until the summer of 1896 that any considerable mining activity was manifest. The country, therefore, is possessed of a very brief history. Aside from the placer mining operations of 35 years ago, which were carried on near the mouth of Salmon and along the Pend D'Oreille, there is now no evidence of mineral location until about 1885, when, some two years before the discovery of the Silver King near Nelson, by the Hall brothers, locations of quartz claims were made by these same men near the head of Wild Horse Creek, a small stream entering the Salmon from the north-east at the present town of Ymir, 18 miles from Nelson.

Nothing more appears to have been done for the next decade along the Salmon valley, but, as stated above, in 1896 many claims were staked, and since then the district has made substantial progress. To-day, aside from the property named in the title, the Fern, on Hall creek, the Porto Rico, on Barrett creek, the Yellowstone, on Sheep creek, the Second Relief and Arlington on the North Fork of the Salmon, are considerable producers, or nearly in condition to produce, and there are many other properties throughout the district affording excellent prospects, and indeed some of them have made small shipments of smelting ore.

Physically, the Salmon country is not complicated in structure. It is mountainous, but few of the mountains reach an altitude of more than 7,500 to 8,000 feet, and the summits are generally rounded The creek valleys are deep, however, and glaciation appears to have been an important factor in determining the present topography. The glaciers, however, have I believe all disappeared, although in the Slocan country to the north there are many remnants of that powerful moulding agent to be seen

The rocks which underlie the region being described, are predominantly of igneous origin. In a very general way it may be said that east of the Salmon the granites are in evidence, while to the west augite porphyrites, schists derived from them, some small gabbro bosses and large areas of tuffs and agglomerate occupy the field. But throughout these rocks may be seen considerable inclusions of sedimentary rocks, principally slates, except along and near the range which forms the watershed between the Salmon and Kootenay lake, where there are thick beds of quartzites and some crystalline limestone, extending more or less continuously south-westerly into American territory. The country is a very interesting field for geological research, and deserves more extended study than can be given it for a long time. The Dominion Geological Survey sent a party into this field under R. G. McConnell during the summer of 1897, but little more than a general reconnaisoner was accomplished, the shortness of the season and smoke from forest fires usually causing an early return of the field parties.

As to the respective ages of the rocks hereabouts, the slates have not been traced to connection with the Kaslo series east of the Slocan slates, but from their lithological features one is inclined to ally them

with that series, and if that is proper then the small slate areas of Salmon river are probably of Cambrian or pre-cambrian age. The various basic igneous rocks may be of different ages, but Mr. McConnell places the augite porphyrites in the carboniferous. Some of the granites appear to be comparatively recent, but the youngest rocks of the vicinity occur in dikes of blackish to dark grey color, varying much in texture and composition, and piercing the rocks above named, and I believe, most of the veins of the district. Generally these dikes may be described as mica diabase, the biotite probably being a first product of alteration, while frequently the whole mass has become completely kaolinized.

Coming to the Ymir mine itself; we find it on the west side of the valley of a North Fork of Wild Horse creek. This valley lies in a slate area several miles in length and about 4,000 or 5,000 feet wide. The slates are limited on the east by granite and on the west by prophyrite. They strike about N. 35 E. and stand on edge, the line of contact with the porphyrites being approximately parallel to the strike. Extending from a point near the contact in a direction about N. 65 E. is a fracture in the slates which is traceable several thousand feet, but within the distance along which this one fracture can be identified there are no ore bodies known other than that which has become the Ymir mine.

This property was taken over by its present owners in November of 1896, since which time 5,000 feet of development has been done, resulting in showing an ore body about 500 feet in length, with its end limits practically parallel and vertical. A depth of nearly 500 feet has been attained, but very little water has been encountered, in fact barely sufficient to justify running a pump for sinking.

In plan this ore body shows a decidedly lenticular shape, with a maximum width of ore of about 30 feet. No disturbances of importance have shown themselves, but there are many slips and several partially open narrow fissures, while two principal dikes with a number of branches cross the deposit generally nearly at right angles to the latter. From a structural standpoint these dikes form one of the most interesting features of the mine, and will be alluded to again. Beside the numerous horses of slate, which in so wide a fissure must be frequent, the vein filling is quartz, impregnated with pyrite, galena and blende, no copper mineral having ever been found.

The ore appears to have been deposited at two different periods or else derived from different sources, for the eastern 300 feet shews a perfectly white quartz, and the sulphides contained are coarser in structure and brighter in color than in the western 200 feet of the ore chute, where the quartz is not only frequently of dark smokey blue color and often nearly opaque, but the gold tenure is considerably higher. Near the region where these two varieties of quartz join they are curiously intermixed, but may be easily distinguished. Throughout the mine the walls are usually very free, but in places along the hanging of the blue quartz there is not only no clay parting, but the quartz seems to have replaced the slate, retaining the structural features of the latter and becoming difficult to distinguish underground from the country rock.

Subsequently to the deposition of the ore of both these bodies, the dykes were intruded and the fractures which rendered their presence possible seem to have been followed by movements more or less in the direction of the plane of the vein and in parts, along both walls, with the result that other fissures were formed, some extending for some distance into the footwall country, diagonally to the strike of the vein, and others along the hanging wall. These last fissures are filled with a very nearly barren white quartz, carrying at times sharply angular fragments of slate.

The later movements have also created fractures in the ore body, along one of which at least, where there is a local concentration of galena,—oxidising action has been going on with the result of producing a band of "carbonate" affording fine specimens of Cerussite and a local but marked increase in the gold values, the gold being largely free but invisible except after careful panning.

