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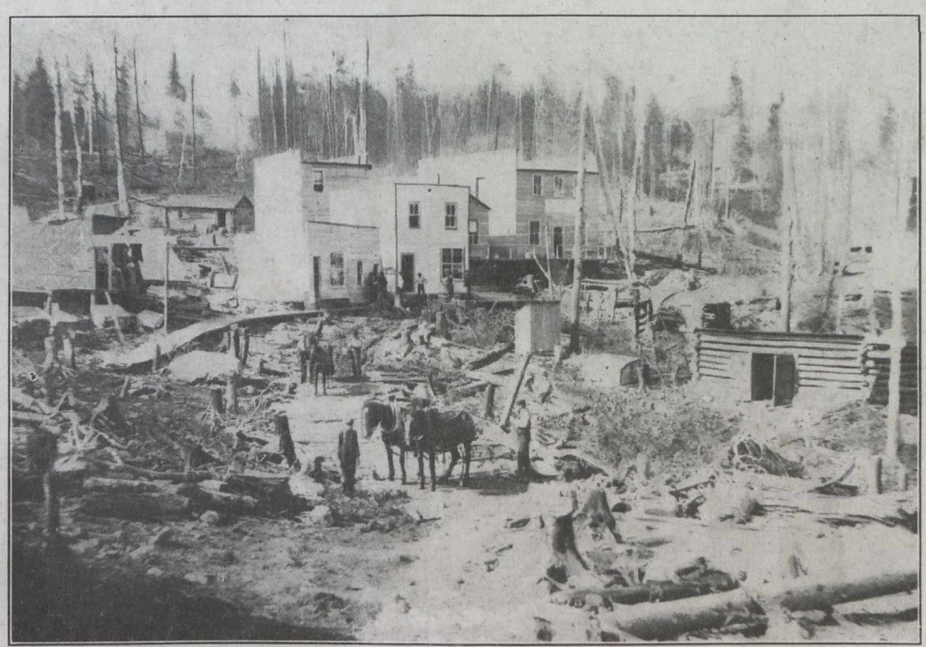

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Map 59A. Wheaton, Yukon Territory.

Map 150A. Ponhook Lake Sheet, Nova Scotia.

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Aggregate Value of $516,270,253

The substantial progress of the Mining Industry of this Province is strikingly exhibited in the following figures, which show the value of production for successive five-year periods: For all years to 1894, inclusive, $88,904,199; for five years, 1894-1899, $46,906,258; for five years, 1899-1904, $90,391,394; for five years 1904-1909, $121,618,733; for five years, 1909-1914, $139,002,161, for the year 1915, $29,447,508.

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THE HON. THE MINISTER OF MINES
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THE CANADIAN MINING JOURNAL

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CIRCULATION

"Entered as second-class matter April 23rd, 1908, at the post office at Buffalo, N.Y., under the Act of Congress of March 3rd 1879."

CONTENTS

SUGGESTIONS WANTED

Mining men throughout the country want to do whatever they can to assist the Government in carrying on the war. They will be found willing to help in any work which they believe to be useful. Our readers are doubtless anxious to do what they can to assist those who are endeavoring to devise methods of utilizing the special services which mining men might render.

Not infrequently mining engineers have offered their services to the Government expecting that such services would be utilized to good advantage. They seem to be under the impression that the Government knows just how to use men of special training to best advantage and are disappointed when they find that such is not the case. The trouble is that we depend too much on the Government officials and do not make clear what we think should be done nor suggest how it should be done.

A movement is now on foot to gather information that would be useful to the Government. Mining men who have suggestions to offer are invited to use our columns or to contribute their suggestions to any of the technical societies for discussion.

In addition to suggestions which might help in carrying on the war there is a demand for ideas which might assist in developing our resources after the war and help to defray the cost. The need for the encouragement of basic industries seems now to be more widely appreciated and there is ground for believing that the public will in the future look with more favor on proposals to assist those who would increase production of raw materials. Those of our readers who, in seeking to develop ore deposits, have encountered obstacles which might be removed by united effort, would do well now to voice their opinions. The appointment of a committee of the Privy Council to have in charge the supervision and direction of scientific and industrial research, is an indication that the Government believes that our people want the services of scientists to be more largely used in the development of our industries. The committee is doubtless anxious to learn what obstacles you have encountered and particularly your views concerning the possibility of removing such obstacles.

We all know that our technical literature is largely a record of successes rather than of failures and that there is a paucity of recorded opinions on the causes of failures. Those who are interested in the mining industry cannot therefore depend on the committee, or any other body, to find out what our problems are and remove them. We must explain the difficulties

that are encountered and suggest ways of removing them.

Many of the problems met must be and are solved by the individual companies encountering them. There are, however, problems of more general nature, for the solving of which united effort is needed. A move has been made to get this united effort. It is now up to those engaged in the industries to make suggestions.

THE NEED FOR AN INVENTORY OF RESOURCES

It has been abundantly proven during the war that men of special training have not been used to best advantage by our military leaders. We can charge this failure in part to our lack of knowledge of the methods of modern warfare, and to our unwillingness to believe that Germany was preparing to make war on the world. In part, however, it is due to lack of information concerning our men and our industries.

When it became apparent in the early days of the war that the services of engineers would be especially useful, engineers throughout the Empire offered their services. Unfortunately the military leaders did not appear to realize that engineers and scientists could be used to great advantage and such offers of service were not highly appreciated. As a result many such men went into the army in positions which might have been as well filled by untrained men. Engineers qualified to take charge of important work were used for work that might have been better performed by husky pick-and-shovel men. Men who would have been invaluable in the production of munitions were accepted for service at the front.

Lately there has been more general recognition of the need for discrimination in recruiting and in providing for the carrying on of necessary work at home. The attempt now being made to carry on the war more intelligently is hampered by our lack of knowledge concerning our citizens and our industries. The need for a detailed inventory of all our resources is being impressed upon us. To utilize our resources to the best advantage we must first know what they are.

At a meeting of the executive committee of the Toronto branch of the Canadian Mining Institute held last November it was decided to ask the Council of the Institute to consider the advisability of urging the Government to take an inventory of our industrial resources. The Council approved of the suggestion and appointed a committee to interview the Minister of Trade and Commerce. The committee was referred to Mr. R. H. Coats, Controller of the Census, who said that his department would welcome suggestions from the Institute. Apparently the Census Branch is the department which the Government considers to be best fitted to consider such suggestions and to assist in carrying out those most likely to be of value.

On December 28th a meeting of Toronto members of several technical societies was held, at the suggestion of Mr. Wills Maclachlan, secretary of the local branch of the electrical engineers' Society, to discuss ways of assisting the Government in carrying on the war. A committee was appointed to organize a movement for utilizing more intelligently the man power of the Dominion.

At a meeting of the Toronto branch of the Canadian Mining Institute held on January 6th, Mr. T. W. Gibson and Mr. W. E. Segsworth reported on what had been done by those attending the December 28th meeting and at a subsequent committee meeting. The Toronto branch appointed Mr. Segsworth as its representative on the engineering societies' committee, and recommended to Council that a census of mining men be taken at once. It is hoped that mining men in all parts of Canada will join with men of other industries and discuss ways of utilizing the ability of engineers and scientists to the best advantage.

DETERIORATION IN ROCK DRILL STEEL

It is often stated that drill steel deteriorates with use. The repeated blows are said to result in crystallization which weakens the steel and results in increase in breakage. The general belief that such is the case seems, however, to be based more on the plausibility of a theory than on the records of users of drill steel. The following record of broken drills indicates that crystallization from use is not such an important factor in breakage as many believe.

A company using 1¼-in. round hollow drills had the following breakage record: Out of 77,305 drills sharpened in the period Feb. 1 to May 1, 1915, 3,570 drills or 4.62 per cent were broken. The same steel resharpened during the period May 10 to August 9, 1915, showed: Out of 85,882 drills sharpened, 2,883 drills, or 3.35 per cent were broken. In the period March 1 to May 29, 1916, out of 54,285 drills sharpened 1,447 drills or 2.67 per cent were broken.

The same company shows similar results from 1-in. hexagonal hollow steel. Out of 116,750 drills sharpened in the period March 1 to September 4, 1916, 208 drills or 0.18 per cent were broken while out of 132,750 drills sharpened in the period September 4 to December 26, 1916, 86 drills or 0.06 per cent were broken.

This record does not afford much support to the opinion that drill steel deteriorates in service by reason of crystallization, though the higher percentage of failures in steel that has been in service for a shorter time may be due to defective steel breaking soon after being put in service.

If crystallization from service is of any importance at all it is evidently quite negligible in comparison with other factors. In this careful record of a large number of drills there is conclusive evidence that as the steel is longer in use the percentage of broken drills becomes smaller.

The figures given above are also illustrative of another important fact concerning breakage in drills. The use of the smaller diameter drill results in an enormous decrease in breakage.

COAL TRADE OF NOVA SCOTIA DURING 1916

A Resume, and a Retrospect.

By F. W. Gray.

With this account of the coal trade of Nova Scotia during 1916, the writer completes a ten years period during which a review of each year's operations has been contributed to the Canadian Mining Journal, and it may be of interest to its readers to briefly look back at the progress of the coal trade during the decade commencing with 1907.

The information contained in the following table has been kindly furnished by the individual coal companies, and with the exception of the figures relating to the smaller companies, may be taken as showing the actual production of the collieries named for the calendar years under review. Statistics relating to the yearly production of Nova Scotia are difficult to obtain, as published tables refer either to sales, or to the fiscal year of the Nova Sotia Mines Department, which ends 30th September.

Dealing solely with the production of Nova Scotia, without relation to outside interests, the following table shows the annual outputs in the decade under review:

Annual Coal Production of Nova Scotia.

	Tons of 2,240 lbs.
1907	5,775,503
1908	6,076,330
1909	5,106,135
1910	5,817,109
1911	6.362 099
1912	6,995.289
1913	7,263,485
1914	6,650 038
1915	6,715,000
1916	6,173,000

Production of the Coal Companies of Nova Scotia, by Calendar Years.

(Long Tons)

Companies.	1907 Tons.	1908 Tons.	1909 Tons.	1910 Tons.	1911 Tons.	1912 Tons.	1913 Tons.	1914 Tons.	1915 Tons.	1916 Tons.
Dominion Coal Co.:										
Glace Bay	3,541,253	3,555,068	2,734,774	3,526,754	3,984,749	4,513,269	4,739,149	4,287,717	4,608,979	4,091,000
Springhill	338,857	450,292	262,985	86,982	266,308	419,096	381,434	417,406	400,791	350,000
Nova Scotia Steel and Coal Co	638,065	680,772	813,453	840,728	780,468	841,528	813,877	752,153	611,923	605,000
Acadia Coal Co	395,963	407,439	361,279	373,550	480,648	435,654	539,121	394,397	340,975	395,000
Intercolonial Coal Mining Co	307,844	305,913	293,314	264,705	262,820	235,857	189,550	213,289	177,977	144,000
Inverness Coal Co	259,056	286,234	260,858	286,935	291,753	279,318	293,847	264,842	245,579	265,000
Maritime Coal, Railway & Power Co	63,132	59,047	127,590	181,272	169,625	166,477	155,051	141,830	175,482	198,000
Minudie Coal Co						60,000	65,500	70,000	86,000	80,000
Colonial Coal Co. (and successors)	231,333	331,565	251,882	256,183	125,728	36,897	65,844	53,134	56,000	40,000
Cape Breton Coal, Iron and Railway Co						....	8,424	49,000	6,000	....
Other small companies						7,193	11,688	6,270	5,294	5,000
Total	5,775,503	6,076,330	5,106,135	5,817,109	6,362,099	6,995,289	7,263,485	6,650,038	6,715,000	6,173,000
Cape Breton Island	77%	75%	75%	81%	80%	81%	81¾%	81½%	82½%	81%
Nova Scotia	23%	25%	25%	19%	20%	19%	18¼%	18½%	17½%	19%

The relation of the coal production of Nova Scotia to the total Canadian production and to the imports of coal into Canada is shown by the accompanying photograph. Up to about 1898 the coal mines of Nova Scotia produced nearly all the coal output of Canada, and although from that year onwards the output of the Canadian west has steadily increased, yet even to-day no less than half the coal production of Canada stands to the credit of Nova Scotia. Up to about 1910 the importations of coal into Canada were less than the home production, but since that date a significant change is to be noted in the curves, and Canada has ceased to supply its own needs in coal. The drop of imports shown in 1915 may be taken as a passing effect of initial war conditions, and during 1916 and 1917 the tendency of the coal imports to exceed the home production will be found to reassert itself with greater emphasis because of the serious drop in Canadian coal outputs.

The natural progress of outputs was interrupted and hindered in 1909 by the numerous strikes occasioned by the abortive efforts of the United Mine Workers of America to control the miners' unions of the Province. The maximum production was reached in 1913, but the record figure of a little over 7¼ million tons to the credit of 1913 did not actually represent the maximum capacity of the Nova Scotia collieries for output at that time, as the trade depression which preceded the war first manifested itself about the middle of 1913, and the collieries did not work full time during the last half of that year. A production of 7½ million tons probably represents the maximum possibility of the Nova Scotia collieries under present conditions of development, and therefore the output of 6.170,000 tons in 1916 represents a decline of 1¼ million tons below capacity for output.

In a period when the necessity for increased production of raw materials is being preached by the

responsible statesmen of every belligerent nation, this very considerable diminution in the production of our most important raw material is sufficiently serious, particularly so when the low figures of 1916 follow large recessions in output during the preceding years of 1914 and 1915, but a still more serious aspect is the probability that the tonnages of 1917 will show a further decline, probably to between 5½ and 5¾ million tons, or say two million tons below the maximum possibility.

A combination of circumstances is responsible for the decline in production.

Foremost and chief among these is the loss of 5,000 colliery workers by enlistment for service at the front, and the fact that a preponderating proportion of these enlistments has been from among the skilled underground workers. The colliery districts of Nova Scotia were for a long time the most fruitful field for the labors of the recruiting sergeants, who flocked into the mining villages to recruit men for units having their headquarters as far away as New Brunswick and Quebec. During the past year, recruiting activities have been restricted throughout the colliery districts, but unfortunately the paramount necessity for coal was not recognized by the authorities until the output capacity of the collieries had been irremediably crippled for the further duration of the war, and, even to-day, the men who are helping the general cause by digging coal have been granted no official recognition of their status as munition workers. If the miner is not a munition worker and entitled to an official badge, who is? He produces the basic, indispensable, essential munition of war, without which not a wheel could turn, nor men or shells be forwarded to the front.

Other factors tending to restrict production are the practical cessation of expenditure on new developments since the Spring of 1913, and the increasing physical difficulties attendant on the mining of coal in Nova Scotia, such as increased depths of extraction, increased proportion of coal won from submarine areas, lengthened haulages, and an unfortunate succession of underground fires at the mainland collieries that has considerably restricted production.

All these causes, however, are to-day subordinated to the shortage of skilled miners, and no amount of new development or capital expenditure will permit of an increase in coal outputs until "the boys come home."

The year 1916 has seen a succession of wage increases granted in quicker rotation and more substantial in amount than in any previous comparable period in the history of coal mining in the Province. Increases in wages aggregating 25 per cent have been given within dates less than six months apart. Yet while these increases in wages have within the past twelve months been so accelerated as to attract general attention, the steady increase during the past ten years probably represents a more permanent and serious problem than the temporary unsettling of markets and staple prices by war conditions. During the past ten years a steady upward tendency has been observable in the rate of wages and the price of all materials entering into the production of coal.

The various increases and adjustments that have been made in the wages paid to colliery workers are too numerous and various to be here enumerated, but, generally speaking, it may be stated that wages since 1907 have advanced by from 45 per cent to 50 per cent. For example, the standard minimum daily wage for ordinary unskilled labor at the mines in the Sydney district has advanced from $1.38 in 1907 to $2.10 in 1916.

The increase in the cost of materials is not less striking. The following comparison between the price of certain principal items of colliery material needs no comment.

	Price in— 1907	1916
Pit Horses, each	$90.00	$175.00
Oats, per bushel	.55	.70
Brattice Cloth, per sq. yd.	.13	.21
Red Brick, per thousand	8.50	13.00
Fire Brick, per thousand	25.00	46.00
Powder, Black, per lb.	.12¼	.15¼
" Permissible	.15¼	.18½
Detonators, per thousand	25.00	58.00
Harness Leather, per lb.	.35	.52
Copper, ingot, per lb.	.16½	.33
Shovels, per doz.	8.70	11.50

These are given as representative items, but there are many others. All iron and steel materials, which enter largely into colliery requirements, have advanced from 25 per cent to 50 per cent. Such materials as hoisting and haulage ropes, pit rails, spikes, air and water pipe, pit props and lumber, tub-wheels and axles, boiler tubes and fittings have steadily mounted in price, as have also oils of various kinds, cotton waste, etc.

Legislative enactments have laid additional burdens on the industry. A general increase of the Government royalty on coal was made in 1913, raising this from 10 cents to 12½ cents per ton.

The Workmen's Compensation Act of 1910 did not apply directly to the coal companies, who were exempted by virtue of the existence of the Relief Societies, but it necessitated increased contributions to these societies that represented an increased cost of about 1½ cents per ton. The Compensation Act of 1915, which comes into force at the beginning of 1917, will cost between three and four cents per ton.

