THE CANADIAN MINING JOURNAL

VOL. XXXVI. TORONTO, November 1, 1915. No. 21

The Canadian Mining Journal

With which is incorporated the

"CANADIAN MINING REVIEW"

Devoted to Mining, Metallurgy and Allied Industries in Canada.

Published fortnightly by the

MINES PUBLISHING CO., LIMITED

Head Office - - - 263-5 Adelaide Street, West, Toronto
Branch Office - - - - - - 600 Read Bldg., Montreal

Editor

REGINALD E. HORE

SUBSCRIPTIONS — Payable in advance, $2.00 a year of 24 numbers, including postage in Canada. In all other countries, including postage, $3.00 a year.

Advertising copy should reach the Toronto Office by the 8th, for issues of the 15th of each month, and by the 23rd for the issues of the first of the following month. If proof is required, the copy should be sent so that the accepted proof will reach the Toronto Office by the above dates.

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

RESEARCH AND INDUSTRY

In this issue we publish some account of the investigation carried on by Dr. H. T. Kalmus and his assistants in the metallurgical laboratory at Queen's University, Kingston, and by Mr. W. S. Barrows at the plating plant of the Russell Motor Car Co., Toronto, in connection with the problem of electro-plating with cobalt.

Cobalt is one of the chief constituents of the silver ores of the Cobalt district, Ontario,. It is produced in larger quantity than the market warrants, owing to the very limited use which it has found up to the present. It is known to have splendid properties as a metal, but for most of the uses to which it might be put, nickel, which is much cheaper, is satisfactorily filling demands.

The experiments carried on last winter by Mr. Barrows to determine the commercial value of the solutions prepared by the investigators at Kingston, seem clearly to indicate that the advantages of the cobalt solutions over the ordinary nickel solutions are such that cobalt is likely to gradually displace nickel for plating purposes.

In our last issue we published an article by Mr. F. M. Turner on the value of research to industry. The investigation of cobalt and its compounds being carried on for the Department of Mines in the laboratories of Queen's University has had results which go to prove Mr. Turner's contentions. Co-operation between the investigators in their laboratories and the foremen in the shops, such as there has been between Dr. Kalmus and Mr. Barrows, is much needed in Canada.

The Canadian Mining Institute is compiling a list of miners throughout the Dominion who have enlisted for military service. The Secretary of the Institute has been advised that such a list, which should particularize the regiment joined, would be useful to the military authorities.

In order that the list be most useful it should be complete and up to date. It is to be hoped, therefore, that the mining companies will promptly advise the Secretary concerning enlistment of their employees.

The Rice Lake, Manitoba, district, is again to the front with another gold discovery. According to interested parties this is a world beater. The information so far available is scanty.

The Sudbury district is making a record production of nickel and copper. There are few places which have been so favorably affected by the war. The demand for the metals is not only good, but likely to continue so.

Several months ago the Department of Militia appointed four members of the Canadian Mining Institute to instruct troops in mining methods useful in warfare. At a recent meeting of the Toronto branch, Capt. Jas. McEvoy, without divulging any military secrets, gave some account of the work accomplished. The results obtained were said to be quite satisfactory. There are few soldiers who would not profit by some of the things that the mining engineers are endeavoring to teach them. Among other things, simple and effective ways for tunneling soft ground are very necessary in this war. It is hoped that not only will these soldiers be able to do such work, but that they will do it in a systematic way known to them all. System and uniformity in methods are obtained only by training.

Since the establishment of a really large gold mining industry in Northern Ontario it has often been remarked that some of the older districts might have also been successful if they had been as capably exploited. Notwithstanding such opinions, however, the gold deposits of Western Ontario still fail to attract the attention that do new discoveries in Northern Ontario. An engineer recently returned from the Rainy River district, visited some claims there on which a few pits had been sunk. The dumps at three test pits were sampled and found to contain $14.10, $21.20 and $18.00 gold per ton. The claims are now being more carefully examined.

NOVA SCOTIA STEEL

Scotia's advance followed the announcement that the company had gone forward to unprecedented production levels. There was an important meeting of directors at New Glasgow on Tuesday, following which Col. Cantley stated that the September output and sales were the largest for any month in the company's history. The management are negotiating for large foreign business and to provide increased working capital necessary in view of the greatly enlarged operations of the company, the directors are considering a proposal for the sale of treasury securities which will place the company in an excellent financial position.—Financial Times.

WEST KOOTENAY NOTES

Slocan.—Among the Slocan mines that had for years been inactive was the Galena Farm, situated near Silverton, Slocan lake. Nearly twenty years ago this mine was one that was prominently before the public, press notices of it having frequently been published. It was closed in the nineties, however, and ever since then had been in charge of a caretaker until early this year, when it was acquired by the late Mr. Patrick Clark of Spokane, Washington. The "Spokesman-Review" of that city on October 16 published the following information concerning it:

"The new 100 tons daily capacity mill at the Galena Farm mine, near Silverton, B.C., has been completed, and is ready to be operated, according to John Clark, son of the late Patrick Clark, who returned recently from a trip to the camp. The plant is of the most modern type, and has been designed and equipped especially to treat the Galena Farm ores which, like most of the mineral deposits of the district, have individual characteristics that must be taken into consideration in working out a concentration system. The Galena Farm was taken over several months ago by Mr. Clark under lease and bond from A. W. McCune, of Salt Lake City, Utah, and the plans that he outlined for development and operation of the property are being carried out by the managers of his estate. One of his sons, P. W. Clark, and two of his former business associates, John Bresnahan and M. Sullivan, who had been interested with him in many mining ventures for more than thirty years, are in charge of the mine and mill, but active management devolves upon Mr. Bresnahan, who personally is superintending operations. About 40 men are now employed, but the number will be increased shortly, when three full shifts will be put on in both mine and mill. The metal content of the Galena Farm ores is principally zinc, although there is also good value in lead and silver. An ore shoot 350 ft. long, conservatively estimated to contain 35,000 to 40,000 tons, has been opened ready for extraction of the ore on the 100 ft. level. Another tunnel, starting 60 ft. below the 100 ft. level, to cut the same ore shoot, is now in 750 ft., and drifting will be commenced at that depth as soon as the vein shall be reached. A 6 ft. vein was encountered in the lower tunnel about 365 ft. in, but it is believed that this is an entirely new vein, not connected in any way with the one showing in the upper workings. The output of the Galena Farm was recently contracted for by the American Metals Co., and the concentrate will go to its smeltery at Bartlesville, Oklahoma.