Another effect of these movements is the faulting and fracturing of the dikes and their being rendered more easily subject to alteration. This faulting movement is in the direction of the plane of the vein, but nowhere has it been extensive; *i.e.*, not more than 3 or 4 feet. The material along the plane is usually so soft as to make it difficult to get specimens shewing striation, still we have one from the hanging wall side with two distinct series of striae.

Stoping has not yet proceeded far enough to enable us know all we desire of the structural features of the vein, but before leaving this part of our subject, I may cite an interesting freak of the larger of the two main dikes we have met with. In the No. 2 Level a four foot dike comes squarely up to the footwall, where it turns a right angle to the left along the wall, and so continues, gradually curving to the right for 20 feet where it crossed the drift squarely. Going through the dike we found slate, and cross-cutting on the outer side of the dike, we found it suddenly turning again and butting against a fault fissure, nearly filled with 2 feet of calcite. Just how or where the dike proceeds into the hanging wall we do not yet know, nor is it specially important. The main point to be observed is that our failure to closely examine what we presumed to be the footwall rock led us astray, and into an expense which was useless at the time except to reveal an interesting structure.

We have not yet developed any special mining system at the Ymir, nor have we so far encountered the necessity of any, for the first stoping was done only in March last, and since the first of June our mill has been principally employed in handling an accumulation of several thousand tons on dumps.

However, the fact that much of the ore body is too wide for stulls and that good mining timbers are scarce, together with the presence of what will probably prove itself to be a not too strong hanging-wall, will undoubtedly necessitate a system of combined crib-work, filled with waste and of square setting.

The mine produces two general classes of ore; first, mill stuff; second, crude ore. The former is sent directly to mill by a Hallidie Ropeway, about 2,400 feet in length from the mouth of No. 3 Tunnel, *i.e.* the lowest which has exit to the surface. The second general class consists of two sub-classes, crude galena, and oxodized ore or carbonate. Both of these are small in amount compared to the milling ore, and they are shipped directly to the Hall Mines Smelter at Nelson, the crude ore in bulk and the carbonate in sacks. Milling material on reaching a bin at the lower tramway terminal passes through a No. 3 Gates Crusher, which reduces the coarsest to pass about a 2-inch ring Below the crusher is a 200 ton bin from which the feed passes by a tram-car after being weighed, into the battery bins proper. The crusher and tram terminal are in a separate building, but the cost of tramming is a very small item.

The mill proper embraces a 40 stamp 850 lbs. battery, arranged in four sets of ten stamps each, eight silvered copper plates 56 in. x 12 ft., four sets of 4 cone Classifiers, and twelve 6 foot Frue Vanners. This plant is driven by water with a 6 feet Pelton wheel under 415 feet net head, the crusher being separately driven by a 24 inch motor under 320 feet head The stamps make from 96 to 102, 6½ inch drops per minute, and with an average issue of 7 inches, crush a little over 100 tons per diem through No. 9 diagonal slot screens, *i.e.* slightly over 2½ tons per day per stamp.

We have found a tendency toward banking of the pulp at each end of the mortar, to avoid which we give the first and fifth stamps about 1½ inch greater drop. I may also say that we intend trying the method of introduction of feed water advocated by Mr. Bernald McDonald,

which formed the subject of an interesting paper by that gentleman read before the Institute.

In operation we employ one inside plate, and on it accumulate about 40 per cent. of our gold. The outside plates slope 2 inchss in a foot, and on the upper 24 inches of their length we gather about 80 per cent. of the recovered free gold which passes the screens. The lower part of the plate, (10 feet) we find to be very valuable, and it passes an extremely small amount only of free gold. An interesting feature of the operation of the lower part of the plate, is that the amalgam on that portion is very much higher higher in silver than that gathered elsewhere, and proportionately lower in gold.

Zinc blende and pyrite cause us no trouble in keeping the plates clean, but the extremely small size of the galena particles, together with their gravity, causes them to catch in the minute depressions of the amalgam and gradually to cover the latter. For this reason our plates are dressed every six hours, and thus we are able to keep them in excellent condition. This result we consider good work in view of the fact that our concentrates amount to 6⅞ per cent. of the mill feed, and contains over 14 per cent. lead, and 10 per cent. zinc.

The bullion produced averages about ⅞⅝⅝ gold, ⅛⅝⅝ silver, and ⅛⅜ base, thus showing practically no amalgamation of lead, but the presence of a very considerable amount of free silver.

Without disclosing the gold tenure of our tailings, I may say that they are most satisfactory, and in fact are remarkably low when we consider the apparent baseness of the ore. Of the total gold and silver recovered we find in the bullion 82 per cent. of the gold, 27 per cent. of the silver, and in concentrates 18 per cent. of the gold and 73 per cent. of the silver.

The ore, thus far, has shown itself quite free from acids and from arsenic, antimony and tellurium, a fact which is partially reflected in the very low consumption of quicksilver, viz., about ⅛ of 1 oz. avoirdupois per ton crushed.

Other properties in the vicinity of the Ymir are not yet sufficiently developed to show whether or not this mine is exceptional in its size or the character of its ore, but it seems highly probable that the success which seems in store for it will have much to do toward bringing the Salmon river country into prominence.

The Small Economies in Mining.

By HOWARD WEST, A.R.S.M., New Denver, B.C.

(Paper read before the September meeting of the Canadian Mining Institute.)