Apart altogether from the increased cost of mining coal, due to the enhanced rates of wages and material costs, is the increase due to the operation of physical causes already alluded to.

The coincident operation of all the foregoing factors of increased cost have brought about a formidable enlargement of the cost of mining and marketing coal, that has not been accompanied by a proportionate enlargement of the selling price. It is true that within the past six months there have been increases in the selling price of coal, and there have been notable advances in the cost of coal to the individual consumer, particularly in the cities, but these increases have represented very largely the greater cost of transportation to market centres and also, to an extent not perhaps appreciated, the greater cost of distribution to the consumer in its final stages. The net enhancement of selling prices at the pit mouth has been far below the increase in the cost of mining, and, if the items of transportation and distribution are eliminated, it may be stated with accuracy that the increase in the selling price of coal as a commodity shows a smaller increment of profit to the producer than other indispensable commodities with which it may fairly be compared, such as flour, leather, groceries and other contributors to the much-debated cost of living.

A statement of wider application may be properly made, namely, that taking into consideration the selling price of coal in other countries, the cost of wages

and materials in Nova Scotia, and the margin of profit left to the coal operator, the price of coal in Nova Scotia has never within the past 25 years been sufficiently high to make coal-mining a reasonably paying investment or to secure the financial stability of the companies engaged in the mining of coal in Nova Scotia.

Under the conditions of increasing costs of production combined with stationary selling prices that have marked the last ten years, it has only been possible for the coal companies to show a profit by the introduction of economies of operation necessitating new modern plants and the utilization of refuse coal and by-products. This has required large capital expenditure, but it does not yet seem to have been recognized that such enterprise is not suitably rewarded by a saving in operating costs, unless the margin of profit will also allow for the repayment of the capital invested, plus a reasonable interest return. There are very few coal companies in Nova Scotia that have been able to pay an interest return to the common stock shareholders, and the companies are still fewer that have been able to recoup their capital outlay.

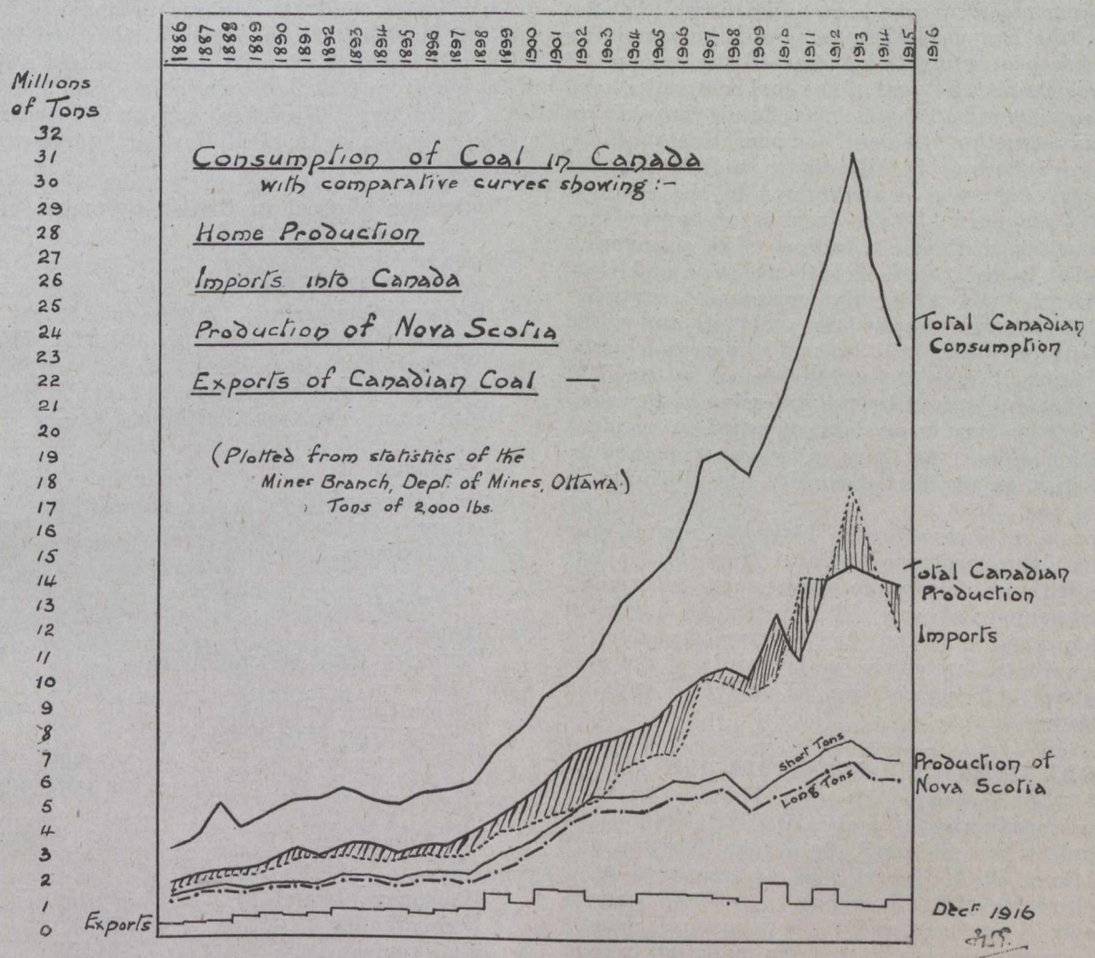
It is therefore quite evident, apart from the temporary disturbance occasioned by the war, that a considerable and permanent increase in the selling price of coal is inevitable in Nova Scotia.

A feature of the year has been the insistent local demand for coal, largely due of course to the increased consumption of coal in iron and steel manufacture, and when this demand has been coincident with a diminished output and a sharp demand for bunker coals f.o.b. at Nova Scotian ports, it has resulted in a marked decline in the amount of coal available for the St. Lawrence market. The export of Nova Scotian coal to St. Lawrence ports in 1916 was only one quarter of the normal shipments, and indications are that next year not even this small quantity will be available.

The result is a pronounced increase in the importations of United States coal, at prevailing high prices of transportation and initial cost, and the loss to the Nova Scotia operators of a market that it has cost much effort to cultivate.

From the national point of view the increased revenue of the Customs Department in import duties is scarcely sufficient to offset the foolishness of spending millions on the purchase of United States coal, while simultaneously the Canadian coal production is steadily dropping. The effect on our national finances is tantamount to raising a loan in the United States at high rates of interest, and it adversely affects both our money exchanges with New York and our national earning power, to say nothing of the larger question of dependence upon our neighbors for such an essential weapon of warfare as coal.

A matter of some interest to the industry is the coming into effect of the Workmen's Compensation Act of 1915, which operates from the 1st of January 1917. This Act supersedes the Compensation Act of 1910 and substitutes a scheme of pensions for the lump sum payments that the old Act prescribed in cases of death or permanent disablement. The new Act is largely



Consumption of Coal in Canada

modelled on the Ontario Act, and is to be administered by a Government Board dealing directly with the workmen affected. The burdens imposed upon the employer by the new Act are much greater than those of the previous legislation, and this has raised in an acute manner the future maintenance of the colliery relief societies for the disbursement of sickness relief. Seeing that the employer has to pay accident compensation at a greatly increased rate, it is hardly to be expected that he can continue to contribute towards the maintenance of sickness funds also, and thus the workmen, for the first time, are faced with the necessity of maintaining sickness funds at their own expense. The situation is rendered more difficult because the income of the sickness funds has been reduced by the loss of young members who have enlisted, while at the same time, the increased average age of the remaining members has proportionately increased the amount of the sickness claims. Several of the coal companies have offered generous aid to the sickness funds in addition to the payments for accident compensation, but the workmen are finding it difficult to understand the necessity for increased contributions to the sickness funds on their part. The reason is of course that whereas in the past the contributions of the companies were applied to the relief of both accident and sickness, under the new order the companies' contributions will be entirely applied to accident, and while the accident payments will be much more adequate, the workmen will have to bear the deficit in the sickness contributions caused by the diversion of the companies' contributions from sickness relief to accident compensation alone. As there is twice as much sickness disability as accident disability, the difficulty is a very real one.

Once more it is due to the Navy to remind our readers that the coastwise trade of Nova Scotia has proceeded without molestation by our enemies throughout a third summer of war. This statement may seem bald perhaps and trite, but the accomplished fact is a modern miracle, for which, in the words of the new national grace before meat, we "Thank God and the British Navy."

COAL IN BRITISH COLUMBIA, 1916.

By E. Jacobs, Victoria, B.C.

The gross production of coal in British Columbia in 1916, including the coal made into coke, is estimated to have been 2,795 400 short tons as compared with 2 209,290 tons in 1915. It being the official custom of the province, however, and of the Vancouver Island coal-mining companies too, to record production in tons of 2,240 lb., it will be more convenient to make comparisons in that measure. Accordingly, the gross production in 1916 is estimated at 2,495 893 long tons, against 1,972.580 tons in 1915 and 2,166,428 tons in 1914. The figures given for 1916 are subject to revision, since the production for the month of December has had to be estimated, but it is not thought probable there will be any considerable change made from the total now estimated. The following table shows the annual totals for seven years:

	Tons of 2,240 lb.
1916 (estimated)	2,495,893
1915	1,972,580
1914	2,166,428
1913	2.570,760
1912	3,025,709
1911	2,297,718
1910	3,139,235

The coal-mining companies operating in British Columbia had in 1916 to contend against conditions that were not favorable to a very considerable increase in total quantity of coal produced, and this notwithstanding that the demand for coal was greater than in any of several previous years. First there was a general shortage of labor for coal-mining, caused in part by the enlistment for service in the European war of many of the English-speaking workers, and in part by the continued internment of a considerable number of "alien enemy" miners, who were not permitted to work in the coal mines but were detained under guard in internment camps. Then there were, so far as the mines of the Crow's Nest Pass Coal Co., were concerned, interruptions from an explosion in one of the Michel mines, and the serious damage to the mine making the biggest production at the Coal Creek colliery by a series of "bumps" which caused a reduction of output from that particular mine from 1,500 tons to 500 tons a day. However, substantial progress was made, as is shown in the following figures of production:

Production of Coal in British Columbia in 1916.

		Tons of 2,240 lb.
Vancouver Island		
Canadian Collieries—		
Comox (Cumberland) mines	453,122	
Extension mines	262,377	715,499
Western Fuel Co.		560.000
Pacific Coast Coal Mines		155,000
Vancouver-Nanaimo Coal Mng. Co.		79,957
Total		1,510,456
Nicola Valley—		
Inland Coal and Coke Co.		30,849
Middlesboro Collieries		49,146
Total		79,995
Similkameen—		
Princeton Coal and Land Co.		24,553
Crownsnest—		
Corbin Coal and Coke Co.		68,896
Crow's Nest Pass Coal Co.—		
Coal Creek	567,535	
Michel	244,458	811,993
Total		880,889
Summary—		
Vancouver Island	1,510,456	
Nicola Valley	79,995	
Similkameen	24.553	
Crow's Nest (East Kootenay)	880,889	
Gross production of coal.	2,495,893	

The increase in gross production of coal in 1916 as compared with 1915 was 523,313 tons. With one unimportant exception, that of the Inland Coal and Coke Co. of Nicola Valley, which produced 3,861 tons less than in 1915, all the companies whose figures are given in the accompanying table of production made an increase. The respective increases of the several companies were as follows: Canadian Collieries (Comox and Extension), 287,687 tons; Western Fuel Co., 144-277 tons; Vancouver-Nanaimo Co., 31,981 tons; Pacific Coast Coal Mines, 25,568 tons; Crow's Nest Pass Coal Co (Coal Creek and Michel), 21.965 tons; Princeton Coal and Land Co., 9,005 tons; Corbin Coal and Coke Co., 6,352 tons; Middlesboro Collieries, 1,343 tons; total 528,179. Of this total there must be deducted de-

creases of 3,861 tons of the Inland Coal and Coke Co., and 1,005 tons of syndicate that operated in Nicola Valley in 1915 but was not among the 1916 producers.

Figures of coal made into coke are estimates based on the average quantity of coal it took to each ton of coke in 1915, it is estimated that 92,405 tons of coal was used in making 28,044 tons of coke at the ovens of the Canadian Collieries, Limited, at Union Bay, Vancouver island, and that the Crow's Nest Pass Coal Co. used 187,050 tons of slack coal at its ovens at Fernie to make 129,000 tons of coke, and 164,475 tons at its Michel ovens to make 113,431 tons of coke. The coke figures total 270,475 tons, which quantity, manufactured in 1916, compares with 245,871 tons in 1915 and 234.577 tons in 1914. The coke made at the Crow's Nest Pass Coal Co's ovens was used chiefly at smelting works in the Kootenay and Boundary districts of British Columbia, which works would have taken more coke had it been obtainable; that made on Vancouver island was used at the Granby Consolidated Co's smelting works at Anyox, Observatory inlet.

Concerning value of products, it has been customary to calculate coal at $3.50 a long ton and coke at $6. If this custom be adhered to in arriving at the value of the mineral production of the province in 1916, it will give the following results: Net coal (that is, after deduction of 443,930 tons made into coke) 2,051,963 tons at $3.50, $7,181,870; coke, 270,475 tons at $6, $1,622 850. Total value of coal and coke, $8,804,720. The value of coal in 1915 was $5,638,952, and of coke $1,475,226; total value, $7,114.178; so the increase in value in 1916 over 1915 was $1,690,542 on the assumption that similar prices, not higher ones, will be used officially for the 1916 production.

Vancouver Island Coal Mines.

The Canadian Collieries (Dunsmuir) Limited, operates several mines at each of its two collieries, the Comox colliery, in the neighborhood of Cumberland, some distance north of Nanaimo, and the Extension colliery, south of that old-established coal-mining center. As no reply was received from an application to the manager, Comox, little can be stated other than that the mines worked were Nos. 4 and 7 slopes and Nos. 5 and 6 shafts. These are the mines in which much Oriental labor—Chinese and Japanese—is used underground; the last published official figures showed that out of a total of 795 employed underground, 376 were Orientals, 185 as miners, 133 as miners' helpers, and 58 as laborers. With the exception of five at Extension, nowhere else in the Province were Orientals employed at mining underground. This has been one of the sources of labor troubles on Vancouver Island, the Cumberland mines being notorious in this direction.

At Extension Nos. 1, 2, and 3 power house a new unit was added in 1916; this increased the power output by about 50 per cent. This unit is a Fleming sett with a 150 k.w. generator and compound engine. In No. 2 mine the No. 4 East section has again been opened and will add substantially to the future production of this mine. Much development work was done in No. 3 mine, the most important of which was the completion of a new air-shaft—a 300 ft. vertical raise. An Ottumwa 50 h.p. electric hoist was installed. At No. 4 shaft the plant has been electrified and power is now available for lighting, pumping, and hoisting purposes. A 4-stage electric turbine pump with 6 inch discharge was placed at the shaft bottom. The slope sections of this mine, which had been flooded since August, 1912, were unwatered and development work was resumed. In addition to the underground development, there was done about 2,500 feet of diamond core-drilling principally in hard conglomerate strata. At the washery on the shipping docks at Ladysmith a new unit was added and the two old units equipped with automatic positive feed from the bunkers and automatic rock discharge. A recovery plant for washery sludge was also put in. The gross output of coal was nearly 263,000 long tons as compared with 167,000 tons in 1915.

The Western Fuel Co's output was approximately 560,000 tons, as compared with 415,723 tons in 1915. The company operated in 1916 its No. 1 shaft, Esplanade, Nanaimo, and connecting mines, and its Reserve mine, situated five south of No. 1; the coal in the Reserve mine is reached by two shafts at a depth of 955 ft.; from these a rock-tunnel, 8 by 16 ft. in area, is driven across the measures on a one-per-cent. grade to the raise, and it entered the seam at a distance of 180 ft. The shaft bottom is arranged in a most up-to-date way for the handling of large quantities of coal. All the tracks are laid with 30 lb. rails and on a grade of one per cent. from the shaft. All the main tunnels leading to this shaft have been retimbered with 12 by 12 in. timbers. Levels have been driven both westerly and easterly. The seam worked in this mine is the well-known Douglas seam. In one of the reports of the mine inspector it is stated that in the development work done the seam shows a thickness of from one foot to twenty feet.

The Pacific Coast Coal Mines, Limited, operates two collieries, namely the South Wellington and the Morden. The latter is known as No. 3 mine; it is a comparatively new mine, with reinforced concrete headframe and new equipment throughout. Two shafts reach the coal at about 600 ft. depth; after working for a time on a temporary bottom, a permanent bottom has been made at 6 ft. greater depth, and a rock slope has been driven about 900 ft. The coal is of excellent quality varying in thickness from 5 ft. upward; where the slope entered it the width was found to be 28 ft. Permanent electrically driven pumps have been installed. A new lamp-house and an office were erected and other surface improvements were made during the year. At the shipping place, Boat harbor, seven miles away, a new coal washery was put in, and a new pier was constructed, commencing 60 ft. outside the old T-head pier and extending seaward for 400 ft. Its total width is 45 ft.; its height from the caps to the top of the superstructure is 52 ft. Nearly 500,000 ft. of lumber has been used in making this improvement, a prominent feature in which is a moveable tower for loading the coal, the tower travelling the whole length of the pier on a 12-ft. gauge track. An incline belt conveys the coal from the electrically operated conveyor belt that brings it along the pier above, and delivers it into the hold of the vessel, this loading belt being lowered to 21 ft. or raised as high as 72 ft. above water level, as required by the stage of the tide. The height of the tower is about 60 ft.; its mechanism is operated by an electric motor. Its delivery capacity is approximately 300 tons of coal an hour. This tower is believed to be an unique feature among the coal-loading appliances on the northern Pacific coast, and it is equal to loading with coal the largest ship at the present time voyaging off the Pacific

coast. To facilitate the handling of the coal along the new pier, a big electric generator is being installed in the power-house on the shore and a motor at the end of the new pier.