During September shipments of zinc concentrates from Slocan mines, according to a published statement, totaled only 806 tons, against 1,113 tons for the corresponding month of 1914. This September's shippers were the Standard mine, 453 tons, and the Hewitt-Lorna Doone mine, 353 tons. A beginning has been made to again ship silver-lead concentrate from the Ruth mill at Sandon, which plant had been inoperative for more than a year. On October 15, the Standard Silver-Lead Mining Co., owning the Standard mine and concentrating mill near Silverton, declared another monthly dividend of 2½ cents a share on its 2,000,000 shares, this being the company's third monthly distribution of $50,000 since payment of dividends was resumed in August. Announcement was made in a district newspaper a short time ago to the effect that the National Zinc Co. of Bartlesville, Oklahoma, had contracted to take the zinc output of the Standard mine to a total quantity stated to be likely to amount to 16,000 tons during the next year.

Ore is again being shipped from the Queen Victoria copper mine, situated about ten miles westward from Nelson along Kootenay river. The ore is being taken out by leasers, who are shipping their product to the British Columbia Copper Co.'s smelting works at Greenwood.

Shipment of ore in small quantities continues to be made occasionally from properties in outlying camps in Boundary district. Two lots, together 57 tons, were recently shipped from the Sally mine, near Beaverdell, West Fork of Kettle river, and 60 tons from the Union mine, in Franklin camp, North Fork of Kettle river. The former was shipped to the Consolidated Mining and Smelting Co.'s smeltery at Trail, and the latter went to the Granby Consolidated Co.'s works at Grand Forks.

CRUSHING AND GRINDING GOLD AND SILVER ORES*

By L. D. Mills and M. H. Kuryla.

Primary crushing is usually done in two stages: first a jaw crusher breaking from run-of-mine to 6 in., and then cone crushers to reduce this material to 2 in. The Symons disc crusher is a recent machine which is giving good results in crushing from 4 or 6 in. down to 1 or 2 in. This machine is good on hard, brittle ores, but not adapted to wet, sticky ores. Undersize must be eliminated from the feed.

Typical costs of coarse crushing and conveying are given below:

Goldfield Consolidated, Nev., crushing and conveying	$0.046
Belmont Milling Co., Nev., crushing and conveying	0.068
Commonwealth Mine, Arizona, crushing and conveying	0.079
Hollinger Gold Mines, Porcupine, crushing and conveying	0.113

Fine crushing or coarse grinding covers reduction from 1½ or 2 in. to 0.25-in. aperture. The term to be used depends on whether the energy is applied by impact or attrition or both.

The gravity stamp crushing by impact is probably used in 95 per cent. of the cyanide plants of the world. In spite of its unquestioned disadvantages, it continues in favor. There is a tendency in American and Canadian practice to adopt the ball mill, and it is the authors' belief that few, if any, new stamp mills will be built on the American continent.

The economic limit of battery-screen aperture in modern plants is considered to lie between 0.15 to 0.4 in. This statement applies either to American and Mexican all-sliming practice, 70 per cent. or more through 200-mesh, or to Rand practice, 95 per cent. through 65-mesh.

Stamp mill practice has reached its highest development in South Africa. The Nissen single stamp has been received with some favor there, showing one-third greater capacity, per pound of falling weight, and an equal gain in efficiency over the ordinary gravity stamp. Of the six new mills built on the Rand since competitive trials were made, however, only one proposes to adopt the Nissen stamp. In modern Rand

STAMP MILLING DATA.

Plant	Tons M'l'd 24 Hr.	No. of St'm's	Run'g Weig't	Disch'ge Apert're	Hp.-Hr. P. T. Mil'd	St'p'g Cost, Cts. P. T. Mil'd	Sizing % -100 0.0055 In.	Sizing % -200 0.0029 In.
Mexico Silver Mill	1000	60	1450	0.371	4.8	10.0	....	14.0
Nipissing	245	40	1450	0.334	12.1	23.8	20.3	16.7
Belmont	500	60	1200	0.131	7.2	20.7	28.3	19.5
Silver Peak	500	120	1050	0.023	13.8	31.4	54.0	40.0
Homestake	4500	1020	850	0.022	11.0	20.4	80.0	60.0
Hollinger	585	60	1400	0.263	8.6	16.0	....	15.0
Porcupine Crown	150	20	1000	0.250	6.0	14.0	....	15.0
Liberty Bell	485	80	750	0.041	7.8	19.1	54.0	46.0

plants the cost of stamping does not exceed 20 cents per ton; the average for the district in 1913 was 29.3 cents for thirty of the large plants

Tube-mills have now been universally adopted for final grinding to a finished product. Classification for the elimination of a finished material from the tube-mill discharge is a matter vital to the efficiency of the mill and has received close attention. Cone classifiers with diaphragms a few inches above the apex are preferred on the Rand where coarse grinding is employed. In America the Dorr, Akins, Ovoca and Esperanza classifiers are used, the tube-mills being in closed circuit.

TUBE-MILLING DATA.

Plant	Tons Mil'd 24 Hr.	No. Tu's	Dimens'ns of Tubes	Hp.-Hr. P.T. Mil'd	Cost P.T. Mil'd	Sizing —Final Product— % -100 (0.0055 In.)	Sizing —Final Product— % -200 (0.0029 In)
Mexico Silver Mill	1000	6	5ft. x 16ft. 5ft. x 20ft.	10.8	22.0	98.0	75.0
Nipissing	245	4	6ft. x 20ft.	44.6	50.0	100.0	100.0
Belmont	500	7	5ft. x 18ft.	16.8	40.9	99.0	72.3
Silver Peak	500	1 2	5ft. x 18ft. 5ft. x 14ft.	2.4	2.6	64.0	50.0
Homestake	4500	2	5ft. x 18ft.	0.5	1.2	87.0	66.0
Hollinger	585	6 1	5ft. x 20ft. 5ft. x 16ft.	16.0	18.8	100.0	90.0
Porcupine Crown	150	1	4ft. x 20ft.	5.7	36.0	100.0	90.0
Liberty Bell	485	3	5ft. x2 2ft.	4.3	7.7	87.0	73.4

The efficiency of the closed circuit has been questioned, but the contentions against it are not borne out in practice. As to moisture in tube-mill feed, 38 to 40 per cent. has been generally accepted, and is probably correct for mills discharging within 6 in. of the central axis; but for mills with peripheral discharge, higher moistures will be found advisable. The proportion of tube-mill capacity to stamp capacity has been increased, and costs have been lowered as more work has been thrown on the tube-mill. It is possible that ball and tube-mills in series may supplant the stamp. Various substitutes for pebbles are being investigated, such as hollow cast iron or steel balls, and special polyhedron shapes. The Marathon or rod mill also has been tested with favorable results. Tube-milling costs in the newer plants on the Rand are about equal to stamp-milling costs; 18 to 20 cents per ton milled.