In presenting a paper of this character at an important meeting of the Institute, I do so with the full knowledge of the vastness of the undertaking—which may seem possibly on a review of the title a somewhat paradoxical statement to make—and the grave responsibility which I am incurring in venturing to discuss a subject which has been so ably and thoroughly gone into by the most eminent authorities in every quarter of the globe.

Granting that much of what has previously been written will apply equally to this section, my excuse is that there may still be some matters which have not been brought to the notice of mine operators, and also that local conditions have such an important bearing on the subject that only those who are thoroughly in touch, can form a conception of the nature of the problems met with in each particular locality. It is unnecessary to add that almost all the world's great producers depend on the strictest economy for their successful operation, for we know that where the cost of extraction on a large scale approximates in any degree the average value of the ore, a very small saving indeed is sufficient to constitute an important item in dealing with the profits, which after all is the fundamental object of mining from a commercial point of view.

The term "small" as applied in this sense is of course merely relative, as a small economy involves a great saving where quantity is concerned.

It would be digressing I think to refer in this paper to the tremendous strides which have been made in this direction of late years by other countries, notably perhaps the Transvaal, where the adoption of the cyanide process for the subsequent treatment of slimes and tailings has done so much to raise the standard of efficiency attained, because conditions here can scarcely be deemed analogous; nevertheless we in British Columbia can boast of isolated examples of economical management which will bear favorable comparison with the best of undertakings elsewhere. No one will contend for a moment that we are as yet all that is possible or indeed that we might be in this direction; my object, however, is only partly to notice the more palpable and obvious shortcomings which may be seen at the majority of mines, but principally to throw light as far as I am able on the apparently unimportant, because often unobserved, details. Before proceeding let me say that I have no intention of ignoring the many disadvantages under which mine operators labor in this country, as compared with other centres of the industry, nor do I wish to insinuate that we are in any way behind rival districts which may have found themselves at one time or another similarly handicapped. My desire is merely to draw attention to the fact that through various causes, many of which it must be confessed are quite incomprehensible to an ordinary individual, real economies are not effected in the manner in which one is taught to look for them, and to explain some few of the reasons why these conditions are allowed to continue.

As this subject can only be conveniently dealt with by taking into consideration the different varieties of ores and the peculiar conditions encountered in each division, I shall confine my subsequent remarks to a very important section of the country, and one of which you have all heard—namely, the Slocan. Having been myself a resident of this district for nearly five years, no one can accuse me of prejudice in expressing the opinion that for a region where mining has assumed permanent proportions, the economies effected are still of the most elementary description. Admitting this then for the sake of argument, we will proceed to observe carefully the cause of this apparant neglect of one of the first principles underlying the success of any industry. Among the chief reasons I am inclined to think is the large element of chance which enters into mining in all localities, but which is perhaps a more noticeable factor in the Slocau than elsewhere. At Rossland, and in fact all camps where medium and low grade ores can be handled to advantage, the tendency is ever towards quantity rather than quality, within specified limits, which as a natural consequence brings matters down to a more or less mathmetical basis, so that comparisons of the cost of production and the value of the ore can easily be made, and the profits estimated with a certain degree of accuracy before hand. This, of course, is the origin of all mining on a large scale, and it must be candidly acknowledged that so far as the Slocan is concerned some considerable time will elapse ere it attains to this desirable end. Not that quantity is despised by any means, but quality is the one essential requisite before a deposit can be considered of practical value. Seeing then that only ore of a fairly high grade will pay to ship (from the reports of the Minister of Mines we find that the average silver and lead contents of Slocan ores for the last two years were 103 ounces and 46 per cent. respectively) it becomes a question of developing small veins of relatively high grade ore in preference to larger ones of somewhat lower value; and in working a deposit under ordinary conditions, one is forced to ignor the wide bodies of what is commonly referred to as concentrating ore and push on towards the richer chutes where the values have already been determined in nature's laboratory. By this I must not be understood as advocating the principle of gutting a mine of its richest ore and leaving behind stacks of material

which under fostering treatment would become marketable: I simply wish to point out in extenuation the allurements which this district offers to the investor in the shape of quick returns, as has been repeatedly demonstrated in the past, in contrast to the system of uniform though more modest gains, which is a feature of lower grade camps. In short, the tendency of those responsible for the operation of our mines in the past, after exercising due judgment and discretion in the selection of properties to work upon, has been to regard mining as essentially a gamble and chance the main factor, because many of the deposits were sufficiently rich near the surface to render economy apparently superfluous: unmindful of the fact that for every mine so favored there are probably a dozen which could be made successful from a business standpoint by the adoption of an economical system of working and development. Fortunately for the survival of the reputation of the district these early impressions are rapidly giving place to more healthy aims, and it is easy to see that simultaneously with the influx of capital more attention is being paid to the other primary factor, namely, that of quantity or tonnage than has been possible to those of small means. This of course is only to be expected, for the old saying that "money makes money" holds true in this department of life as in others. Mine managers in the Slocan are accustomed to pride themselves above all else on the richness of their deposits, which enables them to compete on equal terms with other districts offering considerably more advantages for cheap production. This, however, in no way relieves us of the responsibility which we feel as mining engineers of endeavoring to raise the industry to the position where it will give employment to the greatest number of men and return the maximum of profit to those who show their faith in the province and its resources in the most practical method of all, by investing their surplus capital in our midst. As I have before showed, statistics amply prove the right of this district to the title of a high grade camp, but this is not saying but what there are thousands upon thousands of tons of second class ore—much of which would doubtless not be so designated in more favored regions—which would soon double and treble the production of the district could it only be worked at a profit. The accumulations which are a burden in their present condition are capable of being converted into a source of revenue under efficient management, so that when the necessary co-operation from money centres is forthcoming one of the most important elements of loss will be obviated.