Nicola and Princeton Coal Mines.

The Middlesboro Collieries, Ltd., and the Inland Coal and Coke Co., Ltd., are the principal operating companies in the Nicola district. The latter company is stated to have acquired the property of a smaller neighbor, and the property of the Diamond Vale Company is to be operated under a new organization.

The Middlesboro colliery consists of No. 2 mine, in the Upper or Coldwater Hill series of coal seams, and Nos. 4, 4 East, and 7 mines in the Lower or Coal Gully series. During 1916 no development work was done other than that of extending the main slopes and levels in Nos. 4, 4 East, and 7 mines. No new mines nor seams were opened, nor was there any new plant put in the colliery having been previously well-equipped with tipple, power plant, and all requisite accessories. Demands for coal were light throughout the spring and summer, consequently the mines were worked only about four days a week, but there was a distinct improvement in the autumn, so that during the last three months of the year they were operated full time, and the company was unable to get sufficient miners to allow of its accepting all the business that offered. The output of coal for the year was between 49,000 and 50,000 tons, which was more than that of 1915.

No reply was received from the Inland Coal and Coke Co., but it is known, as already stated in this review, that its production of coal was somewhat smaller than in 1915.

The Princeton Coal and Land Co., Ltd., operating at Princeton, Similkameen, in 1916 added to its coal-handling plant a new bunker and screens to enable pea coal to be made. This colliery is now equipped for shipping coal in the following grades: Lump, over 3-in. bar screen; egg, over 2-in. shaker screen and through 3-in. bar screen; nut, over ¾-in. and through 2-in. shaker screens; pea, over ⅜-in. and through ¾-in. shaker screens, and mine-run. These grades all feed on to the same conveyor belt, so that any combination of them, if required, can be loaded into the same railway car. In 1916 considerable underground development work was done, including new haulage-way, new airway, opening No. 2 mine to the surface, new levels, etc. The main slope is now down 2300 ft. and new levels East and West are being laid off at that point. The coal shows marked improvement in quality at depth. In November the output was about 240 tons a day, and it was expected that an increase to 300 tons a day would be made before the middle of December. The year's output of about 24,500 tons compares with 15,500 tons in 1915, the increase being approximately 9000 long tons.

Crow's Nest Coal Mines.

No information concerning the Crow's Nest Pass Coal Co.'s mines was supplied. The company's output in 1916 was approximately 812,000 long tons gross; as already stated, it is estimated that 351,500 tons was used in making 242,400 tons of coke, which leaves the net output of coal at about 460,500 tons. At the Coal Creek colliery the mines operated were No. 1 East, No. 2, No. 3, No. 1 South, No. 1 North, No. 9, and B. North. A new fan—a Keith-Wheel fan, capacity 100,000 cu. ft. per min.—was put in at No. 1 North and No. 1 South. The damage done by "bumps," to which reference has already been made, was in No. 1 East mine, which had previously been the most productive mine of all being worked at Coal Creek. The mines worked at the company's Michel colliery are No. 3, No. 3 East, and No. 8 North. Repair work has been in progress in No. 3 East since the explosion in that mine last August, but no coal was being produced.

The Corbin Coal and Coke Co.'s production of nearly 69,000 long tons of coal shows an increase as compared with its output in 1915 of more than 6000 tons. There were not any new developments in the underground workings, but at No. 3 open-cut mine, also known as the "Big Showing," which is worked both on the surface and underground, stripping work was continued. Additions made to equipment for stripping were one Class 45C Bucyrus steam shovel and eight 20-yard air dump cars. A transfer plant was put in and connected with the Marcus screen at No. 4 mine, this being to handle the coal from the open-cut whenever grading and sorting of that coal is required to be done. The coal is dumped from the railway cars into a hopper feeding on to an apron conveyor 172 ft. long, which conveys the coal up a pitch of 11 deg. and discharges it on to the Marcus screen, where it is screened.

Mine-Rescue and First-Aid Training.

During 1916 there were issued 103 certificates of competency in mine-rescue work, as compared with 57 in 1915. Most of the men who passed the examinations in this connection were trained at the Provincial Government mine-rescue stations. The number of men who obtained the St. John Ambulance Association certificate of competency in first-aid work was 124 out of the 220 who attended the lectures at the coal mines. Not all presented themselves for examination, however. In 1915 the number at the coal mines who passed was 242, and in 1914, 85.

AMERICAN INTERNATIONAL MINING SOCIETIES

Special Correspondence.

In North America there are at least two great international societies whose activities are connected with the mineral industry. These are the American Institute of Mining Engineers and the Geological Society of America. Both of these societies include many Canadians in their membership, and men from Canada nearly always occupy places at the council boards of each. At times it would appear that Canadians, owing to the liberal spirit shown by United States members, occupy more than their due share in the councils. In 1917, for instance, the president of the Geological Society is a Canadian, and two vice-presidents were born in Canada. Two years ago the president was also a Canadian. It is very pleasant to Canadian members to find such a broad, truly international spirit prevailing in this Society.

The meeting of the American Institute of Mining Engineers takes place annually in New York in February. This year's meeting is to be a very important one, and should be attended by all Canadian mining engineers who can find time to do so. The home of the Institute is the finest building devoted to engineering to be found anywhere. The annual meeting is inspiring, and a visitor should not fail to see the splendid combined library of the Institute and other engineering societies.

The meeting of the Geological Society of America is held annually between Christmas and New Year's day. This year's meeting was in Albany, the capital of the Empire State. It was one of the largest and best that has been held. The president was Dr. John M. Clarke, the distinguished State Geologist of New York. The Geological Survey of this State is the oldest in America, having been in continuous operation since 1836. The first State Paleontologist, the late Dr. James Hall, and Dr. Clarke have a continuous service record between them of over eighty years. And it may be added that Dr. Clarke should easily add twenty years more and thus round off the century of service. That the New York Geological Survey has had a wide influence on science, not only within the boundaries of the State but elsewhere, is shown, for instance, in the wide use of such formational names as Trenton, Utica, Hudson River, Medina, Clinton, Oneida, etc., etc. It was a pleasure to the visitors in Albany to see that this the oldest of the state surveys not only shows no signs of decadence but as the years go on it is increasing its field of usefulness, both in an educational sense and in a direct economic way. It was a source of satisfaction at the more formal meetings to hear leading statesmen of New York speak so highly and appreciatively of the work of Dr. Clarke and the members of his staff.

It is recognized by everyone that, in order to achieve the best results, scientific work should be supported, not fitfully or spasmodically but continuously over a long period of years. New York is a good example of what may be achieved by such support. That this state is not alone in the fine position she occupies as an encourager of science was made evident when the veteran and ever youthful Professor B. K. Emerson of Amherst College playfully told Dr. Clarke at the annual dinner that, while the latter and his predecessor Dr. Hall had a service between them of over eighty years, he, Professor Emerson, and his predecessor, the late Professor Hitchcock, in the chair of geology at Amherst could claim an unbroken record of over ninety years.

New York state has recently erected at Albany, to house the departments of education and science, one of the finest buildings, architecturally and otherwise, in the world. The cost of the building, exclusive of the grounds, was about $4,500,000. The state geological survey and museum occupy an important part of the building. During the meeting of the Geological Society the formal opening of the museum took place. There were addresses by Governor Whitman and other public men, among them being Col. Roosevelt whose address was much enjoyed, at least by the Canadians present. The Colonel, while he said he was trying to give a scientific address, as befitted the occasion, did not neglect the opportunity to say what he thought of the action of certain of his countrymen during the Great War. He referred to the various collections in the museum, among them the beautiful exhibits of Indian life in the state, and showed how the Iroquois induced peace among the aborigines with benefit to all. Other exhibits were used to illustrate the same point. The Colonel's motto still appears to be the title of his book "Fear God and Take Your Own Part"—be loyal to the country to which you owe allegiance, no matter what your origin may have been, protect the weak and be prepared against aggression.

While many of the papers presented at the meetings of the Geological Society have little, if any, economic bearing, it is not safe to assume that they never will have. For instance, a few years ago glacial geology might have been considered to be a purely abstract science, but at present use is made of it in studying clay, gravel and sand resources and even water supply. Similarly an academic study of volcanic deposits, unconformities, faults and other features, frequently leads to a better understanding of structural relations in mining areas and thus becomes of economic importance.

In addition to the numerous papers dealing with so-called pure science, there are presented at every meeting others on subjects such as ore deposits, which everyone recognizes as having a direct economic bearing.

There are two other societies of an international character in North America that deal with mining, namely, the Mining and Metallurgical Society of America, and the American Mining Congress. The membership of the former is much less than that of the American Institute of Mining Engineers and is restricted to men with special qualifications. The American Mining Congress does not insist on technical qualifications from candidates for membership, and its work is more especially concerned with legislation and other matters affecting the industry.

It may be added that the Canadian Mining Institute, whose annual meeting in March is looked forward to with increasing interest by its members, is also international as regards its membership, but it is essentially a Canadian society, supplementing the work, in the northern half of the continent, of the American Institute, and dealing, moreover, with problems that do not come within the latter's scope.

There was a good representation from Canada at the Albany meeting. From Ottawa came Messrs. Bancroft, Jr., Burling, Cairns, Johnston, Kindle and O'Neil, while Montreal was represented by Messrs. Adams, Bancroft, Sr., and Dresser; Kingston by Mr. Mather, and Toronto by Messrs. Coleman, Knight, Miller, Tyrrell and Walker. It may be added that the secretary of the Society is still marooned somewhere in the polar regions, and the members are greatly indebted to Professor Chas. P. Berkey of Columbia University who, in addition to his other onerous duties, has so efficiently performed the work of secretary in Dr. Hovey's absence. It was much regretted that Professor Kemp, who is so deservedly popular wherever he is known, was not present. Hope for his speedy recovery was expressed by all.

MURRAY-MOGRIDGE.

The stock of the Murray-Mogridge property is being offered for public subscription by J. M. Childerhose. This property is located at Wolf Lake in the township of Maisonville, and three or four miles from Bourkes station.

A road has been cut from the railway for the hauling of supplies, and work is proceeding at the property where a small staff of men are employed and preparations are under way for extensive development.

The property is considered to be a promising prospect.

HOLLINGER.

By May or June this year the Hollinger should be treating about a hundred thousand tons of ore a month. The mill addition building has been completed and machinery is now being installed. There will be in the enlarged mill 200 stamps, 20 tube mills and a ball mill.

SOME HISTORIC ROCK DRILLS

By H. B. Willmott*

The subject of machine rock drilling for boring shot holes is one of leading importance to the mining engineer. With the old methods of hand mining, progress was laborious directly hard ground was encountered, and the output in any given case was always restricted, owing to the expensive and difficult conditions surrounding the sinking of shafts and the driving of drifts and raises. In the present condition of mining, when high grade ore bodies are few and far between, and when the future of the industry is essentially the working of low grade propositions and, consequently, the quick output of large tonnage, much ore mining would be commercially impracticable without the aid of the rock drill, which bores its way through rock at the rate of hundreds of blows per minute, each harder than any blow possible by hand labor. In this as in most other mining operations, the days of competition between mechanical power and human muscle are over. It therefore may be safely said the rock drill has been the most important mechanical factor in the remarkable development of metalliferous mining to the present day.

To the civil engineer the subject is of equal importance. Many engineering schemes necessitating the removal of large quantities of hard rock, owe their successful completion to the assistance of the machine drill. The Mont Cenis and St. Gothard tunnels, respectively 7½ and 9¼ miles long, the 34 mile Croton Aqueduct tunnel, the Chicago drainage canal, which involved the removal of fourteen million cubic yards of solid rock, and more recently, the 12 mile Simplon tunnel, and still more recently the Pennsylvania Railway Terminals at New York, the Mount Royal tunnel and the Rogers Pass tunnel, are notable examples. To these must be added numerous other important canal, tunnel, railway cuts, dock, harbor, sewage and other public works, where the rock drill has been employed, and without which the expense and difficulties would often have proven prohibitive. In quarrying also the present enormous output of dimension and road stone at low cost owes much to mechanical boring.

With the exception of the Simplon tunnel, and a few comparatively isolated instances, the whole of the world's machine drilling in hard rock, down to within the last few years, has practically been accomplished by means of striking or reciprocating machines, in which the drill bit is an extension of the piston rod, and is actuated by steam or compressed air.

8 **The Old Method**

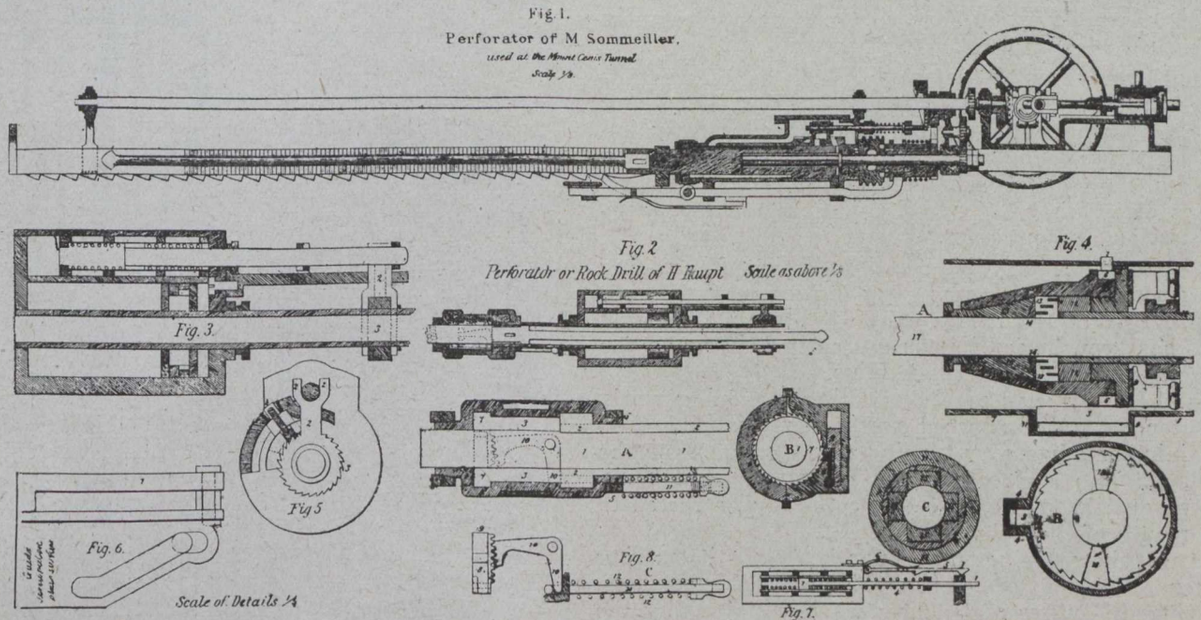
The reciprocating machines of this earlier date were not by any means last. The Mont Cenis tunnel was perhaps the field where was solved the original problems of rock drill use. The tunnel was about eight miles long and was the first connecting link through the Alps of the French and Italian railway systems. From 1857 to 1861 the headings progressed at about the rate of eighteen inches per day. This was of course by hand labor, and using black blasting powder. When machine drills were introduced the speed of advance in each heading rose to nearly five feet in twenty-four hours, and when dynamite was introduced, to a little over six feet.

* Manager Drill and Compressor Department, Mussens, Limited, Montreal.