The use of stamps, Chilean mills and tube mills for stage crushing and grinding at the Goldfield Consolidated is unusual, but productive of low cost of operation. Stamps weigh 1,050 lb., crushing through 4-mesh screen; 6-ft. Chilean mills have 30-mesh screens; tube-mills are 5 ft. by 22 ft. Following are costs per ton milled:

	Stamps	Chilean Mills		Tube Mills	
Labor	$0.039	$0.018		$0.014	
Supplies	0.041	0.041		0.065	
Power (232 hp.)	0.054	(210 hp.) 0.047		(357 hp.)	0.087
	$0.134	$0.106			$0.166

Power consumed by stamps, Chilean mills & tube mills—22.5 hp.-hr. per ton milled.

Total combined cost for stamps, Chilean mills & tube mills—$0.406 per ton milled.

Chilean mills are used at the Portland mill, Cripple Creek, for final grinding where a fine product is not required. Six-ft. Akron Chilean mills run at 36 to 41 r.p.m., using 2.5 to 3 tons of solution per ton of ore. Steel consumption per ton of ore ground is 0.797 lb. gross and 0.692 lb. net. Power consumption per ton of ore in coarse-crushing department is 1.86 h.p.-hr. and in Chilean mills, 13.26 h.p.-hr., or a total of 15.12 h.p.-hr. Following are cost data:

	Coarse Crushing, per Ton	Chilean Mills, per Ton	Total, per Ton
Power (at 0.842c. hp.-hr.)	$0.0199	$0.1118	$0.1317
Labor (operation)	0.0318	0.0179	0.0497
Labor (repairs)	0.0103	0.0039	0.0142
Supplies	0.0284	0.0482	0.0766
TOTAL	$0.0904	$0.1818	$0.2722

Dry crushing in ball mills is still retained at Kalgoorlie, the data for No. 5 and No. 8 mills, respectively, being as follows: Size, 7 ft. 6 in. in diameter by 3 ft. 10 in. long, and 8 ft. 10 in. by 4 ft. 6 in.; screen areas, 70 and 100 sq. ft.; speeds, 25 and 23 r.p.m.; power consumption, 25 and 60 h.p.; capacities, 40 and 95 tons

*Abstract of a paper presented at the International Engineering Congress, San Francisco, Sept., 1915, and published in "Metallurgical and Chemical Engineering," October, 1915.

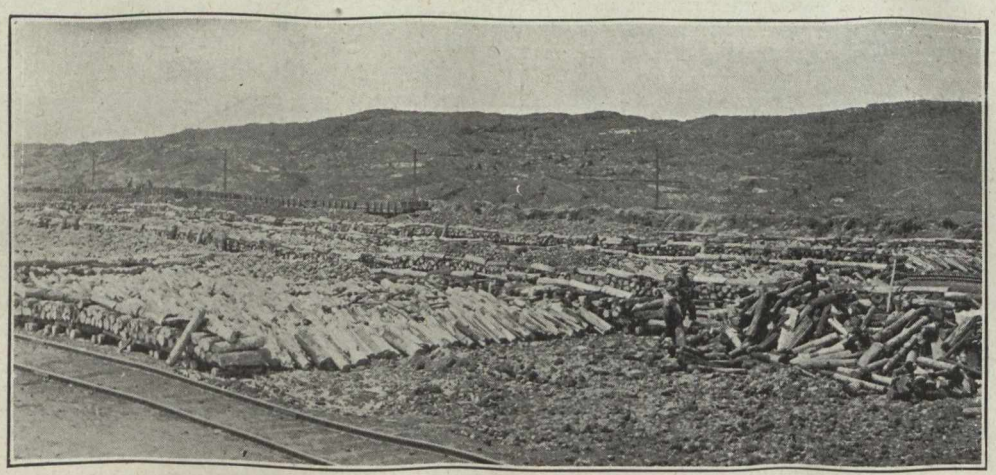
per day, the feed being about 2½ in. and the discharge through 28-mesh screen containing from 40 to 50 per cent. minus 200-mesh; steel consumption per ton milled varies from 0.4 to 0.7 lb.; average cost of ball-milling, $0.50 per ton milled.

Wet crushing ball mills are coming into favor with excellent results. They run smoothly and are free from the noise produced by stamps. Recent tests on an 8-ft. Marcy mill showed that when operated in closed circuit on 4-in. maximum feed, the finished product may be kept under 48-mesh if desired. Steel consumption was 0.75 lb. per ton crushed, and power consumption about 12 h.p.-hr. per ton.

Griffin mills and grinding pans, once widely used, are now rarely installed in new plants.

* * *

In the discussion of this paper Mr. Charles Butters predicted that steel balls would displace pebbles for tube milling, as they would permit the use of shorter tubes with smaller diameter, running at a higher speed, with a consequent reduction in first cost and in operating cost. One pound of steel balls is equivalent to three to five pounds of pebbles.



Building roast heaps, for treatment of nickel-copper ore, Copper Cliff

SUDBURY.

Work on the five-compartment shaft at Creighton is being pushed at a very satisfactory rate. The number of men underground in the district is larger than ever. Until recently the district showed a good accident record for 1915, but last week Mining Inspector Sutherland was called from Toronto to be present at two inquests in one day, the victims being a timberman and a miner at Creighton mine.

Milling nickel-copper ore, Creighton

The Canadian Copper Co. has issued an order, effective the 1st November, that all smelter and surface employees will hereafter work an eight-hour shift, instead of ten or twelve hours, at the same rate of wages as for the long hours.

International Nickel in its first statement since the shares were listed shows total earnings of $6,770,707 in the six months ended September 30. In the entire year ended last March the company reported an aggregate income of $7,230,760, which was only $460,000 more than in the succeeding half year.

The company paid out in dividends in the six months $2,168,953 and, after making reservations for depreciation and decreases of mineral resources, a balance remained of $3,398,466. The balance for the preceding year was $309,378.

NIPISSING.

With the payment of current dividend, amounting to $300,000. Nipissing Mines has disbursed to its stockholders since July 20, 1906, a total of $13,440,000, or more than twice the amount of its capital stock of $68,000,000.

News from Cariboo and Atlin indicates that it is not unlikely the placer-gold yield for the 1915 season will be somewhat less than that for 1914. However, until particulars shall have been received from the local Gold Commissioners, it will not be known what the position in this respect really is.