Let us look for a moment at the true meaning of the word "economy." An economy can only be said to be effected when the saving resulting from an operation or a series of operations is greater than the expense connected therewith. We must be careful therefore to avoid in our handling of the subject too close a comparison with districts differently situated. In speaking of economy then it would be incorrect and misleading to apply the same hide-bound rules which govern mining in far away places to the conditions in the Slocan, and to say that because ore carrying 10 per cent. lead and six ounces of silver per ton can be made to pay in Ontario or Quebec, therefore we are not economical in British Columbia if we cannot do the same thing; our object should be rather to stimulate investigation into the causes which render mining in the provinces first named profitable, and afterward to seek as far as possible a solution of the difficulties here met with. Take as an example my casual mention of an ore carrying 10 per cent. lead and six ounces silver; the reason this can be made to pay in Quebec is because under conditions which are favorable it can be converted into a marketable commodity by the simple process of concentration, whereas by no known method can it be turned to account in the Slocan. I merely instance this as one case in a great many where natural obstacles render it next to impossible to treat with ore which could be handled elsewhere to advantage. This of course does not apply alone to material which is susceptible of concentration, for there are values too vast almost to realize concealed in ore which has already attained its maximum limit through natural agencies and which is too poor even in this condition to warrant further investigation. The utilization of these reserves should be a matter of paramount concern to the engineer, in the study of which he is called upon to exercise his utmost skill and ingenuity; and perhaps it might not be out of place right here for me to add my oft repeated protest to that of others against the practice of placing unqualified engineers in charge of developed properties and leaving to them the details of management, when men of experience are to be obtained without difficulty. In the first stage of operations this can hardly be avoided to some extent, the expense of a trained technical adviser being often beyond the means of pioneers, and his presence too not always so necessary as when the finer matters of treatment are under consideration; but with all due respect to the practical man—and I have every reason to thoroughly appreciate his many excellent qualities—I submit that he is utterly incapable of supervising economic details, many of which require men versed in geology and mineralogy to properly comprehend. This I argue is the first step that must be taken if the mines of any district are to be worked to advantage, and whatever the shortcomings in this direction in the past, it is gratifying to observe that the better class of mines in the Slocan are now almost without exception in charge of men who are equally practical and theoretical.

The main reasons why comparatively low grade ore will not pay to mine in the Slocan are not far to seek, many of them being common to all mining camps in their early history. The necessarily high cost of transportation and treatment is one of the chief factors to be considered, and though little progress appears to have been made during the last few years, we may rest assured that as soon as developments warrant and capitalists see their way clear to erect reduction works nearer the source of supply, they will not hesitate to act upon their convictions. Of equal importance is a matter that I am somewhat chary of touching upon, namely that of the removal of the duty on lead, so much having already appeared upon the subject from those better qualified to discuss the subject in all its different aspects. Looking at it, however, from an economic standpoint, one stares in amazement at the amount which is collected yearly by the United States officials in duty, and speculates idly on what effect it would have on this district were lead added to the free list.

Then again the question of cheap transportation from the mines to the railway is by no means an easy one to solve, even when operations are assured on a large scale, but the advent of capital is bringing machinery of every description to our aid—matters being greatly simplified by the introduction of tramways of various types.

Economies in marketing the ore are admittedly hard to effect, as the majority of smelters have a combined freight and treatment charge and a uniform method of estimating the values which leaves little in favor of any particular establishment There are, however, one or two points in this connection which are well worthy the study of the intelligent manager. In the first place it should be his aim where the quantity of reserves will permit to secure the very best rate possible by guaranteeing the entire output for a given period to one smelter, other things being equal. In this way it is sometime possible to save hundreds of dollars in a year. Then again he should endeavor to suit his ore as far as convenient to the requirements of the smelter by eliminating, where expense is nominal, objectionable material which would otherwise tend to increase the treatment charges and incidentally the cost of transportation as well. I have in mind a case where a manager succeeded in bargaining for a considerable reduction in smelter rates through being able to guarantee that no shipment would contain upwards of 5 per cent. of zinc, and similarly a company which found that its ore invariably overstepped the 10 per cent. limit allowed by most smelters, was enabled to save a dollar a ton by ship-

ping to a concern which inflicted no penalty until a maximum of over 12 per cent. was present. Moreover, by a judicious mixing it is often possible to avoid paying any penalty whatever, and in some instances I have known, matters have been so manipulated that credit was obtained for one ingredient which would not otherwise attain the necessary standard, as in the case of an ore carrying a little less than $2 per ton in gold; by shipping in conjunction with material giving higher returns of this nature, the whole of the gold contents will receive recognition.

The idea of smelters being intentionally dishonest and not paying on the real assay value of the ore received, is one largely held by those who are either suspicious of everyone on principle or in the habit of incorrectly sampling their ore before it leaves the mine. This view I need hardly say is not accepted by the more observant managers, but that smelters may occasionally make mistakes, possibly to the disadvantage of the miner, will be conceded even by their own employees, and therefore a preliminary sampling before the ore is shipped is important to serve as a check on the smelter returns.