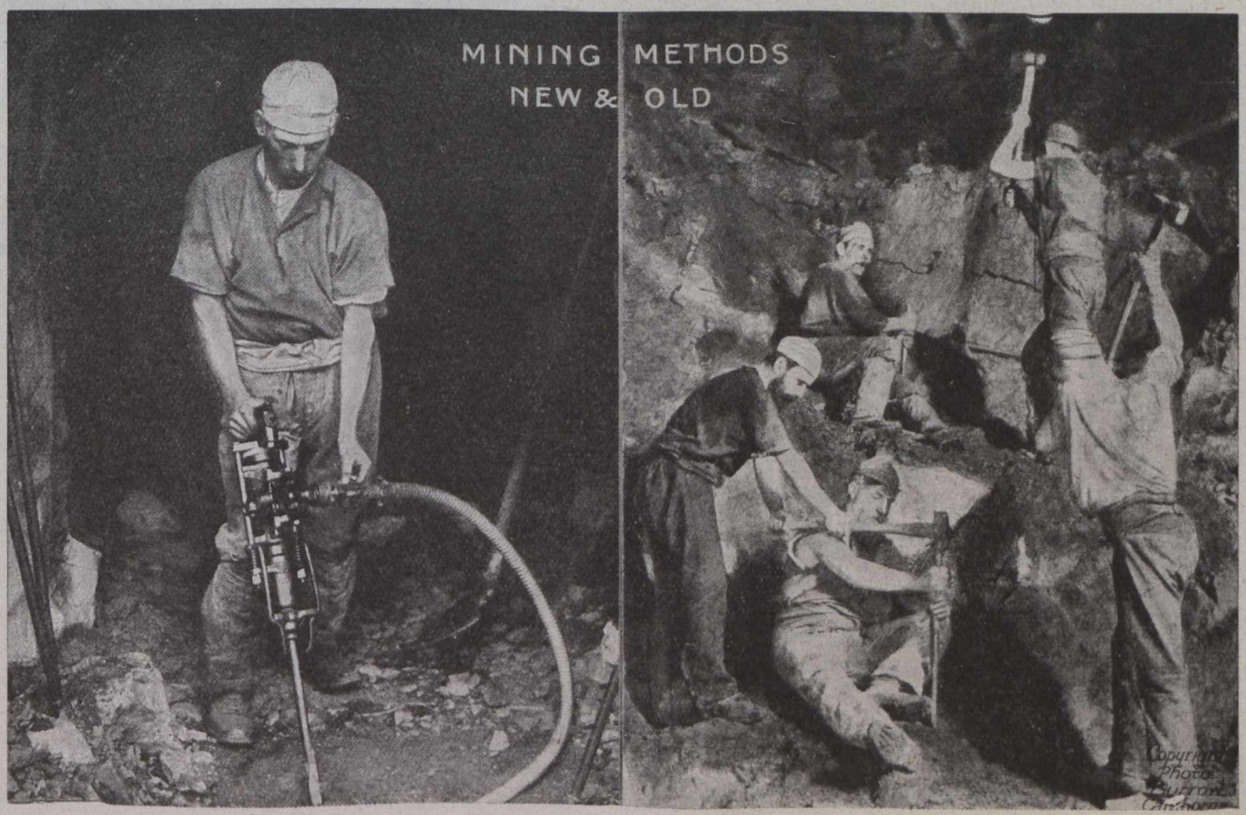
The history of rock drilling naturally commences with hand hammers, which have been used from time immemorial; the next step being perhaps lifting and dropping a weight in the manner still employed in pile driving, and subsequently early in the seventeenth century the employment of a trip hammer for holing. Only vertical holes, however, could be bored by this appliance.

The fluid driven drill did not arrive until the last century and many claims are made for its original invention. Thus in America it is decidedly an American idea, in Germany it is shown that its notion was Teutonic in its inception, whilst the French engineer would probably refer to one of his own countrymen as its inventor. The English claim Richard Trevithick as being closely associated with the first rock drill, for in 1813 he mentions in his letters a machine which bored holes in Plymouth limestone five times as fast as hand labor. This, however, was a rotary machine. About 1842 the idea of fastening a bit to the piston rod of a cylinder was embodied in the invention of Nasmyth's steam hammer.

In 1849 J. J. Couch of Philadelphia invented the first percussion rock drill. This drill contained the principal mechanical features still found in piston drills. Fowle of Boston shortly after patented a rock



Early Types



Old and New Methods of Drilling

drill which contained the idea of imparting a slow rotary movement to the reciprocating motion.

These early drills with their immediate successors were all steam driven. It was not until 1854 that drills were operated on air, when Bartlett's rock drill was tried out at the Mont Cenis tunnel.

Rock drills, however, were not used to any extent until many years had elapsed, as they were at that time heavy and cumbrous, and could only be practically used when mounted on a heavy carriage. Some of the difficulties encountered in the up-keep of these earlier drills may be gathered from the fact that at the Mont Cenis tunnel in 1867 no fewer than 200 Sommellier machines were kept on hand to run sixteen constantly at work.

Couch and Fowle's patents of 1849 have been followed by the well known names of Doering, Wood and others, by whom the machines have been greatly improved, so that to-day we are getting from a dozen sources, high class rock drills, the splendid achievements of which have materially contributed towards civilization and progress.

In passing it may be mentioned, that for mining work, machine boring was early introduced into Cornwall, England, and it is worthy of note, that the rock drill has been in continuous use since 1867 up to the present day at the Dolcoath Mine.

In the early days of rock drilling in mining work, a water jet was considered a necessity, the method of obtaining this being by turning a connection from the air main into a closed cistern of water, a jet being forced out through a hose connection and directed to the mouth of the hole.

It was, however, not infrequently found that a ring of tenacious mud formed some distance inside the hole, causing difficulties and delays when withdrawing the bit; this, and the inconvenience of excessive watering resulted in the total disuse of the jet system.

The spray system was then designed to allay the dust. This system while not popular is in more or less use in different parts of the world at the present time, more particularly perhaps, in connection with hammer drills.

The standard steam or air actuated rock drills gradually divided broadly in two classes according to valve gear, viz.: (a) the tappet type, in which a projection forming part of the reciprocating portion of the machine strikes the rocker arm or tappet, and moves a slide valve by direct contact, and (b) the fluid moved valve type, in which the piston itself, at certain points of its travel, admits a supply of fluid to move the valve, or to move the supplementary piston which in turn moves the valve.

There is a third arrangement, which may be termed the valveless type, in which the moving piston acts as its own valve, as during its stroke it alternately opens and closes certain ports, so that the fluid acts on each end of the piston in turn. This arrangement is still found in several pneumatic tool drills, and in hammer rock drills, but has been discarded for piston drills since the Darlington drill of 1873. The general arrangements of the tappet and air thrown valve drills are shown in the following two cuts, so that a detailed description of the parts is unnecessary. The present day reciprocating type rock drill follows in all essentials the general plan of these older machines.

The following chronological table is an interesting compilation of some of the most important events concerning rock drills, boring shot holes, explosives and

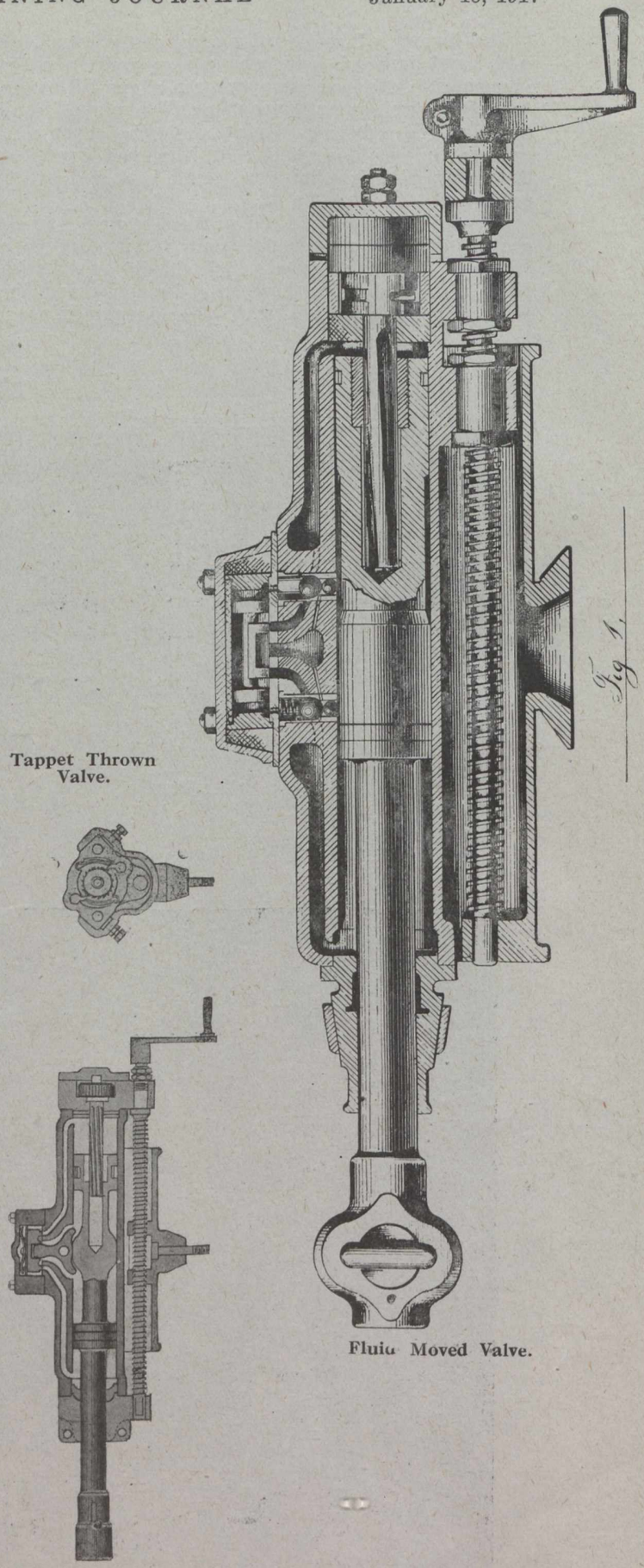


Fig. 1.

Tappet Thrown Valve.

Fluid Moved Valve.

blasting ground. It was partly compiled by Rziha and Drinker and is supplemented with additional information.

A.D.

1280 Albert Magnus, the German friar, describes an explosive powder.

1280 Roger Bacon notices the composition of an explosive powder.

1324 Berthold Schwartz is said to have invented gunpowder.

1412 Gunpowder manufactured in England.

1613 Martin Weigel, mining superintendent of Freiberg, proposed drilling and blasting in mines.

1670 German miners introduced blasting into England.

1685 Tamping with clay known in Saxony.

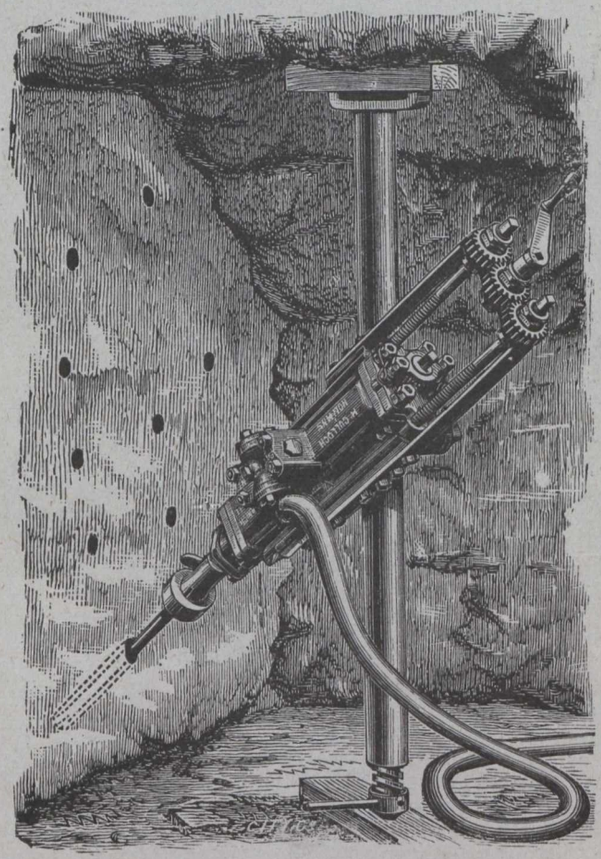


Fig. 11. Rock Drill in 1880.

1687 Lumbe introduced into the Harz, tamping with clay, and straws filled with powder for firing the shot holes.

1688 Singer of Clausthal employed small firing tubes of hard wood.

1689 Luft of Clausthal used paste-board cartridges.

1717 Fritsch proposed to save powder, and to break rock by wedges driven into the bore holes.

1725 At this date the simultaneous firing of several shots was known.

1749 Hungarian miners first introduced the chisel-bit drill into the Harz. For a period of one hundred and thirty-six years, from Weigal's day to this date, all drilling had been done by means of crown and cone "bits."

1759 Drilling with a chisel-bit introduced into Saxony.

1760 Thumberg introduced into Sweden tamping with wedges.

1791 Le Plat used sand as a tamping.

1795 Humboldt proposed making the shot holes wider at the bottom (of a conical shape).

1811 Spangenberg of Sahl, used wooden tamping rods, also wooden needles and soft clay for tamping.

1813 Trevithick invented a rotating boring machine, which was made at Hayle Foundry, Cornwall, and put into operation at some limestone quarries near Plymouth.

1823 Harris fired a blast by the electric spark.

1829 Needles made of a composition of lead and tin used in the district of Ehrenfridersdorf.

1829 Moses Shaw of New York fired several charges of powder simultaneously by passing an electric spark through a priming composed of the fulminate of silver.

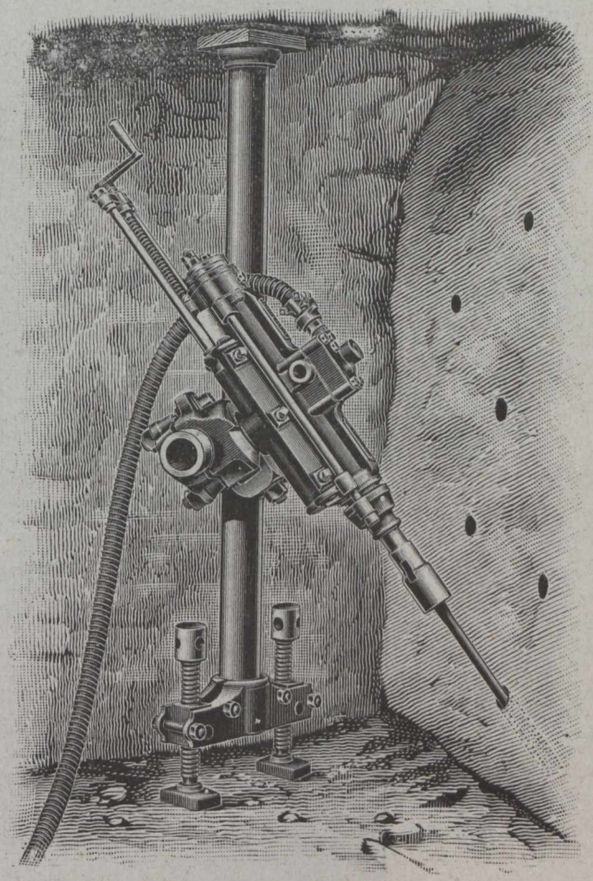


Fig. 12. Rock Drill in 1890.

1831 Bickford of Cambourne invented the safety fuse.

1834 Pischal proposed ignition of blasting powder by means of percussion.

1838 Prideaux used oxyhydrogen for deepening bore holes, and with it burnt a hole at the rate of one-eighth of an inch per minute.

1839 Hague injected water into air compressing cylinders.

1840 Bore holes made with rotary drills at Lankowily.

1840 Cast steel borers used in the Derbyshire mines.

1844 Brunton of Cornwall, proposed using compressed air for working drill hammers, the air after use to improve ventilation.

1845 Cast steel drills tested at Freiberg.

1846 Schonbein exhibited a sample of gun cotton at the British Association.

1847 Sobrero discovered nitro-glycerine.

1849 Randolph of Glasgow introduced into an air compressor, a spray of water for cooling the air during its compression.

1849 Couch of Philadelphia patented a "lance" percussion drill.

1850 Robert Hunt, E.R.S., made low tension electric fuses and used them in sinking a pit at the Abercarn Colliery, South Wales, the firing of the fuses having been performed by means of an electric battery. The holes were bored in one operation, and fired simultaneously in volleys. The holes were placed so as to obtain a "sink" of ground from the blast.

1861 On the first of January, Sommeiller's perfected drill commenced to work at the Mont Cenis tunnel.

1861 Lisbet applied his boring machine in soft rock (coal, soft limestone, etc.)

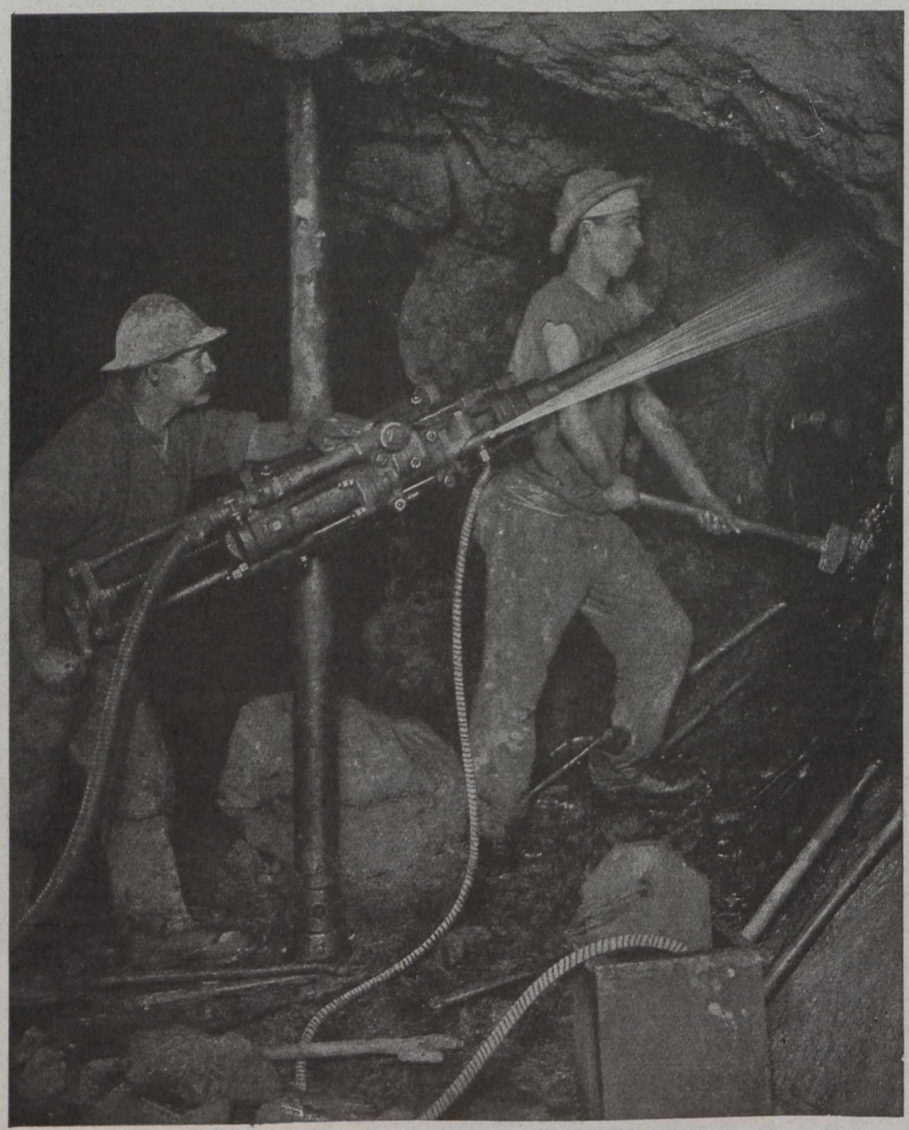
1862 Bornhardt's air-tight electric firing machine brought into successful use.