MINING IN THE YUKON*

By J. B. Tyrrell.

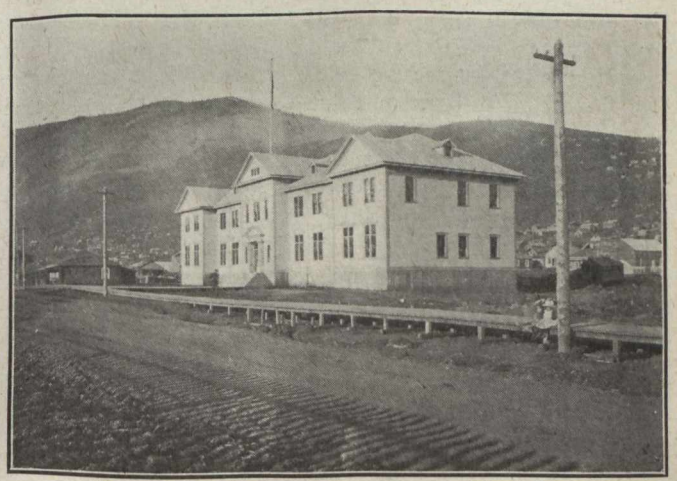
Gold.—Gold mining has been the principal and controlling industry in the Yukon up to the present time, the agricultural and other products having been used for the support of the gold miners and those dependent on them. Gold has as yet been mined entirely from gravel deposits, for although it has been found in reefs and ledges in a number of places, none of these have so far been worked at a profit. The history of gold mining in the country, therefore, is the history of its placer-mining, and this has been confined largely to the Klondike district, though gold-bearing gravels have been found on many other streams outside this district, such as the Big Salmon, Lewes, Stewart, Forty-mile, etc. The native gold in nuggets, pellets and dust is found free in the gravels on the banks and bars of streams and in the alluvial deposits that form the bottoms of the valleys. These gravel deposits are classed as placers, but there is a very vital difference between such mines on the tributaries of the Yukon river and other alluvial or placer mines in countries farther south, a difference so great as to put them, from an operative standpoint, in a class by themselves.

The gravel is frozen into a solid mass and remains frozen summer and winter alike, and at the same time it is almost everywhere covered by a layer, from two feet to as much as one hundred feet in depth, of vegetable mould or "muck," which is also frozen into a solid, coherent, icy mass. On the banks of the streams farther south the miner, with his pick, shovel and rocker, or sluice-boxes, can take up the gravel and wash the gold from it cheaply and easily, but here the pick will make little or no impression on the frozen ground. The gravel has to be first thawed by some means before it can be raised, and the development of the most economical methods of thawing it has been a dominant factor in profitable mining in the Klondike.

For two years after gold was discovered by George Carmack on the banks of Bonanza creek mining was almost exclusively confined to the gravel deposits in the bottoms of the valleys, and was performed entirely by hand, with the assistance of such simple implements as the pick, shovel, wheelbarrow and windlass.

Ground Sluicing and Shoveling-in.—Two general methods of mining were in vogue, depending on whether a claim was worked as a pit or "cut" open to the surface, or through a shaft or shafts and tunnels or chambers underground. The first method, usually known as "ground sluicing and shoveling-in," involves expensive preparation before the pay-dirt can be reached. It is conducted as follows: A narrow ditch is dug in the muck lengthwise of the claim, and a part or the whole of the water from the adjoining brook is turned into the ditch by a wing-dam. The water rapidly deepens the ditch to the level of the bottom of the muck, or the top of the underlying gravel, and the miners pick down the muck and ice from the sides of the ditch into the running water below, by which it is in part dissolved and in part carried away down the stream. As the ditch is thus widened, the water is kept flowing against one side by little dams, and thus an area from one hundred to two hundred feet in length and fifty feet or more in width is freed from its covering of muck, and the underlying sand and gravel is laid bare to be thawed by the sun and warm winds and rain of the remainder of that or the following summer. Of the gravel so exposed the upper portion usually contains so little gold that it is of no value. It is, therefore, shovelled into wheelbarrows and wheeled away and dumped to one side, all the ground being removed until the gold-bearing layer near the bed rock is reached. A dam is then built in the stream some distance above the area of uncovered gravel, which being now lower than the surrounding part of the bottom of the valley, or than the bed of the stream itself, is known as the cut; and a flume is built from this dam to sluice-boxes, which are strung on a proper grade across the top of the cut. Water is turned into the flume and sluice-boxes, and the pay-dirt is then shoveled, usually in two stages, from the bottom of the cut into the sluice-boxes.

Cost of Shoveling-in.—This shoveling-in was a slow and expensive process, for wages were high, even though many of the men employed had never been accustomed to handle a shovel. An average gang of six men, working in a cut and shoveling dirt into the sluice-boxes in two stages, will thus handle from fifteen to twenty cubic yards in a day of ten hours. In some of the richest mines the expense was, of course, a trifling matter compared to the great value of the output. For example, in the summer of 1898, at one mine, a force of six or eight men, working for three shifts of ten hours each, produced eight gold-pans full of clean gold. The owner at that time was obliged by law to pay a royalty of ten per cent. of this gross output, and the return made by him of the value of this clean-up was $45,000.



Administration Building, Dawson City

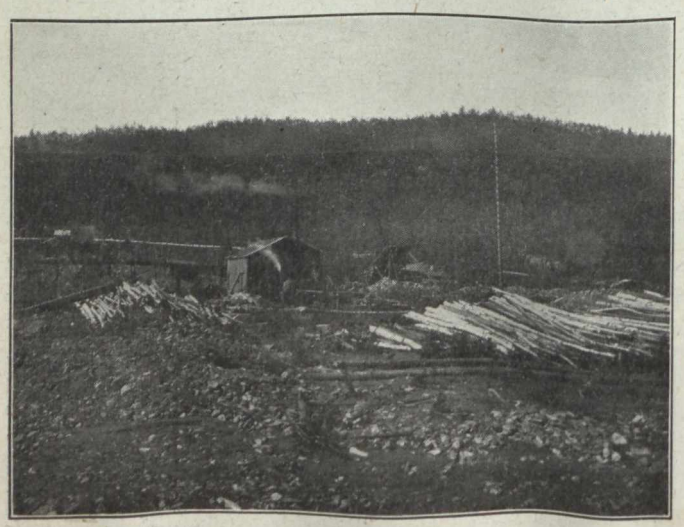
Drifting.—The other method—"drifting"—in vogue in the early days of the Klondike camp, chiefly on claims where the muck and underlying barren gravel were too deep to permit of their being removed economically by the process of open cutting just described, was conducted as follows:

In the winter season a shaft, about three feet by six feet in horizontal dimensions, was picked down through the frozen muck to the sand or gravel. As a rule it is not difficult to pick out the muck, as it flakes off

*From "The Yukon Territory," by J. B. Tyrrell, in "CANADA AND ITS PROVINCES," Toronto. Glasgow, Brook & Co. 1914. Vol. 22, pp. 583-636.

easily; and much of it is so free from grit that it will not even blunt the point of the pick. As soon as the shaft was sunk to the gravel, a fire was built in the bottom of it, and after this fire had burned out, and the gases arising therefrom had risen to the surface, the gravel that had been thawed by the fire, extending probably to a depth of from twelve to eighteen inches, was dug out and hoisted to the surface with a bucket and hand-windlass. Another fire was then built in the bottom of the shaft, the gravel being afterwards removed as before, and so the work went on until bed-rock was reached. One, and sometimes two, fires were lit in a shaft each day. When the bed-rock was reached, fires were built against the face of the gravel, green timber being piled on the dry wood to keep the heat down as much as possible, and the gravel and bed-rock were hoisted to the surface as before and piled up in a dump. During the following spring, when the water was flowing in the adjoining creek, it was diverted into sluice-boxes and led past the dump, the surface of which, as it was thawed by the sun and atmospheric agencies, was scraped off and shoveled into the water in the boxes, the rate at which this pay-dirt could be handled being determined by the rapidity with which the dump thawed. If the dump was large, it might not thaw out thoroughly until well on towards the end of the summer; and, when the creek was a small one, it very often happened that the water in it, supplied by the melting snow of the previous winter, failed and so put an end for that season to the possibility of sluicing.

Cost of Drifting.—Exact accounts were rarely kept in the Klondike in those days, except by the banks, so that it is difficult to determine the precise cost of much of the mining that was then done, but it is safe to say that it varied from ten dollars to twenty-five dollars and more to the cubic yard.

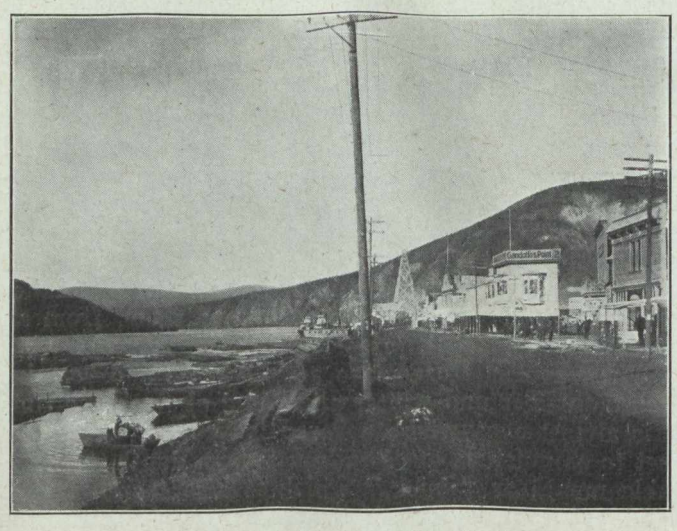


Placer Mining in Summer. Claim 44, Humker Creek

Summer Methods.—Such underground mining, with the help of wood fires, could only be carried on in winter, for at that time of year the air in the drifts, though at freezing-point, was much warmer and lighter than the air above, which was probably 50 degrees lower in temperature, and the noxious gases formed by the fires would quickly rise to the surface and be dissipated; while in the summer the air in the drifts, with its load of noxious gases, being surrounded by frozen ground, was still at freezing-point, and the air above was much warmer and lighter, so that the poisonous gases generated by the fires would not rise to the surface, and men were consequently unable to work in the drifts.

But the miners were determined, if possible, to prospect and work their claims whether the season was summer or winter, and after a number had been overcome and killed by gas, the following plan was adopted:

A shaft was picked down through the frozen muck to the gravel as before, and then a big fire was built on the surface at the top of the shaft in which a number of large rocks were heated. These were then thrown to the bottom of the shaft and covered with moss or brush. Next day the moss, brush and rocks, now cool, were hoisted to the surface with a windlass



Front street Dawson, on bank of Yukon river

and as much of the gravel as the hot rocks had thawed; then the rocks were again heated and thrown down the shaft, and the process was repeated until the bed-rock was reached.

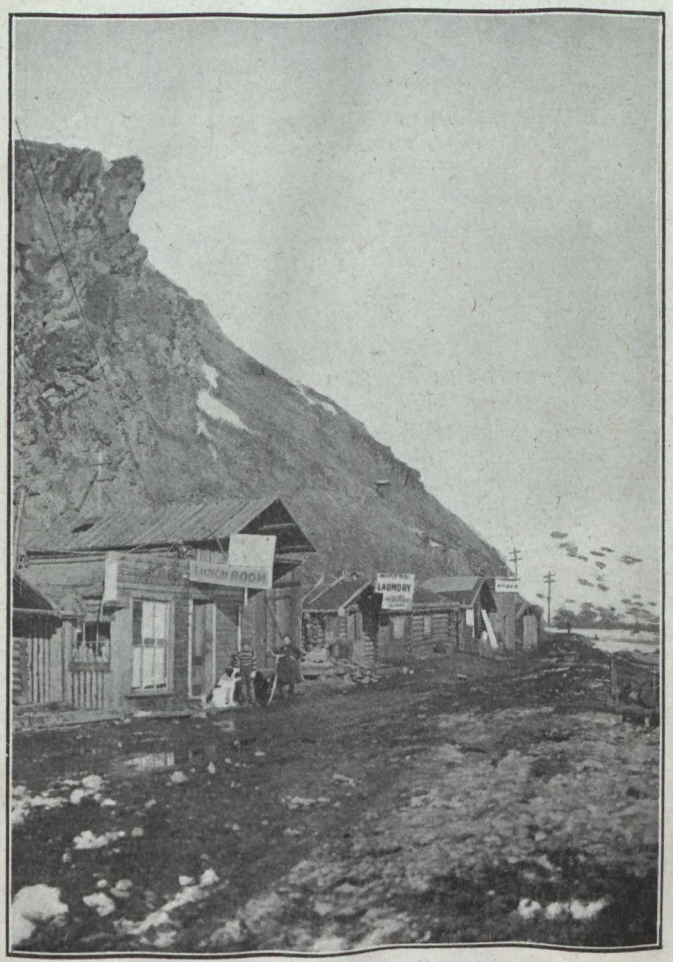
Such were the methods of mining practised in the Klondike in 1897 and 1898, and it must be remembered that such are still the only methods available in remote districts to which machinery cannot be transported.