When convenient it is more satisfactory perhaps for the shipper to go himself or send a representative to supervise the sampling done at the smelter, for I know of one case at any rate where the check pulp corroborated the actual returns as given by the smelter, and yet on a representation from the mine that it did not accord with their preliminary results the car was re-sampled and the returns materially increased.

The value of pulp as delivered for check purposes is, I suppose, questionable, unless the shipper has, as suggested, personally seen his ore weighed, crushed and sampled, and further assisted at the moisture determination, but the smelter company practically agreeing to pay on the assay value as shown by this sample, it is always advisable and sometimes profitable to carefully check their returns. It will detract in no way from the recognized efficiency of smelter assayers if I say that even they are occasionally caught napping, and in justice to their integrity I wish to record the fact that on several occasions I have discovered that the smelter has paid for more than other competent assayers were able to detect in the pulp which was furnished them.

One other matter to which I should like to draw your attention is that I have been taught by experience that owing possibly to a slight difference in practice, smelters assayers themselves vary to a degree, which is well worthy of consideration, and that whereas I invariably obtain a fraction of aa ounce less than actual returns as given by some smelters, the reverse is the case in others, one instance coming to mind where there is always a deficiency of from one to three ounces. We are justified in assuming therefore, that slightly better returns will be obtained on the same ore from an establishment belonging to the former class than from one of the latter, and in practice it is manifestly economy to take advantage of experience of this kind.

Then too in the case of ore which is characterized by containing part of its value in the form of metallic prills there is need for the most searching investigation, as owing to the unevenness of its distribution smelters are sometimes doubtful of their own assays even representing the contents of the ore in bulk, it being much more convenient to entirely ignore the prills, a course of proceedure which I have been assured is occasionally followed where the value represented is small in comparison to the whole.

These are all doubtless matters of little importance by themselves, but in the aggregate they mount up and may assist in determining the difference between the successful and unsuccessful management of a property. I do not, however, cite them as common experiences by any means, but simply to show that they may occur unless guarded against, and that therefore it pays to devote the most careful attention to detail in every direction alike.

It frequently happens that a variety of minerals of an essentially different nature are encountered in the same workings, but we find that very often, owing possibly to prejudice or the apathetic determination to follow custom in the matter, no effort is made to dispose of anything but the main product. This is a very serious error, and one which may be rectified by a careful stndy of the situation and the demand for any particular class of ore. It is safe to say that tin mining in Cornwall would not have survived to the present day but for the recovery of the associated copper, arsenic and tungsten minerals, and instances abound the world o'er where the comparatively unimportant element has furnished the margin of profit on the investment. Hitherto the Slocan has been regarded solely as a silver camp, no other metal, with the exception of the lead, having found favor in the eyes of the smelter men. It is by no means certain, however, that other descriptions of ore, some possibly unknown at the present time so far as this region is concerned, will not eventually constitute part of the output; indeed there is one mineral very intimately associated with galena which ought to be turned to account, and this in spite of the fact that it has so far proven a source of considerable loss and been regarded generally as a detriment—I refer of course to zinc blende. It is no secret that the Bosun mine has disposed of several car loads of ore in London at a large profit, for which it was absolutely impossible to find a market this side of the Atlantic, constituting, if I am not mistaken, the first record in the history of the Slocan where actual payment has been made for the zinc contents, although the penalty inflicted by American smelters on ore of this class may be avoided by shipping to certain works on the Manchester ship canal. I commend this to the attention of mining men generally and those of this district in particular, as there is a possibility that in many cases it may lead to encouraging results. The ore in question I may say was hand picked until it averaged roughly 45 per cent. metallic zinc, 1.5 per cent. lead and from fifty to eighty ounces of silver per ton.

The ever widening nature of the subject I have chosen is becoming so alarmingly apparent as I progress, that I find it expedient to make no effort to complete the undertaking in the manner originally contemplated. I beg leave, however, before concluding to refer to two other matters which fully merit our notice. The first is the absolute necessity of every mine being supplied with a proper system of accounts so that the manager can refer whenever he desires to the cost of any particular piece of work and make the necessary comparisons as he goes along. There is no need, however, for me to dwell upon this at length, even if I had not already trespassed too long upon your time, for I notice that Mr. Hardman, the worthy president of the Institute, intends to go into the subject more fully in his contribution to the proceedings.

The other matter which I had in mind would fill a volume if necessary, as it relates to the much vexed subject of concentration. While I have had some little personal experience in work of this kind, and am thoroughly conversant with the principles underlying the process, there are members present I know who have been making a special study of this branch for months past, so that I shall be very brief indeed, in order to give them an opportunity to speak for themselves. I would willingly have omitted all mention of this matter were it not self-evident that the process is destined to be the chief factor, if I may be allowed to say so, in the future advancement of the district. In no other department perhaps is the strictest supervision so essential to success, for even a little carelessness may result in large values being persistently run to waste. It is economy of the first order to employ a thoroughly competent mill man, as he will save hundreds of dollars worth of ore in a month which would doubtless be irrevocably lost under less skilful treatment. So too the highest professional skill is the cheapest in the long run, and a mine owner makes a serious

mistake when he employs an engineer or an assayer simply because his fee may be lower than that of others.

The type of concentrator generally adopted in this district was dealt with in a paper entitled "Mining Machinery in the Slocan," which I submitted some eighteen months ago. Since that time but little alteration or improvement has taken place, if we except the introduction of the Willfley table at the Alamo works where it is used in place of the round buddles. In the newer types of concentrators now under consideration to be erected before long, it is probable that in view of the prospective importance of the zinc blende in the ore, four compartment jigs will replace those previously employed so as to facilitate the recovery of this product.