1863 Edward Crease introduced his rock boring machine into the Clogan Mines, North Wales.

1863 Lowe rock drill invented.

1863 Sach's rock drill invented.

1863 Nobel applied nitro-glycerine as a blasting agent.



Rock Drill Fitted With Spray Attachment

1851 Fowle of Philadelphia patented a direct action percussion drill.

1851 Cave of Paris invented a reciprocating percussion drill.

1853 Piatti proposed using compressed air in the construction of the Mont Cenis tunnel.

1854 Bartlett's rock drill tried at the Mont Cenis tunnel.

1854 Schumann invented his percussion power drill.

1857 Schumann's drill employed in the Frieberg mines.

1857 Sommeiller invented a drill for use in the Mont Cenis tunnel.

1857 Ebner employed a frictional machine for blasting.

1857 Schwarnzkopf's drill tried at Bingen.

1864 In March, Carl Sach's machine introduced in the Altenberg Mines, Aix-la-Chapelle.

1865 Gun cotton tried at Hoosac tunnel.

1866 Lithofracteur manufactured by Ergels near Cologne.

1866 Nitro-glycerine tried with great success in the Hoosac tunnel.

1866 Jordan and Darlington invented the rifle-bar and ratchet wheel for turning the piston carrying the drill.

1866 The Burleigh drill successfully introduced at the Hoosac tunnel.

1867 Jordan & Darlington invented the straight and spiral shot, and double ratchet wheel for turning the drill.

1867 Dynamite patented in England.

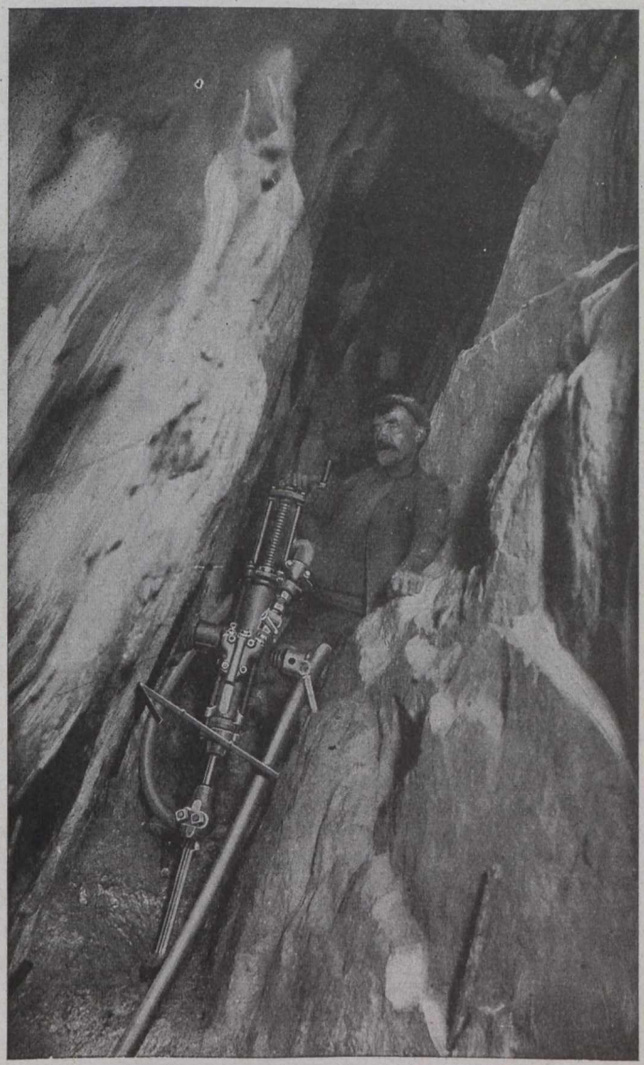
1867 Doering introduced his boring machine into the Tincroft Mines.

1867 Dubois & Francois rock drill invented.

1870 Beaumont & Appleby's diamond boring machinery introduced at the Croesor United Slate Quarries, North Wales.

1870 Sir George Denys, Bart., commenced driving an adit for the Old Gang Company, Yorkshire, by means of the McKean drills.

1873 The Ferroux rock drill invented.



A Piston Drill at Work in an 18-inch Stope

1873 The Darlington rock drill invented.

1874 The Mowbray mica powder patented.

1874 Electric blasting introduced by Darlington into the Minera Mines; Bonhardt's machines, the blasting stick, and wire electric fuses being employed for that purpose.

1874 Darlington invented the spinning piston.

1876 The Beaumont rock drill employed at Carn Brea.

The last forty years have been marked by brilliant achievement in almost every department to which the admirably compiled table refers. In rock drills, particularly, enormous strides have been made: Since 1876 other well known names have followed from practically every quarter of the globe. The long list of inventions, which in the present instance is simply hinted at, has greatly improved the rock drill, until to-day the great mining camps all over the world have high class machines, each contending for supremacy. In addition to the steam and air actuated piston drills, we have the electric drills, hydraulic drills, gasoline drills, hammer drills, and well drills. In concluding the table, however, the following events are probably worthy of note:

1879 Rock drills made at the Camborne Engineering Works—now Holman Bros.

1903 Air hammer rock drills first used.

1908 The world's record for incline shaft sinking made in South Africa.

1909 The world's record for driving made in South Africa.

1914 The world's record for tunnel driving made at Montreal, Canada.

The reciprocating rock drill to-day is a vastly improved machine over those used in the past. Not only are rock drills mechanically better but they are structurally better, and doubtless, as the years go by, further improvements will be made, until at last the "perfect machine" is achieved.

In closing, acknowledgment should be made to Messrs. Holman Brothers of Camborne, England, manufacturers of the well known line of Holman Rock Drills, for the cuts given herewith, and for a great deal of the information contained.

PLENAURUM.

It was announced at the meeting of McIntyre shareholders, held in Toronto on December 28, that a year's option has been secured on the Plenaurum property, which adjoins the Jupiter on the east. Although the terms of the option have not been announced, it was stated that the McIntyre was to spend $53,000 on the property within a year, for which it would receive stock in the Plenaurum company.

ACCIDENTS AT PORCUPINE.

Timmins, Jan. 4.—Wednesday of last week was "accident day" in the Porcupine Camp, no less than three serious accidents occuring and two deaths resulting.

Wednesday morning, at an early hour Geo. Mudato, a Russian, was blown to pieces at the Hollinger mine. Toni Mascioli, an Italian, who was working with him in the blasting operations, also received a bad shaking up, but was not seriously injured.

THE DOME MILL.

The present plan of mill extension at Dome Mines now gradually being carried out is the substitution of ball mills for stamps. There are now two ball mills and sixty stamps working, which can easily give a combined capacity of fifteen hundred tons a day. The sliming capacity of the mill does not exceed that, so until other sections than crushing have been enlarged there will be little change in mill capacity. It is proposed to instal five ball mills, each having a capacity of about five hundred tons a day.

SCHUMACHER.

Like most of the mines in Porcupine, the Schumacher is figuring on mill expansion. The mill, now treating about a hundred and forty tons a day, will be increased to 300 tons, and stock has been issued to cover the expenditure.

ROCK DRILLS

By M. M. Morrison.

The relative merits of rock drills are usually based on drilling speed, freedom of rotation and reciprocation, and the time required to change drills.

Drilling speed being the chief aim, the drill steel should be as small in cross section as the service will permit. Within economical and practical limits, a light drill will drill faster than a heavy one by reason of lower resistance to acceleration. Other things being equal, the drilling speeds of drills having bits of different diameters will vary inversely as the areas of the holes drilled. The smaller steel costs less per foot, is easier to carry, and does not break as frequently as steel of larger diameter.

The time devoted to actual drilling of the daily quota of holes for blasting is but one of several items that enter into the cost of mining. It may constitute a higher percentage of cost in some mines than in others and routine and appliances well suited to one mine may not be so well adapted for a different rock formation and different conditions. The hardness and abrasive qualities of rock formations differ, and while a blunt, obtuse bit may be the best form for drilling a hard, brittle formation, a sharper, or less obtuse bit may drill faster in softer, more tenacious rock, especially if it contains a calcareous, or other binding element, that imparts a tendency to pack under pressure.

Machinists find it profitable to grind their cutting tools at different angles for cutting different qualities of metal; so too, the mine manager may find it profitable to determine, by trial and observation, the bit angles best suited for his rock formation.

With a view to maintaining the diameter of the hole as nearly uniform, from start to finish, as may be economically practical, the outer corners of the vanes and the reaming shoulders should be the same radial distance from the centre, so that all that the cutting portion of the vanes will cut and ream in the same circle.

Since the corners of the forward cutting edge cut around the longer circumference they will be worn the most, and when they are much worn it will economize drilling time to replace the drill by a sharp one, of the same gauge, or a trifle smaller. The depth to which a drill will penetrate economically should determine the "run" or difference in length of successive drills.

A drill that is fit to use will drill a hole that is a little larger than the diameter of the bit, probably due to the abrasive action of the sludge, and the quivering of the bit against the sides of the hole. This slight clearance permits the drill to rotate and reciprocate with sufficient freedom.

By reason of greater flexibility the smaller steel will rotate more freely in a hole that is not absolutely straight, and will bend to a sharper angle without breaking.

HUNTON—KIRKLAND LAKE.

It is reported that work is to be resumed on the Hunton-Kirkland Gold Mines property early this year. This was considered one of the most promising of the Kirkland Lake prospects at one time, and comprises about 40 acres lying close to the principal producers of the Camp.

McINTYRE.

Shareholders of the McIntyre, Extension and Jupiter companies have ratified the amalgamation of the three properties.

NORTHERN ONTARIO MINES IN 1916

The following review of progress in Northern Ontario during the past year is from Gibson's "Fortnightly Review":

Porcupine.—Looking back over the past year one can see momentous changes in Porcupine, and it needs no stretch of the imagination to say that all of these changes have been made for the better.

Without exception, those mines which were being operated a year ago are now in better physical condition than at that time. Production has increased at a most satisfactory rate, and additions to mining and milling plants now being installed make certain still further increases in months to come.

The startling feature of the enlargement of activities in the camp during the year, however, is that of the greater number of properties now being developed. Many prospects of certain promise, which a year ago were idle, are now being energetically and intelligently operated, and it would appear reasonably certain that new producers of wealth will be added to the already respectable list.

A confidence, born of certain knowledge that the extent of Porcupine's mineral wealth is as yet entirely unknown, is part of the make-up of every person acquainted with conditions there, and that such confidence has not been ill-founded in the past gives ground for the belief that such will be equally well founded as regards the future.

During the year the camp has attracted the attention of outside capital to an extent before unknown, and the indications of a continuance of such a flow of capital into new ventures during the coming year would appear very bright indeed.

The almost unexampled prosperity of both the United States and Canada, together with the success that has attended operations on the better known Porcupine properties are factors that must have a large influence. That operations on properties recently refinanced and on which operations have been recently or are about to be resumed are almost entirely on those which can be considered to "have a chance" is also worthy of comment. Wild-catting, beyond an occasional example of a sky-rocketing stock market in certain new issues, is conspicuous by its absence.

Cobalt.—In spite of many predictions that Cobalt was approaching the end, progress can be noted here. The year 1915 was indeed an unsatisfactory one from the standpoint of the producers of silver metal, and even at the beginning of the present year matters were in such a state that no wild enthusiasm could be noted in the attitude of the operators of properties there.

Early in the year, however, an improvement in the price for silver metal caused a more optimistic frame of mind to come into being, and when, in May, the price reached 77 1-4c per ounce, a figure never before realized in the history of the camp, an impetus was given to production and development that has since had a decided effect.

The adoption of the oil flotation process of treatment of ores bids fair to add years to the life of the camp, for the reason that this method allows the handling of the very low grade ores that under former methods were necessarily treated as a waste product. This method has even made it possible to re-treat the large tailings dumps which had accumulated in past years of operations. These are known to contain millions of ounces of silver, which, with present prices for the metal and more scientific methods of treatment can be handled profitably, and thus add largely to the total of production from the district.

The high average price for silver that has prevailed during the year has made it possible for the production of the camp, although smaller in point of silver ounces, to exceed in value that of any recent previous year. Although the cost per ounce of production will probably average higher than heretofore on account of labor conditions and the high cost of mining supplies generally, such increases are very much more than offset by the better price, so that the percentage of profits to production will no doubt exceed that of any previous year in the camp's history.

The success that has attended the later operations in the Southeastern Coleman section of the field, notably at Beaver and Temiskaming, has given an impetus to development in that section. With that section, because of the geological conditions which prevail, would seem to rest the probability of a continuance of Cobalt's wonderful production of the white metal.

To us it appears that the most important single development now taking place in the camp is the effort being made by the Beaver and Temiskaming companies to prove the existence of values at the lower or second contact. This effort has required the expenditure of an enormous amount of money in sinking two shafts to a depth of 1 600 feet, where development is now actually proceeding.

The courage shown by those responsible for this development carried out to prove or disprove what is conceded to be a logical theory, is to be commended, and it is particularly gratifying to all who have the best interests of the camp at heart to know that, although no commercial silver values have as yet been demonstrated to exist at this great depth, geological conditions have been proven to be almost identical to those which prevail at the upper contact. It would seem reasonable, therefore, to expect success to crown this effort during the year 1917.

The most graphic illustration of the real success that has attended operations during the year, however, is given in the disbursement of extra dividends by several of the operating companies and the resumption of such disbursements by other companies who had suspended dividend payments since 1914.

In spite of these added payments, the surpluses now being carried by many of the producing companies now stand at record levels, foreshadowing still further heavy distributions. Such a condition must be conceded to be a most satisfactory one, and it would seem therefore that the full tale of Cobalt's wonderful wealth is as yet far from told.

Kirkland Lake.—Second only to Porcupine, the development of this field has made progress during the year. It may even be safely said that this camp has outdone Porcupine in the number of properties that have passed from the stage of raw prospect to that of proven mines, only awaiting the installation of milling machinery to make production a reality.

The Tough-Oakes, on which development has been carried farthest, has been a profit-maker from the "grass roots," and is now paying dividends at the rate of 10 per cent. annually. The unfortunate litigation in which some of the larger interests have been involved for several years, however, must have had its effect on the proper development of the mine, as the management cannot have been free to carry out their ideas under such a handicap. It is to be hoped for the good of the property and of the district generally that these conflicting interests can be gotten together.

The Teck-Hughes now only awaits the advent of electrical power to begin milling the ore that has been developed since it has been handled by the present interests. Thus the next sixty days should see this company definitely embarked on a producing career.

The Lake Shore, McKane and La Belle have also now reached the stage of reasonable certainty, and announcements that milling plants are to be erected on one or more of them would not come unexpectedly. The Wright-Hargraves, on which development was recently resumed, also gives great promise, so that it would appear safe to say that Kirkland Lake now has six proven mines, with excellent prospects for three or four more which are located on the belt.

Other Districts.—The stick-to-it-iveness that certain owners in the Gowganda and Miller Lake fields have shown has been rewarded during the year by very favorable results, which lead to the hope that these districts are about to "come back." Notable among these are the Miller Lake-O'Brien, where a short time ago what is conceded to be the richest deposit of high-grade silver ore ever opened up in the north country was encountered. Although handicapped by lack of proper power and transportation facilities, development has proceeded without interruption for several years, and it now bids fair to become one of the big silver producers of the north.

The Reeves-Dobie, at Gowganda, after a somewhat checkered career, lately shipped about eleven tons of ore, which gave returns of $57,000 at the smelter. In point of values per ton, therefore, this is one of the richest shipments that ever left the north.

The knowledge that several strong companies are financed to carry out extensive development of promising properties in the South Lorrain, Munro Township, Boston Creek, Tashota and West Shining Tree districts, leads to the hope that 1917 will see new fields under energetic development. This, in our opinion, is all that is needed to bring the great north country into its own.

It is certain that mining in Northern Ontario was never before on such a solid foundation as at the end of 1916.

BOSTON CREEK.