Thawing by Steam.—But the men soon began to recognize that while shallow ground might be worked by hand with a possibility of profit, deep ground, which would need to be undermined, must be thawed in some other way than by wood fires or hot rocks, if it was to be mined quickly and cheaply, and that most of the mining in the country must be done in deep ground. Many plans were suggested and tried for thawing ground, but it would appear that John McGillivray, a mining engineer from California, was the first to adopt the method which has since come into general use. In the winter or spring of 1899 he took a small steam boiler to a mining claim on Sulphur creek, and then began thawing the frozen gravel by steam, the method adopted being about as follows:

A shaft was picked down through the muck, and near it the boiler was set up on the surface. A small iron pipe was connected to the boiler and run down to the bottom of the shaft, where it was connected by an india rubber hose to a loose piece of one-half inch pipe pinched in at the point. Steam was raised in the boiler to a pressure of from twenty to thirty pounds to the square inch, a valve which had been set in the pipe was opened, and steam was let into it. The loose pipe, known as the "point," was then gradually pushed or driven into the gravel to its full extent, the steam issuing from the aperture at its tip thawing the gravel

in front of it, and it was allowed to remain for several hours, during all which time steam was supplied through it from the boiler to the gravel in front of and around it. In this way the gravel was thawed to a much greater depth than a wood fire would penetrate, and by increasing the size of the boiler and the number of points, a long section of the wall of a drift could be readily thawed at one time.

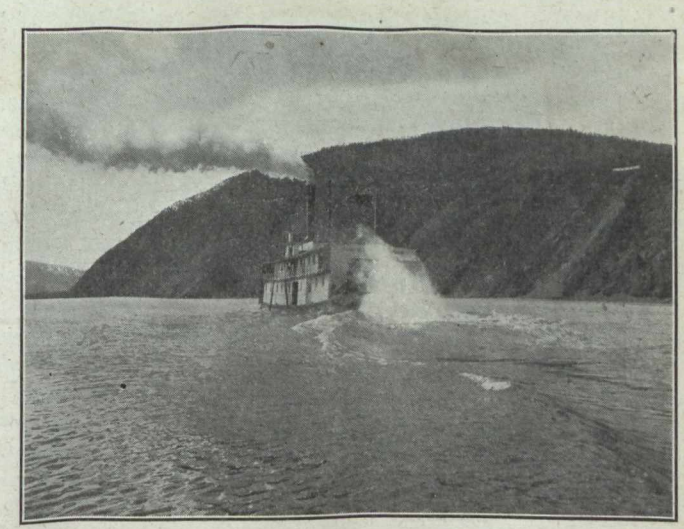
McGillivray's plant was undoubtedly inefficient, as the pipes, rubber hose, and especially the points were too weak for the work required of them, but nevertheless he had discovered the correct way of thawing



Street at south end of Dawson City

frozen ground by steam. From his little boiler and plant has developed the efficient steam-thawing plant in use at the present time in so many of the placer mines of the Yukon territory and Alaska. The plant consists of a boiler of twenty-five to fifty horse power, not too heavy so as to be immovable under ordinary conditions; iron piping to conduct the steam to the place where it is to be used; steam hose of the best quality; and points, five feet or more in length, made of double thickness hydraulic steel pipe, each with a tip of very hard manganese steel, in the end of which is a hole a quarter of an inch in diameter; and a heavy steel head, into the side of which is welded a hollow nipple over which the steam hose may be clamped. The points are driven into the gravel, or loose bed-rock, with a heavy mallet, while at the same time the steam from the boiler, which is kept at a pressure of from eighty to one hundred pounds, is turned into them. As a rule they can be driven to their full length in a few minutes, for the steam thaws the gravel in front of them very quickly, while at the same time it prevents any pebbles or chips of rock from becoming wedged in the hole in the tip.

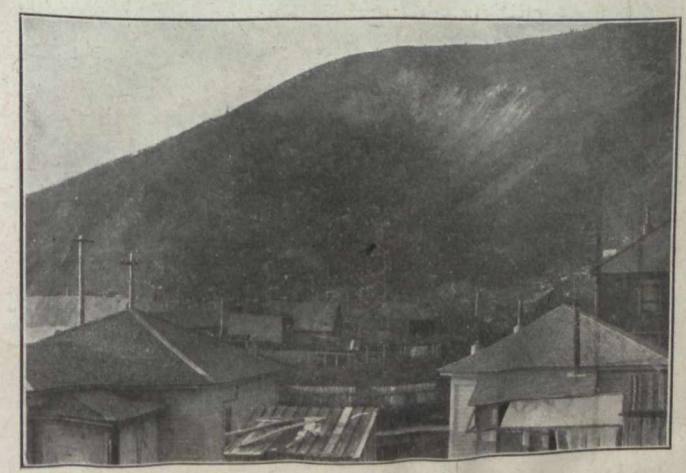
One great advantage of this steam-thawing plant was apparent from the first, namely, it made underground mining of frozen ground possible in summer. It not



Steamer on Yukon river, near Dawson

only meant that mining could be prosecuted throughout the whole twelve months of the year, it also meant that the dirt mined in summer need not be piled up in dumps, from which it would again need to be thawed and afterwards shoveled into sluice-boxes, but that it could be discharged into sluices as soon as it was extracted, and that the gold could be immediately separated from it.

There are many occasions on which the steam-thawer is now used, other than for thawing the gold-bearing gravel in the drifts underground. A shaft may be sunk with it, either by driving short points vertically into the frozen ground, and digging out the thawed dirt from time to time, or by driving a long point, from twenty to thirty feet long as occasion may require, vertically down through the muck and gravel to bed-rock, steaming it for a day or two, and then



Dawson City, at foot of Moosehide Mt.