COMPANIES.

Nova Scotia South Uniacke Mining Syndicate, Limited.—This company was registered in London on 28th ult., with the authorized capital of £50,000, in £1 shares.

Dominion Coal Company.—We give comparative coal shipments by months from the beginning of the company's fiscal year.

	1899.	1898	1897.	1896.
March	22,300	20,900	24,000	9,171
April	50,000	23,597	32,000	30,315
May	105,300	125,190	105,000	112,544
June	103,900	158,500	148,000	152,409
July	183,400	175,400	173,100	168,839
August	220,000	165,800	159,000	149,532
Total	833,500	675,030	638,100	613,810

Fairfield Exploration Syndicate.—Cablegram from the manager in Vancouver: "Doratha Morton Mine. Output for the month ended August 31st: Gold, 581 oz.; silver, 1,601 oz.; total value, £2,076. 910 tons treated; assay value per ton, £2 18s. 9d.; silver, 5s. 8d. Calculated extraction, gold, 87 per cent.; silver, 70 per cent.; 10 stamps ran 29 days, 19½ hours, crushed 1,243 tons."

Canadian Pacific Exploration. The mine manager at the Porto Rico Mine cables: "660 tons of ore crushed yielded $10,540. Total working costs, $7,100."

Athabasca.—Cablegram from manager at Nelson (B.C.), September 9th: "432 tons milled; the approximate value, $8,550."

Le Roi Mining Company. Mr. Carlyle, the company's manager, reports as follows:—I am pleased to say that the development work done during the past month has been very satisfactory in its results, disclosing, as it has, much more ore of good value on each of the 500 ft., 600 ft., 700 ft., and 800 ft. levels, and I am more than ever convinced that if for some time to come I devote most of our efforts to the thorough development of this property, making the shipments of ore altogether a secondary matter, as I am practically doing now, the results will amply repay us. Ore shipments—During the past month, owing to holidays and the accident to the compressor, we only shipped for twenty-four days, viz., 6,307 tons (2,000 lb. net); 2,855 oz. gold, gross value $85,638; 6,471 oz. silver, gross value per ton $13.55; 193,482 lb. copper. 450 ft. level—This level is now ready to permit the extraction of ore lying beneath the level floor, but at present we are not touching this body. 500 ft. level—This level was extended until it connected with a raise from the 600 ft. level, thus giving good ventilation in both of these. In the report for last month I stated that in this level we have found shute of rich ore, 75 ft. long and 2 ft. to 4 ft. wide. I began a stope on this ore body, and as we proceed we are finding the vein there to be from 7 ft. to 9 ft. wide of excellent ore. As we have a large amount of unexplored ground above this, this new body of ore promises well. Daily assays from this ore show that it is carrying from $15 to $30 in gold per ton. 600 ft. level—In the old or main stope considerable ore is being taken out; in the drift started from a cross-cut, to follow along the hanging-wall streak of the vein, we have found that we have a shute about 70 ft. long and 4 ft. to 10 ft. wide, carrying good values, showing that we will have here another good stope available. In the west end of this level in the Tregear stope, in the second floor of the stope, for the length of over 100 ft., we now have a fine face of ore 8 ft. to 12 ft. wide, averaging $15 per ton in all values. This stope has improved very much during the last month, and now looks very well. 700 ft. level—On the level floor this stope is now 280 ft. in length, and at the west end we are extracting all the ore in the vein to a width of 45 ft. Much of this ore is low grade, running 6 dwt. to 8 dwt. in gold, but scattered through is better ore, so that the whole mass is worth $10 to $12 per ton. In the upper part of the stope we are getting opened up much more ore of higher grade. In the west the face of the drift is nearly all ore of low grade of 4 dwt. to 12 dwt. in gold, but this working is looking very favourable, and is being pushed ahead to get under the Tregear stope of the 600 ft. level. During the month we started an upraise about 200 ft. back of the face of this drift, but we are only up 18 ft., showing 1½ ft. to 2 ft. of ore, assaying from 14 dwt. to 22 dwt. in gold. 800 ft. level—The raise mentioned last month is now up 30 ft., and, so far, has been all the way in high-grade ore assaying from $18 to $75 in gold. We are now preparing to begin a stope at this point which, when opened, will give us a good tonnage. Immediately below this vein we intend sinking a winze on the ore to explore this ground, and have this working ready when the shaft has been sunk and the 900 ft. level run in. Just west of this raise we are starting a stope westward along the footwall side of the vein, and yesterday I saw from 8 ft. to 10 ft. of ore that assays $16, carrying good copper values as well as gold. The face of this drift is now all in ore that yesterday assayed $15 in gold. This level has shown radical improvement during the past month's development. 900 ft. level—The shaft is now down to 896 ft., and we will begin shortly to cut out its station for 900 ft. level, which will be started at 908, but so that the square setts of the timbering as we stope up to the 800 will correspond. Very good progress has been made in sinking the shaft."

LAKE OF THE WOODS.

The most important piece of news since last writing is the arrival of General Wilkinson, manager of the Regina mine, and the report that this property is to be reopened shortly.

There is very little to record in the way of mining deals during the present month, except perhaps some of an unimportant nature. Negotiations have been afoot for some time about the Pritchard Scovil-Moore property in the Virginia mine country, but as yet no bargain has been made, but it is likely the crisis will be reached pretty soon now.