Timmins, Jan. 4.—The two compressors at the Boston Creek mine are now in position and will greatly augment mining operations at that property. Work to date has been carried on through the shaft of the R. A. P. Syndicate, but the connection of the raise from the drift at the two-hundred foot level will now facilitate future developments.

THE McINTYRE MILL.

During 1916 milling capacity at the McIntyre was increased from an average of 290 tons per day to about five hundred tons a day at the close of the year. This increase was brought about by the addition of a unit of ball and pebble mills and an auxiliary ball mill. It is quite likely that more units will be installed during 1917.

The Pas, Man., Dec. 22.—Henry McCafferty arrived in town on Sunday's Muskeg after the completed camps at the Rex mine, Herb lake. He has freighted into the mine thirty tons of machinery and supplies. He reported the vein on the property was showing up well. The head-frame, hoist and shaft-house are now completed, and everything is ready to continue sinking the shaft as soon as the miners arrive from The Pas.

UNIVERSITY PROFESSORS LECTURE ON MINERALS.

The Pas, Man., Dec. 15.—A real event in the history of The Pas was the course of lectures delivered at the Central school during the past week by Professors Wallace and DeLury of the University of Manitoba, on mining, mineralogy, prospecting and matters pertaining thereto.

These gentlemen arrived last Saturday morning and immediately set up their equipment in the school house. That evening Professor Wallace delivered a lecture on "Manitoba in the Making." It was illustrated by lantern slides and proved exceedingly interesting, as well as instructive. Dr. Wallace discussed the general structure of that part of North American continent in which Manitoba is situate, showed the various geological developments that had taken place, and indicated the present structure of the province, and particularly of this northern part. The lantern slides certainly added much to the way of bringing clearly before those in attendance the points referred to by the speaker. At this lecture the program for the week was announced.

The professors offered during the days following to give instruction to any of those interested in prospecting and mining work. This instruction was entirely informal, the main work being examination of a large number of specimens which the professors brought with them and discussion incident thereto.

On Monday evening Dr. Wallace, in a general lecture, told of the different mining fields in Manitoba. As he had examined these personally he was in a position to give accurate information. As in the preceding lecture, this was illustrated by lantern slides. There are three mining districts in Manitoba, Star lake, Rice lake, and the country north of this point. The last mentioned has much the largest territory, although, up to date, possibly more has been expended in development in one of the other districts. The lecturer pointed out that the discoveries made in The Pas district covered a large area, and were such as would in all possibility change this order before very long.

Professor DeLury was in charge on Tuesday and Wednesday evenings, during which time he took up the systematic study of the general formation of the rocks composing the earth's crust; how they became mineralized, and the main character of the different minerals. These lectures were also illustrated by both lantern slides and samples of different rocks which were on hand. After the lectures each evening there was a free discussion on any matters which those in attendance cared to take up.

In the final lecture on Thursday evening, Dr. Wallace took for his subject that very interesting topic "Gold." This proved to be a very fitting wind-up to a most interesting and satisfying series.

The thanks of the people of The Pas and the north country generally, are due to these gentlemen for their trouble in coming here at this time. Some of the mining men from the various districts to the north came in to hear the lectures and expressed themselves as having been greatly benefited thereby. These lectures are an indication of what the University can do in a practical way to help in the legitimate development of the country.

IRON AND STEEL PRICES.

"Opinion is gaining strength," Iron Age hears from Pittsburgh, "that top prices have been reached in the steel and iron market."

UTILIZING WASTE HEAT FROM REFINING FURNACES.

The International Nickel Company (Orford Copper Works) has in service over 3,000 h.p. of waste-heat boilers set in connection with nickel-refining furnaces. As in the case of zinc furnaces the temperature of the waste gases is high. While it varies during different portions of the operation, the average is probably in the neighborhood of 1,700 deg. when leaving the furnace. The boilers at this plant are of practically standard design, such as used for coal fuel, insofar as baffle arrangement is concerned. No complete test figures are available, but from data at hand the boilers are developing over 90 per cent. of their rated capacity with exit gas temperatures of approximately 600 deg. With such a temperature leaving the boiler and a draft resistance through the boiler corresponding to about rating in coal-fired practice, the low draft requirement at the furnace exit is readily met by a 100-ft. stack.

These boilers, as stated, are of practically standard design. As compared with the exit temperature of 600 deg. actually being obtained it would be entirely possible, with the modern type of waste-heat boiler, to reduce this to 450 deg., corresponding to an increase of over 13 per cent. in capacity. On the other hand, the design of boiler in use is developing approximately its rated capacity with gases that previous to 1911, the date of the first installation, were wasted. The success of the first units installed was such as to cause this company to duplicate them in later installations, and since these waste-heat boilers have made it possible to shut down a large portion of the coal-fired boiler plant, there was no apparent reason for changing the first design.

In this class of work, as with copper-refining furnaces, the saving due to the reclamation of dust, within the setting is an item that compares favorably with the saving, due to the steam generated from the waste gases.—Met. and Chem. Eng.

DOME MINES.

In the month of December, Dome Mines milled 39,000 tons of ore and produced $133,300 worth of bullion. The tonnage treated has been exceeded in only three months previously and values were higher in only two months of the year. The most interesting feature of the Dome statement is that the total cost per ton was reduced eleven cents. This in face of the continued high cost of mining materials is rather a surprise. The average value per ton was $4.70, which is higher than for any month since July and about the average of the year.

Figures for the twelve months of last year compare as follows:

1916 Month.	Tons milled.	Bullion produced.	Value per ton.	Total cost per ton.
Jan.	31,600	$175,639	$5.558	$2.77
Feb.	32,040	164,037	5.119	2.71
March	34,300	173,724	5.064	2.64
April	37,300	177,624	4.762	2.40
May	39,400	190,229	4.828	2.44
June	36,700	179,245	4.883	2.66
July	38,150	179,370	4.701	2.57
Aug.	40,010	179,530	4.487	2.55
Sept.	38,300	179,500	4.686	2.59
Oct.	40,200	185,000	4.601	2.69
Nov.	37,900	177,000	4.670	2.88
Dec.	39,000	183,300	4.700	2.77

PERSONAL

Mr. Harry Sparks, who has been assisting Mr. Julius Cohen at the Croesus Mine, is in the Shining Tree district in charge of the operations at the Caswell property, for the owners of the Croesus.

Mr. J. B. Tyrrell has returned to Toronto from British Columbia.

Mr. Clyde Weed has been appointed general manager of the Lake Copper Mining Co., Michigan.

Mr. Frank Oliver, Toronto, has been elected a member of the Canadian Mining Institute.

Mr. W. E. Segsworth, Toronto, has been chosen to represent the Toronto branch of the Canadian Mining Institute on a committee recently organized in Toronto to assist the Government in utilizing the services of technical men in carrying on the war.

Dr. W. G. Miller, Mr. C. W. Knight and Mr. J. B. Tyrrell have returned to Toronto after attending the annual meeting of the Geological Society of America.

Mr. E. V. Neelands has resigned as general manager of the British Guiana Gold Concessions Co.

Mr. H. M. Porteous is now manager of the Burnt Hill tungsten mines, Maple Grove, N.B.

Mr. George G. Thomas, has resigned as manager of the Dome Lake in Porcupine and the Hudson Bay in Cobalt. He will open an office in Toronto as consulting engineer. Mr. Thomas will act as consulting engineer for the Calumet and Montana Company in Cobalt, the Murray Mowgridge Company at Wolfe Lake and the Comstock. He is succeeded by Mr. H. W. Darling of the Porcupine Crown as manager of the Dome Lake and Mr. Douglas Much, assistant manager of the Dome Lake, as manager of the Hudson Bay in Cobalt.

Mr. George H. Williams, who was construction engineer in charge of the erection and equipment of the smelting works at Crofton and Ladysmith, Vancouver Island, British Columbia, the former for the Northwestern Smelting Co., and the latter for the Tyee Copper Co., and afterward superintendent of the British Columbia Copper Co's smeltery at Greenwood, Boundary district, has gone to Chuquicamata, South America, from Anaconda, Montana, at which last mentioned place he was with the Anaconda Copper Mining Co.

Mr. Herman C. Bellinger of Spokane, Washington, for more than ten years actively connected with copper smelting in British Columbia, has been appointed general manager for the Chile Exploration Co., Chuquicamata, Chile. He was metallurgist for the late F. August Heinze when the latter in the nineties was operating the smelting works at Trail, B.C., afterward sold to Canadian Pacific Railway Co. interests which organized what is now the Consolidated Mining and Smelting Company of Canada. Later Mr. Bellinger was associated with Mr. James Breen in the establishment and operation of the Northwestern Smelting Co's smelting works at Crofton, Vancouver Island, B.C. Still later, he was general manager for the Cobar Copper Co., with big mines and smelting works in New South Wales, Australia. In quite recent years he has been consulting engineer in South America, where he is now continuing his work but in the capacity of general manager.

Mr. G. S. Rice, of the United States Bureau of Mines, has returned to Washington, D.C., whence he will send to the Minister of Mines for British Columbia his report on the mines of the Crow's Nest Pass Coal Co., at Coal Creek, Southeast Kootenay, B.C., in which a succession of "bumps" lately wrecked a considerable area of the company's No. 1 East mine and had previously done damage in other parts of the property. Mr. Rice was assisted in his investigations by Mr. Wm. Fleet Robertson, Provincial Mineralogist, and Mr. Thomas Graham, Chief Inspector of Mines, for British Columbia. On Mr. Rice's report will be based the decision of the Department of Mines as to what part of the mines affected by the "bumps" will be declared unsafe for further working and consequently be permanently closed.

Mr. F. P. Burrall, mining engineer, New York City, who has for some time been engaged in professional work in mines in the neighborhood of Dawson, Yukon Territory, left that region early in December to spend the winter "on the outside."

Mr. James Cronin, for many years managing mines in British Columbia, went from the Babine country, in Omineca division of that province, to Spokane, Washington, last month to spend the Christmas season at his home there.

Messrs. Robert R. Hedley and S. J. Castleman were members of a party from Vancouver, B.C., which last month visited the Ikeda copper mine, on Moresby island of the Queen Charlotte group, on the coast of British Columbia.

Mr. W. E. Zwicky, of Kaslo, B.C., went to Butte, Montana, last month. It is stated that he intended to endeavor to interest Montana men in the Cork-Province silver-lead mines, a promising group situated on the south fork of Kaslo creek, in Ainsworth division of British Columbia.

Messrs. P. W. Clark and J. Bresnahan, of the Galena Farm silver-lead zinc mine, near Silverton, Slocan lake, B.C., were in Nelson on December 20 on their way to Spokane to spend Christmas in that city.

Mr. Alfred McMillan, formerly of Rossland, B.C., and afterward for several years in charge of the Northport Smelting and Refining Co's inoperative smelting works at Northport, Washington, went to New York City in December in connection with a move to interest United States capitalists in the Velvet mine, about a dozen miles southwest of Rossland. The mine is owned in England, but has been operated on a small scale lately under lease and option of purchase.

APEX.

The shaft on the Apex property which had been sunk to a depth of 90 feet by the old management, has been dewatered, and sinking has been started. It is the intention to continue this shaft to a depth of 300 feet, from which level lateral work will be done. A contract for 5,000 feet of diamond drilling has been let, and a start already made on this contract. Mr. W. J. Trethewey is in charge.

PORCUPINE CROWN.

The discovery of good ore between the 800 and 900 foot levels has greatly improved the position of the Porcupine Crown company. Early in the year results of development were rather disappointing; but the mine is again in good shape.

NORTH THOMPSON.

Ore from the North Thompson mine, Porcupine district, is now being treated at the Vipond mill. The properties adjoin and a satisfactory working agreement should be possible.

SPECIAL CORRESPONDENCE

BRITISH COLUMBIA

While it is not practicable, in the absence of returns from many of the larger producers of mineral, to make a definite statement as to the total value of the mineral production of the year 1916, there does not seem to be room for doubt that it will be found to be fully 50 per cent. larger than that of the year 1915 and probably nearly 40 per cent. greater than that of 1912, the year of highest record until 1916. Roughly, a total of about $45,000,000 is estimated, and of this comparatively large amount somewhere about $35,000.000 will be the value of the metalliferous minerals and the remaining $10,000 000 that of coal and coke and miscellaneous products. The outstanding feature of the year's production is that of copper, which in both quantity and value will be found to have considerably exceeded that of any other of the twenty years that have elapsed since the production of this metal commenced to be of importance in the province. Next to copper, coal and coke make a good showing, with a total value of approximately $8.800.000, which is an increase over the value of the output of those minerals in either 1915 or 1914.

WEST KOOTENAY.

Ainsworth.—Several mines have been continuing to ship ore notwithstanding that with the coming in of the winter season it is less easy to transport ore than either after the snow on the roads or trails shall have been well packed down, or in the summer, when the hauling by horse-wagon is good. The present largest shipper in this division is the Bluebell, which being situated near the lake-shore has no freighting difficulties to provide against as the seasons change. The Highland sends its ore down to the lakeside over an aerial tramway, so is also comparatively free from hauling troubles. Other shippers from the neighborhood of Kootenay lake are the Comfort and the Banker-Maestro group, the latter having resumed production after two years of inactivity. In the western part of the division, the Utica continues on the shipping list, and the Charleston and Whitewater (Retallack & Co's mine) each made a small shipment lately.

Slocan.—The Galena Farm, Rambler-Cariboo, Ruth, and Standard, have maintained an output of silver-lead ore, and the Hewitt, Idaho-Alamo, Lucky Thought, Queen Bess, Sovereign, Slocan Star, and Wonderful have made occasional shipments. The Lucky Jim has been for several months a regular shipper of zinc concentrate to the Trail smeltery, and the Galena Farm, Rambler-Cariboo, and Standard have shipped much zinc concentrate to the United States.

Nelson.—The Eureka copper mine shipped ore to Trail about the middle of December after a suspension of production of three months' duration. The mine is now being worked by the company owning it, the syndicate that for some time previously operated it under lease and bond having relinquished possession. The Granite-Poorman has been milling gold ore and, as well, doing underground development to gain depth on the Hardscrabble vein. The California, near the town of Nelson, has been shipping ore to Trail lately. The Molly Gibson, at the head of Kokanee creek, has been closed for the winter, the snow being too deep for advantageous working. The Jennie Bell, near Ymir, recently made a small first shipment to Trail. The Yankee Girl, also near Ymir, is reported to have opened a new shoot of ore at considerable depth. The Emerald, near Salmo, sent 339 tons of lead ore to Trail during three weeks in December, after a temporary suspension of output, probably caused by bad roads for hauling.

Rossland.—Late in December it was announced that the Consolidated Co. intended to resume shipment of ore from its Centre Star group and Le Roi mines, after a short period of non-production, the result of coke shortage at the smelting works at Trail. The Josie group, of the Le Roi No. 2, Limited, continued shipping without intermission. This company's managers at Rossland reported to the London office for October, as follows: Josie mine shipped to Trail 1,511 tons of ore. Receipts from the smeltery were $24,554, in payment for 1.768 tons of ore; sundry receipts were $561; total of receipts $25,115. Estimated working costs for the corresponding period were $9,000 for ore production. Other expenditures were: On capital account, $139; on development (including diamond drilling) $9,770. Total expenditures, $18,909.

VANCOUVER ISLAND.

The first coal shipped from the newly opened mine of the Nanoose or West Wellington Collieries, situated ten or twelve miles north of Nanaimo, was taken by scow to Vancouver city late in December. A shaft has been sunk and at a depth of about 130 ft. it reached the coal, which is the old Wellington seam there four feet six inches in thickness.

The Canadian Collieries (Dunsmuir) Limited, being short of men to work in its coal mines on Vancouver island, recently communicated with the City of Victoria Municipal Labor Bureau, as follows: We have vacancies for a considerable number of good, practical coal miners. The tonnage price for mining the coal is 82 1-2 cents; a miner doing company work or paid by the day, receives $3.45. Timber men receive $3.45, drivers $3.15, leaders $3.15, pushers 2.87 1-2. Board and lodging which is not included, runs from $27 to $30 a month at hotels and private boarding houses. The employment is steady; the transportation charges are not paid by the company."

OMINECA MINING DIVISION.

Interviewed at Winnipeg, Manitoba, Mr. W. P. Hinton, traffic manager for the Grand Trunk Pacific Railway, is reported to have said: "Central British Columbia, along the line of the Grand Trunk Pacific railway, is an especially promising field, the big mining interests of the United States having been attracted, notably to the Telkwa and Hazelton districts during the past year, and from the preliminary development in hand and the experience of actual shipping mines, a fair conclusion would be that in the comparatively limited Telkwa and Hazelton region, exploration so far shows that the copper area is at least as large as and is much richer than, the Montana copper field. In addition to this, valuable coking-coal areas have been discovered in the same region, and this is sure to be of untold benefit to the development of that part of the province, inasmuch as there are no copper fields in the world of any extent possessing the right kind of coal for smelting purposes in the same area. This mining development will encourage further settlement of the millions of acres of first-class agricultural land in the Bulkley and Nechaco valleys."

ATLIN MINING DIVISION.