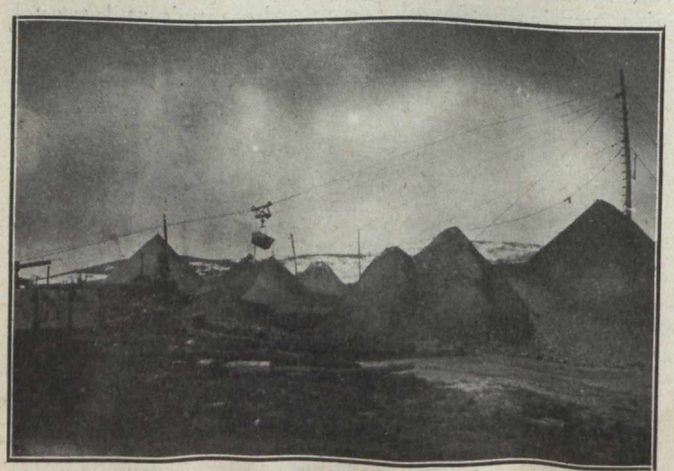
digging out the whole of the thawed dirt at once, the result being a shaft with roughly circular outlines. Dumps of pay-dirt extracted during the winter, and again frozen hard, may be quickly thawed by the steam-thawer in order to enable the miners to make full use of the heavy rush of water in the spring to wash the gold from the gravel. In the open cuts the

uncovered gravel may be thawed in order to hasten the mining work in the early summer, or to prolong it in the autumn.

Pulsometers.—In some mines pulsometers were used underground to thaw the pay-dirt in the drifts, the water being pumped over and over again against the face of the gravel, breaking it down and washing it and the gold contained in it back for a short distance, this latter process being assisted by a man with a rake. In this process the water is heated by the condensation and discharge into it of the steam used in the pulsometer. In other mines a similar result was attained by pumping water with a small duplex pump from the sump against the face of the gravel, the water being first slightly heated by steam direct from the steam-pipe.

Steam Hoists.—At first the steam generated in the boiler was used entirely for thawing the frozen ground and the pay-dirt, as before, was shoveled into small buckets, dragged on skids to the shaft, hoisted with a hand-windlass, and then emptied by hand on the dump or into the sluice-box. This arrangement necessitated the keeping of one windlass man on the surface for each miner underground, and so, with firemen, wood-haulers, etc., it meant that altogether too small a proportion of the crew were actually engaged in getting pay-dirt. Small steam-hoists were therefore introduced, which would hoist as much as two or three men could shovel up and bring to them; but this did not materially lessen the cost of operations, for more wood as fuel was needed to generate steam to supply the hoisting engine, a man was needed at the engine and another at the top of the shaft, and thus the amount of unproductive labor demanded was but slightly reduced. The limit of size of the bucket raised by the hoist was determined by the size and weight which the man at the mouth of the shaft could handle and empty.

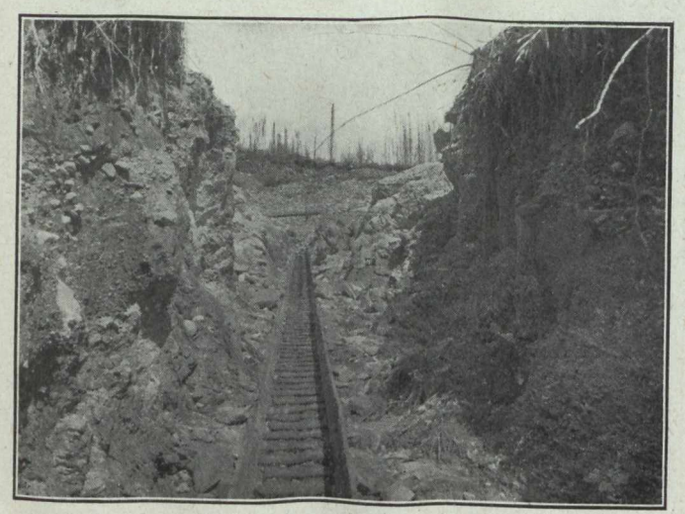
Dawson Carrier.—The greatest improvement in the mechanical moving of the pay-dirt was accomplished by the invention of the self-dumping cable-tram, or



Dumps of pay-dirt on Gold Run creek, showing Dawson self-dumping carrier

"Dawson carrier," carrying a bucket with a capacity of from nine to eleven cubic feet. By its means one man at the hoist can raise from the shaft, and either pile up in a conical dump or empty into a sluice-box, as much dirt as eight or ten miners underground can pick down and wheel to the roisting bucket. By its assistance pay-dirt in solidly frozen ground can be mined from tunnels and drifts, and hoisted and sluiced for about three dollars a cubic yard, with wages at six dollars a day, and dry spruce wood for fuel at ten dollars a cord. Since, with this plant and in a properly conducted mine, about two-thirds of the men employed are working underground with pick and shovel, it is not likely that this cost can be greatly reduced while wages remain at their present rate.

Improvements Above Ground.—The modifications of the methods of open cutting and ground-sluicing adopted in 1897 and 1898 have been usually on well-known engineering lines, and have not exhibited the same originality as has been shown in the improvements of the underground mining methods. The general practice is still to pick the muck down into the stream and then to allow the water to carry it off. After the muck has been removed and the frost has been drawn out of the gravel by the warm air of one or two summers, the barren upper gravels are usually removed, either with shovels and wheelbarrows, horse-scrapers, or steam-scrapers, and piled into waste dumps.



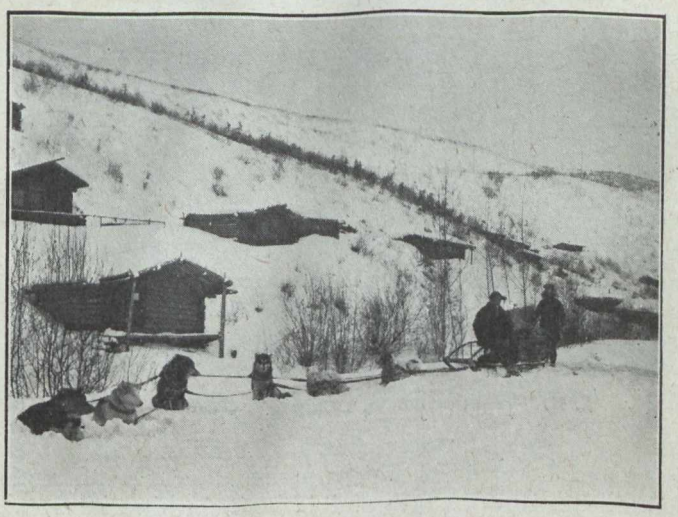
Sluice from Tyrrell's hydraulic mine on the Bonanza creek benches

After the barren gravel has been removed the pay-dirt is either shoveled into sluice-boxes set in the bottom of the cut, the water used being afterwards raised by a centrifugal pump to the general surface level; or the sluice-boxes are set over the cut, and the pay-dirt is shoveled, usually in two stages, into them; or the sluice-boxes are set above and to one side of the cut, and the pay-dirt is wheeled to a bucket which is hoisted in some way, preferably by a "Dawson carrier," and emptied into the sluice-boxes.