The owners of a property composed of an island in Sturgeon lake, towards the Virginia Mining Co.'s camp, recently brought to town some very rich quartz from their claim.

Mr. Ralph McKinstry has surveyed a few locations on the rich find he made early in the season in the country between Eagle lake and Spider lake.

Mr. Geo. Swanson and his two partners are putting up a comfortable cabin on their property on Eagle lake, just west of the Indian reserve. They will also cut out a road to connect their property with Eagle River Station on the C.P.R.

At Hay Island work is going on in the cross-cut from the 103 foot level, to intersect the vein that was located by the diamond drill last winter.

Work has been stopped at the Boulder mine for the present. T. G. Smith has just finished the diamond drill boring at the bottom of the shaft. The hole slanted off from this point to a total distance of 315 feet, the object being to locate a parallel vein—this vein was pierced and found to be a mixture of quartz felsite and other gangee. The shaft is 300 feet deep. J. M.

Rat Portage, September 19, 1899.

NOVA SCOTIA.

At no time since the inception of gold mining in this province has there been as much interest taken in gold mining as at the present time. At last a firm conviction has seized the best mining men that deep mining will pay here, and this conviction is not the result of operations in other countries, but the results of actual operations now demonstrated in several of our districts within the past year.

The "Guffey Jennings" mine at Caribou, Halifax County, gives, perhaps, the best evidence of this important fact. This mine was practically abandoned two years ago—the lead had become small and poor as well, and was sold to the present owners, who abandoned the old workings and sunk a new shaft several hundred feet away from them. At a depth of 500 feet they tapped the vein, since which they have driven 800 feet of drifts on the vein both ways from the shaft, carefully testing the vein matter as they proceeded with this development work. The results show that this vein has been found to run from four to 12 feet wide, every ton of which has proved to be pay ore and some of it very rich, running up into the ounces per ton.

The owners of this mine are a close corporation who purchased it for what they can make by operating it for the gold they can obtain from it.

A few days ago the writer in speaking to one of the interested parties in asking what their prospects were received the following reply: "We are perfectly satisfied; our development work has paid expenses; we have 500 feet of ore over head; we are now going down 300 feet farther, when if our beliefs are verified we will put in from 60 to 100 stamps; there is no question about the value of the mine."

The Brookfield Gold Mining Co. at North Brookfield has recently returned 996 ounces from 2,665 tons of ore. The richest ore ever taken from the mine is now being taken from its lowest levels between 500 and 600 feet vertical depth.

The Richardson mine, Isaac's Harbor, yielded for the month of August 340 ounces from 2,200 tons of ore, leaving $3,000 net profit.

The Hurricane Point mine, Isaac's Harbor, returned for August 135 ounces.

The Blue Nose mine, Goldenville, yielded 331 ounces from 1,080 tons for the month of August, and the New Glasgow 114 ounces from 606 tons of ore.

The Blockhouse mine, Lunenburg County, recently returned 677 ounces from 390 tons of ore.

By far the largest owners of gold mines in Nova Scotia to-day is J. Burpee Neily and associates of Boston, Mass. Mr. Neily is a Halifax man and went to Boston something over a year ago. Since then he has purchased the Gold Lake mine, the North Brookfield mine, (adjoining Mr. Libbey's valuable holdings) the Bonanza mine, Ocoham, the Neily mine, Lake Catcha district, a mine at Cow Bay and one at Porter's Lake, the Cochran Hill mine, Sherbrooke district and the Truro mine at Caribou. For this aggregation of mines Mr. Neily has paid and expended for plant nearly $400,000. Not satisfied with the above eight mines he has recently purchased the Stuart-Hardman holdings at Goldenville. This property is composed of the Wellington, Denver, Palmerston, Little Palmerston, Dominion, Mayflower, Bowlder and Grape mine, and he has added thereto the Alexandria, Hayden and Durbey. This aggregation of properties in one district makes probably the most valuable mining property in the province.

Recently Mr. Neily has secured the services of Mr. A. B. Call, M.E., as his general superintendent, who is now at Goldenville making arrangements for the erection of a large pumping, hoisting and drilling plant to be erected at once. The intention is to sink a main shaft 500 feet from which cross-cuts and levels will be driven and a thorough system of over head mining established. The site for a 100 stamp mill has been selected and operations for its erection will commence in the early spring. The material will all be laid on the ground during the winter.

A Tremaine mill is now being erected on the ground for the purpose of milling some thousands of tons of old dump which has been found to contain from $1.50 to $4.00 per ton. With the Tremaine mill Mr. Neily expects, from the dumps, to obtain gold sufficient to repay the expense of sinking his deep shaft.

The Richardson Gold mine at Isaac's Harbor, in the district of Stormont, has a 40 stamp mill, which has been crushing on an average of 2,000 tons of ore per month for several years. This ore has been yielding an average of $2.00 per ton which has left a fair margin of profit for the owners.

The tailings from the mill have been permitted to run into a lake near by; gradually the sand displaced the water until what was a lake is now an immense bed of quartz sand. Recently a Wilfley concentrator has been placed at the tail of the mill. This machine has proved that 5 per cent. of the tailings are concentrates. Several lots of these concentrates have recently been sent to England and the United States, and the results are a yield of $40 per ton, leaving a good margin of profit after all expenses are paid. Thus it will be seen that the tailings, which have been permitted to run into the lake, contain as much gold as what was saved in the mill. It is estimated there are no less than 100,000 tons of sand now deposited in the displaced lake, representing a value of $200,000.