Concerning Atlin, the Whitehorse Star said recently: "Despite the shortage of labor in Atlin mining district the gold output for the 1916 season has been greater than for any year since the big rush in 1898. Efficiency has been greatly hampered this year because of the fact that many of the experienced hydraulic men have enlisted for war service and new men have had to be trained to take their places, thus causing a serious loss to operators. Notwithstanding this, however, everyone in the district prospered last season. Things have been on the upgrade since the summer of 1913. In that year the minimum of output was reached since the days of discovery. It took a good deal of optimism to hold through the lean years, but those who did are now repaid. Three rediscoveries were made last summer. On one creek there were no less than twenty small operators at work, and all were making money. Quartz operations will be begun on a large scale next year if the people interested can obtain facilities for treating their ore." While part of the foregoing is probably quite justified by the 1916 season's results, the writer of it does not seem too well informed as to production from Atlin creeks. Official records give $75,000 for 1898, $800,000 for 1899, and totals varying from $530,000 in 1904 down to $200,000 in 1909, that year having been the lowest on record. Thereafter there was a gradual increase, to $315,000 in 1913 and to $377,000 in 1915.

It is stated that during a recent month United States Consul Alger, of Fernie, Crowsnest district, Southeast Kootenay, passed through his office records of 75 cars of lead bullion shipped by the Consolidated Mining and Smelting Company of Canada, Limited, from its works at Trail, West Kootenay, to the East Chicago refinery, Illinois, the contents of those cars representing a total value of approximately $800,000. This would make it appear that the electrolytic lead-refining capacity of the Consolidated Co's works at Trail is not as large as capacity of its lead blast furnaces for producing bullion.

The Lanark Mining Co., of Spokane, Washington, which for nearly two years has been working the old Lanark mine, near Illecillewaet, Revelstoke mining division, expects to commence in January operating its concentrating plant, now nearly completed. In 1915 nearly 100 tons of ore shipped to the smelting works at Trail, ran from 29 to 34 per cent. lead and from 26 to 33 oz. silver to the ton. During the first half of 1916, 415 tons averaging about 19 per cent. lead and 20 oz. silver to the ton, was shipped to Trail, and then production was suspended pending provision of a concentrator near the mine. The plant is designed to treat about 75 tons of ore a day. A Riblet aerial tramway, constructed in 1915 in two sections, is of a total length of 6,900 feet. Mr. W. B. Dornberg is in charge of the property.

Mr. L. R. Margetts, superintendent of the Anaconda Copper Mining Co's Washoe Sampling works, Montana, recently spent a week visiting lead-zinc mining properties in Ainsworth and Slocan divisions of West Kootenay district, British Columbia. He is reported to have said in Spokane, when on his homeward journey: "The field includes many valuable mining properties, some of which, though, are not being worked. Production has been increased since the advance in the prices of metals. I heard of the transfer of various properties in different sections, and of improvements and new installations at several concentrating mills. At some of the mills the flotation concentration process is being used with success. We have begun negotiations for the shipment of zinc ore to the Anaconda Co's electrolytic reduction works at Great Falls, Montana."

MINERS' CERTIFICATES.

The report has recently come to hand of the Board of Investigation appointed in British Columbia to inquire into the matter of alleged improper holding and using of certificates of competency by coal miners in the Comox Colliery, operated by the Canadian Colliery at Cumberland, B.C. The members of the Board were the Honorable Mr. Justice Macdonald, Robert R. Hindmarch and Robert Henderson. Counsel appointed by the Provincial Department of Mines brought to the Board's attention two cases where, apparently, certificates of competency had been improperly used. In one case a coal miner was convicted of an infraction of the Coal Mines' Regulation Act and his certificate was cancelled by the Department of Mines. Before the certificate was cancelled, however, a substituted certificate was issued to a person of the same name on the ground that his original certificate had been lost and this substituted certificate at the time of the cancellation referred to was still outstanding. A miner of the name in question was found in one of the mines, and when summoned, gave evidence that he had never been convicted of any offence under the Coal Mines' Regulation Act; it soon became apparent that for a time two persons had worked under the same certificate and that the genuine miner was entitled to hold the substituted certificate. The evidence indicated the ease with which a person could obtain the certificate of a miner, then change his name to suit the circumstances and obtain employment in a coal mine without being duly qualified. A special rule passed in December, 1914, requiring coal miners to deposit their certificates with the owner before obtaining employment in a mine greatly lessens the opportunity for accomplishing this fraudulent purpose. In the second case it appeared that after a miner had been killed while working in a mine, a substituted certificate was issued to a person of the same name on the ground that the original certificate had been lost. It was evident that fraud had been committed by a person familiar with the existence and contents of the original certificate and desirous of obtaining work in the colliery under false pretences.

NEW JERSEY ZINC CO.

Boston.—The New Jersey Zinc Co. in 1916 paid dividends amounting to $76 per share on its $35,000,000 capital stock. Had the capital stock remained at $10,000,000 dividends would have amounted to $266 per share.

Not only was $26,600,000 taken from the year's earnings for stockholders but large sums were spent on plant improvements and equipment while a material addition was made to surplus account.

The principal beneficiaries from the past year's dividends were the following: August Heckscher, $2,448,264; Edgar Palmer, $2,289,424; David B. Jones, $1,366,176; T. D. Jones, $1,431,724; J. L. Riker, $831,516; J. P. Wetherell, $1,339,000; S. P. Wetherell, $956,536; J. E. Hayes, Jr., $817,912; W. O. Morse, $798,000.

BOOK REVIEWS.

Heaton's Annual, Heaton's Agency, Toronto, Price $1.25.

The thirteenth edition of Heaton's Annual has just come from the Press and again we have to note improvements which have marked its progress from year to year. The first part of the book contains complete official directories of the Dominion and Provincial Governments, to which is added this year a long list of titled and decorated Canadians that will be of interest to many families who have boys at the front; also postal information; a shipper's guide giving every banking town with banks and railway connections, population, etc; commercial regulations and complete customs tariff revised to date. In the last half of the book we find up to date complete descriptions of every commercial town in Canada with hotels in order of merit, industries, population and industrial opportunities and summary of the resources of the Dominion, covering agriculture, agricultural districts, finance, fisheries, forests, fur farming, mining, sport, water powers, etc. The information is up to date, clearly arranged and concisely stated. Cross references are given throughout the text to a most valuable bibliography of Government and Standard publications under the heading "Where to Find It" so that the reader has access to complete information upon any subject in which he is interested.

THE CANADA YEAR BOOK, 1915.

This publication of the Census and Statistics Office, Ottawa, is now ready for distribution. It will be found to contain the following special articles: (1) Local Government of Canada by various writers; (2) Economic Geology in Canada 1915; (3) Flora of Canada; (4) Faunas of Canada. The following are the other principal new features of the work. In Section III (Area and Population), tables relating to the foreign-born population, the population of military age and the occupations of the people, as derived from the Census returns of 1911, replace other Census tables previously given. Statistics of the universities and of higher education generally have been added to the tables of elementary and secondary education in Section IV (Education). Amongst other new statistics in Section VI (Production), are tables of grain prices and of ocean freight rates over long series of years and of the numbers of farm live stock in the principal countries of the world. This Section includes also a description of the Dominion and Provincial Agricultural Experiment Stations. To Section VII (Trade and Commerce) have been added tables showing the increase or decrease due to variation in quantity and in price of the exports and imports of Canada, by principal classes of products, for the year 1915 as compared with 1914. In Section X (Finance), the results are given of further efforts to collect municipal statistics, the new tables presenting (a) statistics of a general character and (b) financial statistics. Section XI (Administration) includes an outline of the work of the Commission of Conservation and finally Section XII (Principal Events of the Year) summarises the Acts of Provincial Legislatures in addition to those of the Dominion Parliament as heretofore.

MANDY MINING CO., MANITOBA.

The Pas, Man., Dec. 22.—H. C. Carlisle, superintendent of the Mandy Mining Co., a subsidiary company of the Tonopah Mining Co., returned to town from Philadelphia on Saturday last.

It is the intention of the Mandy Mining Co. to proceed at once with the active development of their property at Schist lake, and already a contract has been signed up with Charles Morgan for the hauling of 3,000 tons of ore from the mine to the head of navigation on Sturgeon lake, from where it will be brought to The Pas after the ice break-up in the spring by steamboat and barges, and shipped by rail to the smelter.

The operations of the Tonopah Mining Company in this district will henceforth be looked after by the Mandy Mining Co., which is under the control of the Tonopah people, and will have the same officials and staff.

The machinery and supplies necessary for active development work have been purchased, to the amount of several hundred tons, and will be taken to the mine by teams. The contractor expects to have about one hundred teams at work as soon as stables and road houses are completed.

The Mandy Mining Co., are making arrangements for the building of narrow-gauge railway over the portage, and, if found feasible, the shipment of ore will continue at the rate of 1,500 tons per week during the period of navigation each summer.

QUINCY.

Quincy has run its daily tonnage up to between 4300 and 4400 tons daily, a wonderful production with only three shafts and with some of the rock coming from below the 70th level on the angle of the lode. Moreover, great care is taken to keep the reserves up to the proper figure all the time. This gain has come mostly from the increase in the force that it has been possible to make with those men who have been working outdoors in different parts of the country and who are now seeking cover.

GRANBY.

Boston, Jan. 3.—For the first five months of its new fiscal year Granby Consolidated earned $2.400,000, figuring its unsold copper at 25c a pound. Subsequent copper transactions at a higher price actually raised the earnings to about $2.600,000 for the period to Dec. 1. This was at the rate of about $6,000,000 for a full year.

Granby should have no difficulty in maintaining its new dividend rate of $10 per annum even should copper metal take a severe slump. Granby has only 149,975 shares.

Development work at the Hidden Creek property is showing excellent results. Production all comes from above the tide water level, below which it is thought another large mine exists.

The Pas., Man., Dec. 22.—Frank Carrie, Jack Hammell's partner, departed for Toronto on Monday. Messrs. Dan and Jack Mosher, Dan Milligan and John Dion, who are also interested in the properties, went out on the same train. Dan Mosher stated that he thought diamond drills would be again working on the property in the near future.

DOMINION ASSAY OFFICE, VANCOUVER, B.C.

The Vancouver Daily Province said on December 30th: "That gold is commencing to flow in increasing quantity to the Dominion of Canada Assay Office, Vancouver, is shown not only by the returns for the calendar year ending to-day, but also by the returns for the month ending to-day. The new regulations inaugurated this year by which the Assay Office can issue cheques payable at par in New York have had their effect.

"The gold bullion deposited at the Dominion of Canada Assay Office for the calendar year ended December 31, 1915, represented in value $2,736,302.31. For the calendar year ended to-day the total is $2,828,-239.65, showing an increase of $91,937.34.

"For the month just closed the increase is more striking. For December, 1915, the total was $189,304.47. For the month ending to-day it was $262,663.43, showing the large increase of $73,358.96.

"Mr. G. Middleton, manager of the Assay Office, said this morning that not only was gold coming to Vancouver that formerly went to Seattle, but that British Columbia mines are increasing their output. This is due partly to the fact that increased development naturally brings a larger output, but that returned soldiers are finding employment as mine-workers. Many of the mines would have shown larger returns during the earlier months of the year if men could have been found to work on them."

Note by Editor.—The British Columbia correspondent of The Journal states that he thinks either Mr. Middleton has misunderstood or is not yet fully informed as to the gold production of British Columbia in 1916, that is the total gold, including lode as well as placer gold. From figures the correspondent received late in December, he thinks it will be found that there has been less gold, both placer and lode, produced in the province in 1916 than in 1915. Rossland mines, which are the largest source of lode gold in British Columbia, made a much smaller production during the last two months of the year, owing to a shortage of coke at the smeltery for smelting gold-copper ores; the production from the Hedley Gold Mining Co's mine in Camp Hedley, was somewhat less than in 1915 and late advices from Cariboo state that the yield of placer-gold from that district shows a decrease this year owing to a short water supply for hydraulicking.

U. S. IRON RECORDS SMASHED.

The January first estimates of shipments of iron ore from United States mines during 1916 are 75,500,000 gross tons, compared to 55,493,100 tons for 1915, according to Ernest F. Burchard of the United States Geological Survey, Department of the Interior. Not only are these record-breaking figures, but the ore sold for $178,935,000, an increase of over $77,000,000 compared with 1915. Ore in stock at the mines approximates 10,486,000 gross tons, compared with 13,748,000 tons in 1915.

Production of pig iron in the United States also made a record in 1916 a total of over 39,000,000 gross tons, compared with 29,916,213 tons in 1915.

DOME.

The official statement of production of Dome Mines for December shows gross output of $183,300 from 39,000 tons of $4.70 ore milled. This compares very favorably with the average for the year.

DOMINION STEEL.

Montreal, Que.—An official statement of the Dominion Steel Corporation's output for the calendar year 1916, issued to-day, showed a new record in tonage of ingots, the figures being about 8 per cent higher than in 1915. Pig iron production was more than 12 per cent in excess of the previous year's showing. Coal output was lower at about 4,500,000 tons, against 5,000,000 in 1915, recruiting and the shortage of shipping facilities entering as adverse factors. The approximate output of the steel company is given as follows:

	1916	1915	1914
Pig iron	348,000	309,800	334,101
Steel ingots	376,000	349,000	331,349
Rails	17,495	57,500	176,505
Wire rods	112,400	73,500	30,778
Wire products	47,500	34,000	32,414
Blooms, billets, etc.	150,000	.....	.....
Merchant bars	9,950	.....	.....

Large expenditures have been made during the year for improvements and extensions to plant, as well as for renewals.

The statement adds: "The tonnage of steel on order is sufficient to keep the works actively employed for several months, and so far there is no indication of any slackening in the demand for all the materials that the company can produce."

CROWN RESERVE.

The Crown Reserve mining company has taken an option on the O'Donnell claims adjacent to the property of Boston Creek Gold Mines and the R. A. P. Syndicate in the Boston Creek district.

SILVER PRICES.

		New York, cents.	London, pence.
December	19	76⅝	36⅛
"	20	76⅝	36⅛
"	21	76½	36⅛
"	22	75¾	36⅛
"	26	75¾	....
"	27	75⅜	36½
"	28	75⅜	36½
"	29	75⅜	36½
"	30	75⅜	36½
January	2	75⅜	36½
"	3	75⅜	36½
"	4	75⅜	36½
"	5	75⅜	36½

MOLYBDENITE PRICES.

Schedule of prices per unit (20 lbs.) of Molybdenite in ore delivered at concentrator, Renfrew.

Ores carrying between 2% and 3% MoS_2, $14.00 per unit.
Ores carrying between 3% and 5% MoS_2, $16.00 per unit.
Ores carrying between 5% and 10% MoS_2, $17.50 per unit.
Ores carrying between 10% and 15% MoS_2, $18.50 per unit.
Ores carrying between 15% and 20% MoS_2, $19.50 per unit.
80% concentrates, $1.09 per lb. of MoS_2.
Penalties imposed for copper and bismuth.
No settlement made for any molybdic oxide in ores.
Settlement ten days after sampling.
Samples of ores to be submitted before any shipment made.

MARKETS

TORONTO MARKETS.

Cobalt oxide, black, $1.05 per lb.
Cobalt oxide, grey, $1.15 per lb.
Cobalt metal, $1.25 to $1.50 per lb.
Cobalt anodes, $1.50 to $1.75 per lb.
Nickel metal, 45 to 50 cents per lb.
White arsenic, 5½ to 6 cents per lb.

Jan. 8, 1917—(Quotations from Canada Metal Co., Toronto)—
Spelter, 13½ cents per lb.
Lead, 9½ cents per lb.
Tin, 46 cents per lb.
Antimony, 18 cents per lb.
Copper, casting, 35½ cents per lb.
Electrolytic, 36 cents per lb.
Ingot brass, yellow, 22 cents; red, 24 cents per lb.

Jan. 8.—(Quotations from Elias Rogers Co., Toronto)—
Coal, anthracite, $9.00 per ton.
Coal, bituminous, $10.00 per ton.

NEW YORK MARKETS.

Connellsville Coke—
Furnace, spot, $11.00 to $12.00.
Furnace, contract, $6.00 to $8.00.
Foundry, prompt, $11.00 to $12.00.
Foundry, contract, $5.50 to $7.50.
Straits Tin, f.o.b., nominal, 42.50 cents.
Copper—
Prime Lake, nominal, 28.50 to 29.00 cents.
Electrolytic, nominal, 27.75 to 28.25 cents.
Casting, nominal, 27.00 to 27.50 cents.
Lead, Trust price, 7.50 cents.
Lead, outside, 7.50 to 7.62½ cents.
Spelter, prompt western shipment, 9.67½ to 9.92½ cents.
Antimony—Chinese and Japanese, 14.25 to 14.50 cents.
Aluminum—nominal—
No. 1 Virgin, 98-99 per cent., 60.00 to 64.00 cents.
Pure, 98-99 per cent. remelt, 55.00 to 58.00 cents.
No. 12 alloy remelt, 40.00 to 45.00 cents.
Powdered aluminum, 90.00 to 93.00 cents.
Metallic magnesium—99 per cent. plus, $3.50.
Nickel—shot and ingot, 45.00 cents.
Electrolytic, 50.00 cents.
Cadmium, nominal, $1.45 to $1.50.
Quicksilver, $80.00.
Cobalt (metallic), $1.50.
Tungsten ore per unit, $17.50 to $20.00.
Silver (official), 75⅜ cents.