The Richardson people are at present devising means of treating this body of sand, and the Truro Foundry and Machine Co. have been asked to prepare plans and estimates for a plant to raise and concentrate this large body of valuable auriferous sand. The plant will probably consist of a large centrifugal pump to raise the material and eight Wilfley concentrators. It is thought that $1.00 per ton will cover the entire cost, including treatment of the concentrates, which will leave the nice little sum of $100,000 profits for the company.

REVELSTOKE.

Continuous heavy rain has been the chief feature of the past month, accompanied by unusually chilly weather; indeed much snow has fallen lately on the higher mountains, though with a month of the lovely weather common here in the fall, it will probably all disappear. But it has been impossible to do much prospecting, and in some cases even assessments could not be done owing to the depth of old and new snow on the claims, it being considered no joke at all to wade up to your neck in snow for the purpose of getting to your work. That is certainly one drawback to the rapid development of this country, so much snow falls here and remains so long on the hills, that there is no time at all to make a thorough examination of the ground before the arrival of the new season's snow sends prospectors down from their claims and stops their arduous but still fascinating employment for that year. On prospects however, that have been more fully developed, where the work is advanced to the extent of a tunnel or two, the snow is an advantage rather than a drawback, as much heavier pieces of material can be handled on it, than on the dry ground, and with due regard to the clothing worn, locomotion is rendered easier also. But notwithstanding the cold, wet, and snowy August that has been our lot in this district, there has been a very large amount of work done, and no reports are to hand yet saying that the owners are dissatisfied with their holdings on account of the vein proving worse than was expected, or even pinching out altogether, but on the contrary all are jubilant over the proved permanency and increased value also in many cases, of their ore.

This has been the case in more than one instance in the Lardeau District, that land of promises which are likely to be fulfiled.

On the Nettie L. near Ferguson, a vein has been uncovered in the tunnel which did not appear at the surface—the vein varies from 2 to 3 feet wide, and is composed of galena, grey copper and some iron pyrites, it assays about 700 ozs. silver, 1 oz. gold, 10 per cent. copper, and 60 to 70 per cent. lead, which is indeed a very fine showing. As this vein was struck some 70 feet below the surface there is very little doubt of its permanence and consequently of the great value of the mine. This is no isolated case; from all sides come accounts of ore bodies being unexpectedly met with in the course of development, and while all cannot be so extraordinary rich as the example just given, yet they are always good and an addition to the previously known value of the claims.

The advent of the railway into this quarter of the Kamloops, combined with its known richness, has induced capital to venture here, and mining syndicates from Ontario and elsewhere have sent their representatives to the ground to secure properties while they may be had, and to develop them without delay. There is no reasonable doubt that any such venture undertaken with proper caution and intelligence, will repay its organizers many times over.

The railways referred to above are the C.P.R. and the Great Northern, both of which are making rapid progress towards Trout Lake, while the latter has a large staff of men clearing part of the townsite of Ferguson for the erection of a Roundhouse and other workshops connected with a railway system.

It would not be fair to quit the subject of the Lardeau, inexhaustible as it seems, without specially making mention of the Sunshine, in the tunnel of which mine a vein has been found 18 inches wide of clean galena and grey copper, which assays so highly that the management consider they have enough ore actually in sight to pay for 12 months' development. If this statement is nearly correct, as it very likely is, the old banner mine of the district, the Silver Cup, will have to look out for its laurels, and on the Towser, an adjoining claim, preparations are being made for a full winter's work.

From Illecillewaet there is no news whatever, so it is reasonable to conclude that the camp is pursuing its rather too peaceful way as usual. Miners are asked for, however, to work on the Tangier mine.

From Big Bend there is a great deal of information, mostly good, but the late season and early snow this year have retarded matters very considerably as far as regards prospecting. Where, however, the claims had been further worked, and where in consequence the snow was no drawback, very satisfactory results have been obtained.

The Carnes Creek Company have worked steadily on their property the Rosebery, and have proved in their lower tunnel that the high grade ore vein on the sur-

face (arsenical iron, with gold-bearing pyrites) is continuous to a depth of at least 200 feet below the upper workings, so there is no fear of that vein pinching out. All arrangements are being made there, also, for a steady winter's work.

On the Eureka claim (Laforme Creek) big stringers of ore are being cut through in the tunnel, though there are many feet yet to be driven before the ledge is reached, which shows what a highly mineralized location this is, though indeed the same remark applies to the whole of the Kootenay District.

On Smith Creek, much further north, very excellent results are still being obtained on the Placer claim now being worked there, and the owners are likely to find themselves comfortably fixed for the rest of their days. Much more ground has been lately staked in that vicinity, and there really seems some hope that the Big Bend's ancient reputation as a gold producer will be revived. Some very fine gold-bearing quartz was brought down this week from McCullough Creek, the gold being thickly disseminated all through with the quartz itself and also in the decomposing iron deposits that accompanied it, and everything seems to indicate that money and time can be very profitably spent in that neighbourhood.

The Boston and B.C. Copper Company about whom so much has been said and written, have wisely decided to ignore that wonderful prospectus, and to go ahead with development—this should of course have been done before, but it is better late than never. Ample supplies have been and are being sent up to the claims in the Standard Basin, and by next spring it is hoped by all that the rather tarnished name that company now bears, will be made thoroughly clean and brilliant.

A. H. H.

REVELSTOKE, 12th September, 1899.

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