Metal Products—Following quotations represent mill prices and are strictly nominal except in the case of lead sheets and sheet zinc:
Sheet Copper—
Hot rolled, 42.00 cents.
Cold rolled, 43.00 cents.
Copper bottoms, 50.00 cents.
Copper in rods (round), 41.00 cents.
Square and rectangular, 42.00 cents.
Copper wire, nominal, 34.75 cents.
Copper wire, February, nominal, 34.50 cents.
High brass—
Sheets, 39.00 to 40.00 cents.
Wire and light rods, 40.00 cents.
Heavy rods, 38.00 to 39.00 cents.
Low Brass—sheet wire and rods, 42.00 cents.
Tubing—
Brazed bronze, 51.00 to 52.00 cents.
Brazed brass, 48.00 to 49.00 cents.
Seamless copper, 45.00 to 46.00 cents.
Seamless brass, 43.00 to 45.00 cents.
Seamless bronze, 52.00 cents.
Full lead sheets, 9.25 cents.
Cut lead sheets, 9.50 cents.
Sheet zinc, f.o.b. smelter, 21.00 cents.

STOCK QUOTATIONS.

(By courtesy of J. P. Bickell & Co., Toronto.)

As of close January 8th, 1917.

Porcupine Stocks.

	Bid.	Asked.
Apex	.12½	.13
Dome Extension	.30¾	.31
Dome Lake	.64	.69
Dome Mines	23.50	24.50
Foley O'Brien	.70	...
Gold Reef	.05¼	.05½
Homestake	.58	.60
Hollinger Cons.	6.85	6.90
Inspiration	.23	.25
Jupiter	.32½	.33
McIntyre	1.99	2.00
McIntyre Extension	.60	.62
Moneta	.15¼	.16
Newray	1.40	1.41
Porcupine Crown	.75	.78
Porcupine Gold	.01	.02
Porcupine Imperial	.04¼	.04¾
Porcupine Tisdale	.05⅛	.05¼
Vipond	.50	.52
Preston East Dome	.04½	.05⅞
Schumacher	...	.72
Teck Hughes	...	.74
West Dome	.31	.32
Boston Creek	1.14	1.16
Ken. Silver	.30	.30½

Cobalt Stocks.

	Bid.	Asked.
Adanac	...	.25
Bailey	.06½	.07½
Beaver Con.	.40	...
Buffalo	1.00	1.25
Chambers Ferland	.16	.17
Coniagas	4.40	4.50
Foster	.04	.05
Gifford	.04	.04⅞
Gould	.00¼	.00⅜
Great Northern	.11	.12
Hargraves	.19½	.20
Hudson Bay	...	74.00
Kerr Lake	4.70	4.90
La Rose	.53	.56
Lorrain Con.	.50	.51
McKinley Dar. Sav.	.49½	.51½
Nipissing	8.30	8.60
Ophir	.11¼	.11½
Peterson Lake	.10½	.11½
Right of Way	.05½	.06
Seneca Superior	.02	.03
Silver Leaf	.02¼	.02½
Shamrock Cons.	.20½	.21
Temiskaming	.60	.63
Trethewey	.16	.18
Wettlaufer	.09	...
York, Ont.	.02	.02¼

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Mining & Metallurgical Engineer
Chuquicamata, Chile
Chief Construction Engineer for Chile Copper Co.

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Amalgamators—
Fraser & Chalmers of Canada, Limited.
Northern Canada Supply Co.

Antimony
Canada Metal Co., Ltd.

Assayers and Chemists—
Milton L. Hersey Co., Ltd.
Campbell & Deyell, Cobalt
Ledoux & Co., 99 John St., New York
Thos. Heys & Son.
C. L. Constant Co.

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Lymans, Ltd., Montreal, Que
Stanley, W. F. & Co., Ltd

Babbitt Metals
Canada Metal Co., Ltd.

Ball Mills—
Fraser & Chalmers of Canada, Limited.
Hull Iron & Steel Foundries, Ltd.

Belting—Leather, Rubber and Cotton—
Northern Canada Supply Co.
Jones & Glassco

Blasting Batteries and Supplies—
Can. Ingersoll-Rand Co., Ltd.
Curtis & Harvey (Canada) Ltd.
Northern Canada Supply Co.
Canadian Explosives, Limited

Blowers—
Fraser & Chalmers of Canada, Limited.
Northern Canada Supply Co.

Boilers—
Fraser & Chalmers of Canada, Limited.
Northern Canada Supply Co.
Can. Ingersoll-Rand Co., Ltd

Boxes, Cable Junction—
Standard Underground Cable Co. of Can., Ltd.

Buckets—
Hendrick Mfg. Co
M. Beatty & Sons, Ltd.
Northern Canada Supply Co.

Cable — Aerial and Underground—
Fraser & Chalmers of Canada, Ltd.
Northern Canada Supply Co.
Standard Underground Cable Co. of Can., Ltd.

Cableways—
Fraser & Chalmers of Canada, Limited.
M. Beatty & Sons, Ltd.

Cages—
Fraser & Chalmers of Canada, Limited.
Jeffrey Mfg. Co.
Northern Canada Supply Co.

Cables—Wire—
Standard Underground Cable Co. of Canada, Ltd.

Car Dumps—
Sullivan Machinery Co.

Cars—
W. Fraser.
Jeffrey Mfg. Co.
Northern Canada Supply Co.

Cement Machinery—
Northern Canada Supply Co.
Hull Iron & Steel Foundries, Ltd.

Chains—
Jeffrey Mfg. Co.
Jones & Glassco
Northern Canada Supply Co.
B. Greening Wire Co., Ltd.

Chemists
Canadian Laboratories.
Campbell & Deyell.
Thos Heys & Sons.
Milton Hersey Co.
Ledoux & Co.

Coal—
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Nova Scotia Steel & Coal Co.

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Sullivan Machinery Co.
Can. Ingersoll-Rand Co., Ltd.

Coal Dock Bridges—
Roberts & Schaefer Co.

Coal Mining Explosives—
Curtis & Harvey (Can.), Ltd.
Canadian Explosives, Limited

Coal Mining Machinery—
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Fraser & Chalmers of Canada, Limited.
Jeffrey Mfg. Co.
Roberts & Schaefer Co.
Sullivan Machinery Co.

Coal Pick Machines—
Sullivan Machinery Co.
Can. Ingersoll-Rand Co., Ltd.

Coal Washeries—
Jeffrey Mfg. Co.
Roberts & Schaefer Co.

Coaling Stations—
Roberts & Schaefer Co.

Compressors—Air—
Darling Bros., Ltd.
Escher Wyss & Co.
W. Fraser.
Smart-Turner Machine Co.
Fraser & Chalmers of Canada, Limited.
Sullivan Machinery Co.
Can. Ingersoll-Rand Co., Ltd.
Northern Canada Supply Co.

Concentrators and Jigs—
Fraser & Chalmers of Canada, Limited.

Concrete Mixers—
Northern Canada Supply Co.

Condensers—
Fraser & Chalmers of Canada, Limited.
Smart-Turner Machine Co.
Northern Canada Supply Co.

Converters—
Fraser & Chalmers of Canada, Limited.
Jeffrey Mfg. Co.
Northern Canada Supply Co.

Conveyor—Trough—Belt—
Jeffrey Mfg. Co.
Hendrick Mfg. Co.

Cranes—
Smart-Turner Machine Co.
M. Beatty & Sons, Ltd.

Crane Ropes—
Allan, Whyte & Co.
B. Greening Wire Co., Ltd.

Grinding Plates—
Hull Iron & Steel Foundries, Ltd.

Crushers—
Fraser & Chalmers of Canada, Limited.
Lymans, Ltd
Jeffrey Mfg. Co.
Mussens, Limited.
Hull Iron & Steel Foundries, Ltd.

Cyanide Plants—
Fraser & Chalmers of Canada, Limited.
Roessler & Hasslacher.

Derricks—
Smart-Turner Machine Co.
S. Flory Mfg. Co.
M. Beatty & Sons, Ltd.

Diamond Drill Contractors—
Diamond Drill Contracting Co.
Smith and Travers.
Sullivan Machinery Co.

Dredger Pins—
Armstrong, Whitworth of Can., Ltd.

Dredging Machinery—
M. Beatty & Sons.

Dredging Ropes—
Allan, Whyte & Co.
Fraser & Chalmers of Canada, Limited.

Drills, Air and Hammer—
Can. Ingersoll-Rand Co., Ltd
Jeffrey Mfg Co.
Sullivan Machinery Co.
Northern Canada Supply Co.

Drills—Core—
Can. Ingersoll-Rand Co., Ltd
Standard Diamond Drill Co.
Sullivan Machinery Co.

Drills—Diamond—
Sullivan Machinery Co.
Northern Canada Supply Co.

Drill Steel—Mining—
Armstrong, Whitworth of Can., Ltd.

Drill Steel Sharpeners—
Can. Ingersoll-Rand Co., Ltd
Northern Canada Supply Co.
Sullivan Maclinery Co.

Drills—Electric—
Can. Ingersoll-Rand Co., Ltd.
Sullivan Machinery Co.

Drills—High Speed and Carbon—
Armstrong, Whitworth of Can., Ltd.

Dynamite—
Curtis & Harvey (Canada). Ltd.
Canadian Explosives.
Northern Canada Supply Co.

Ejectors—
Darling Bros., Ltd.
Can. Ingersoll-Rand Co., Ltd
Northern Canada Supply Co.

Elevators—
Darling Bros., Ltd.
Jeffrey Mfg. Co.
M. Beatty & Sons.
Sullivan Machinery Co.
Northern Canada Supply Co

Engineering Instruments—
C. L. Berger & Sons.

Engineers and Contractors—
Fraser & Chalmers of Canada, Limited.
Roberts & Schaefer Co.

Engines—Automatic—
Smart-Turner Machine Co.

Engines—Gas and Gasoline
Fraser & Chalmers of Canada, Limited.
Alex. Fleck.
Sullivan Machinery Co.
Smart-Turner Machine Co.

Engines—Haulage—
Fraser & Chalmers of Canada, Limited.
Can. Ingersoll-Rand Co., Ltd

Engines—Marine—
Smart-Turner Machine Co.

Engines—Steam—
Fraser & Chalmers of Canada, Limited.
Smart-Turner Machine Co.
M. Beatty & Sons.

Fans—Ventilating—
Fraser & Chalmers of Canada, Limited.
Jeffrey Mfg. Co.

Feeders—Ore—
Fraser & Chalmers of Canada, Limited.

Flights—
Hendrick Mfg. Co.

Forges—
Northern Canada Supply Co., Ltd.

Forging—
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Smart-Turner Machine Co.

Furnaces—Assay—
Lymans, Ltd.

Fuse—
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Canadian Explosives.
Northern Canada Supply Co.

Gears—
Smart-Turner Machine Co.
Northern Canada Supply Co.
Hull Iron & Steel Foundries, Ltd.

Hammer Rock Drills—
Mussens, Limited.

Hangers—Cable—
Standard Underground Cable Co. of Canada, Ltd.

Hand Hoists—
Darling Bros., Ltd.
Fraser & Chalmers of Canada, Limited

High Speed Steel—
Armstrong, Whitworth of Can., Ltd.

High Speed Steel Twist Drills—
Northern Canada Supply Co.
Armstrong, Whitworth of Can., Ltd.

Hoists—Air, Electric and Steam—
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Hoisting Engines—
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Sullivan Machinery Co.
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M. Beatty & Sons.

Hose—
Northern Canada Supply Co.

Ingot Copper—
Canada Metal Co., Ltd.

Insulating Compounds—
Standard Underground Cable Co. of Can., Ltd.

Jacks—
Can. Ingersoll-Rand Co., Ltd
Northern Canada Supply Co.

Kiln Linings—
Hull Iron & Steel Foundries, Ltd.

Kominuters—
Hull Iron & Steel Foundries, Ltd.

Lamps—Safety—
Canadian Explosives.

Link Belt—
Northern Canada Supply Co.
Jones & Glassco.

Locomotives—
W. Fraser.

Machinists and Founders—
Hull Iron & Steel Foundries, Ltd.

Metal Merchants—
Henry Bath & Son.
Geo. G. Blackwell, Sons & Co.
Consolidated Mining and Smelting Co. of Canada.
Canada Metal Co.
C. L. Constant Co.

Monel Metal—
International Nickel Co.

Nickel—
International Nickel Co.

Ore Sacks—
Northern Canada Supply Co

Ore Testing Works
Ledoux & Co.
Can. Laboratories.
Milton Hersey Co., Ltd.
Campbell & Deyell.

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Geo. G. Blackwell.
Consolidated Mining and Smelting Co. of Canada.
Orford Copper Co.
Canada Metal Co.

Perforated Metals—
B. Greening Wire Co., Ltd.
Fraser & Chalmers of Canada, Limited
Northern Canada Supply Co
Hendrick Mfg. Co.

Pig Tin—
Canada Metal Co., Ltd

Pig Lead—
Canada Metal Co., Ltd.

Pipes—
Canada Metal Co., Ltd.
Consolidated M. & S. Co.
Pacific Coast Pipe Co., Ltd.
Northern Canada Supply Co.
Smart-Turner Machine Co.

Pipe Fittings—
Northern Canada Supply Co.

Piston Rock Drills—
Mussens, Limited.

Pneumatic Tools—
Can. Ingersoll-Rand Co., Ltd
Jones & Glassco.

Prospecting Mills and Machinery—
Standard Diamond Drill Co.
Fraser & Chalmers of Canada, Limited

Canadian Miners' Buying Directory.—(Continued from page 14.)

Pulleys, Shafting and Hangings—
Fraser & Chalmers of Canada, Limited
Jeffrey Mfg. Co.
Northern Canada Supply Co.

Pumps—Boiler Feed—
Darling Bros., Ltd.
Smart-Turner Machine Co.
Northern Canada Supply Co.
Canadian Ingersoll-Rand Co. Ltd.
Fraser & Chalmers of Canada, Limited

Pumps—Centrifugal—
Darling Bros., Ltd.
Escher Wyss & Co.
Mussens, Limited.
Smart-Turner Machine Co.
M. Beatty & Sons.
Can. Ingersoll-Rand Co., Ltd
Fraser & Chalmers of Canada, Limited

Pumps—Electric—
Darling Bros., Ltd.
Smart-Turner Machine Co.
Canadian Ingersoll Rand Co., Ltd.
Fraser & Chalmers of Canada, Limited

Pumps—Pneumatic—
Darling Bros., Ltd.
Smart-Turner Machine Co.
Can. Ingersoll-Rand Co., Ltd
Sullivan Machinery Co.

Pumps—Steam—
Can. Ingersoll-Rand Co., Ltd
Darling Bros., Ltd.
Mussens, Limited.
Northern Canada Supply Co.
Smart-Turner Machine Co.

Pumps—Turbine—
Darling Bros., Ltd.
Smart-Turner Machine Co.
Canadian Ingersoll-Rand Co., Ltd.
Fraser & Chalmers of Canada, Limited

Pumps—Vacuum—
Darling Bros., Ltd.
Smart-Turner Machine Co.

Quarrying Machinery—
Sullivan Machinery Co.
Can. Ingersoll-Rand Co., Ltd.

Rails—
W. Fraser.

Roasting Plants—
Fraser & Chalmers of Canada, Limited

Rolls—Crushing—
Fraser & Chalmers of Canada, Limited

Roofing—
Northern Canada Supply Co.

Rope—Manilla and Jute—
Jones & Glassco.
Northern Canada Supply Co.
Allan, Whyte & Co.

Rope—Wire—
B. Greening Wire Co., Ltd.
Allan, Whyte & Co.
Northern Canada Supply Co.
Fraser & Chalmers of Canada, Limited

Samplers—
C. L. Constant Co.
Ledoux & Co.
Milton Hersey Co.
Thos. Heys & Son.

Screens—
B. Greening Wire Co., Ltd.
Jeffrey Mfg. Co.
Northern Canada Supply Co.
Fraser & Chalmers of Canada, Limited
Roberts & Schaefer Co.

Screens—Cross Patent Flanged Lip—
Hendrick Mfg Co.

Separators—
Darling Bros., Ltd.
Smart-Turner Machine Co.

Sheet Lead—
Canada Metal Co., Ltd.

Sheets—Genuine Manganese Bronze—
Hendrick Mfg. Co.

Shovels—Steam—
M. Beatty & Sons.
W. Fraser.

Smelting Machinery—
Fraser & Chalmers of Canada, Limited

Stacks—Smoke Stacks—
Hendrick Mfg. Co.

Stamp Mills—
Fraser & Chalmers of Canada, Limited

Steel Barrels—
Smart-Turner Machine Co.

Steel Drills—
Sullivan Machinery Co.
Northern Canada Supply Co.
Can. Ingersoll-Rand Co., Ltd

Steel Drums—
Smart-Turner Machine Co.

Steel—Tool—
N. S. Steel & Coal Co.
Armstrong, Whitworth of Can., Ltd.

Surveying Instruments—
W. F. Stanley.
C. L. Berger.

Tanks—Cyanide, Etc.—
Fraser & Chalmers of Canada, Limited
Hendrick Mfg. Co.
Pacific Coast Pipe Co., Ltd.

Tipples—
Roberts & Schaefer Co.

Transits—
C. L. Berger & Sons.

Tube Mills—
Fraser & Chalmers of Canada, Limited

Turbines—
Escher Wyss & Co.
Fraser & Chalmers of Canada, Limited

Winding Engines—
Canadian Ingersoll-Rand Co., Ltd.

Wire Cloth—
Northern Canada Supply Co.
B. Greening Wire Co., Ltd.

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