In mining the gravel on the terraces or benches, high above the level of the streams, the early miners were usually at the disadvantage of having no water immediately available, so that the pan and rocker were the only washing plants that could be used, and water for these had often to be carried up a height of several hundred feet in pails. The owner of one of the richer of these claims might have from six to ten men with rockers working for him, but on account of the great expense of such work no attempt was made to mine ground that would yield gold of less value than fifteen or twenty dollars a cubic yard.

After the narrow belts of rich and shallow ground along the edges of the benches or terraces had thus been shoveled off, and the gold extracted from them in rockers, the miners began to run adits into the hills, along the bottom of the gravel on top of bed-rock, and to bring out the pay-dirt to the "rim" to be washed in

rockers. But this process of mining and hand-washing proved entirely too slow and expensive. Consequently the pay-dirt was mined and brought out to the mouths of the adits, where it was piled up for a time, and was then either run down the hill in a chute to a sluice set near the creek, and supplied with water from it; or, if it was impossible to dump tailings on the creek claim, a pump was installed and water was pumped up the hill and allowed to run down again through the sluice-boxes, being often used two or three times over by different parties in its descent. At a later date



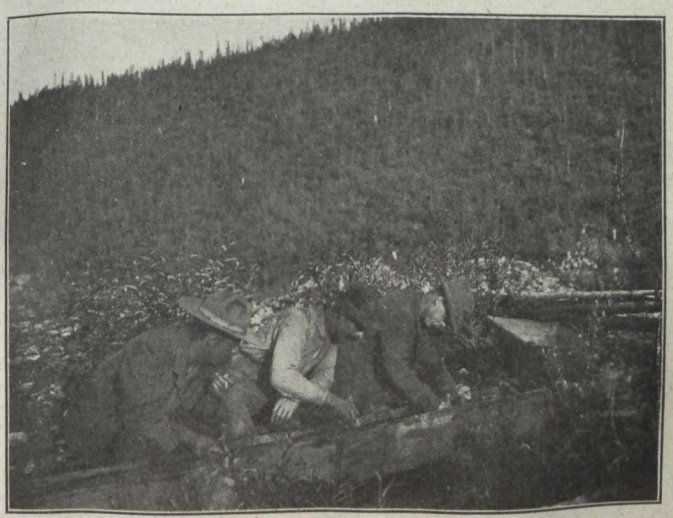
A winter scene in valley of Klondike river, near Dawson

ditches, sometimes several miles in length, were dug to bring water from tributary streams at a sufficiently high elevation to enable the miners to wash these dumps of pay-dirt.

The methods of mining adopted on these terraces, or so-called "hillside" claims, were for the most part very similar in character to those used in underground mining in the creek claims. An adit was run along the top of the bed-rock to the rear boundary of the claim, or as far as pay-gravel could be found, and drifts were driven at regular intervals at right angles to it. The intermediate pillars were then taken out, a certain amount of timbering being usually necessary to support the roof while the pay-gravel from these pillars was being recovered. In most of these mines the ground was frozen and had to be thawed with steam-points; but in some cases, generally where the overburden of barren gravel was more than two hundred feet thick, the ground was not frozen, and in such places mining could progress much more steadily and regularly. In some instances, however, the claim which the miner desired to work did not extend to the rim, so that it could not be worked from an adit; and in that case it was necessary to sink a shaft and mine in the same manner as in the bottom of the valley, the chief difference being that the shaft was usually deeper, and the expense of obtaining water for washing the gravel was very much greater. In other instances, after the value of the gravel in these bench deposits had been proved by tunneling, water was pumped up from the creek in the bottom of the adjoining valley to heights of from fifty to one hundred feet above the level of this gravel, and was then delivered against it through hydraulic giants, thus washing it off the rocky bench on which it lay, the water with its load of gravel being directed in its flow through cuts in the bed-rock, and then through sluice-boxes in which the gold was caught before it was allowed to fall into the valley below.

The enormous expense of installing such a pumping plant in a region so remote and difficult of access, and the great cost of fuel after the plant had been installed, soon proved that such a method of mining was too expensive, even for the very rich ground that was being operated upon; but it also proved that hydraulic methods of mining were quite feasible in the Klondike, and that the frost in the ground was no bar to the employment of such methods.

The gold-washing and separating apparatus in use in the Klondike has remained practically unchanged throughout the life of the camp. Leaving the "rocker" out of consideration, it consists of a string of sluice-boxes, each twelve feet long, twelve or fourteen inches wide at the upper end and two inches narrower at the lower end. These boxes are placed so that the small end of one box just slips into the large end of the one below it, and are supported and braced so as to have a grade of from six to nine inches to each box. In the middle of the string there is usually one box much larger than the others, called a "dump-box," in which a man stands with a heavy "sluice-fork" to stir the gravel and throw out any rocks too large to run easily through the smaller boxes. In the bottom of all these boxes small rounded poles, called "riffles," are laid lengthwise and are fastened together by short transverse strips every six feet. Water varying in quantity from two hundred and fifty to seven hundred gallons a minute is turned into and allowed to flow through these sluice-boxes, and as the pay-dirt is shoveled or



Brushing gold from black sand, Claim 44, Hunker creek

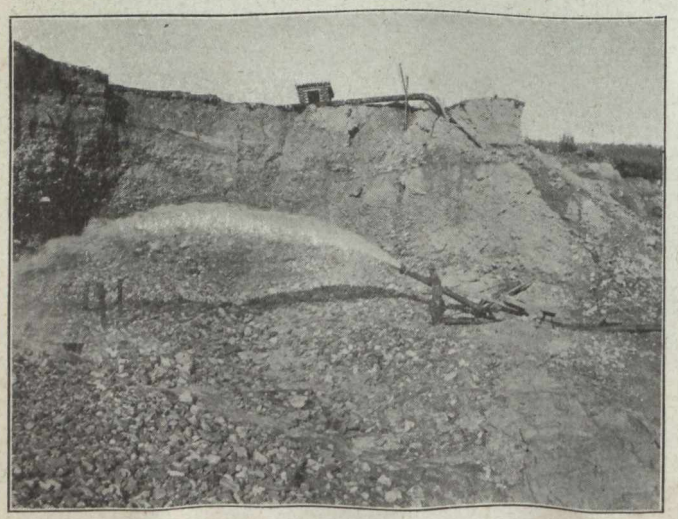
emptied into them, it is carried along by the water, and the gold settles to the bottom and is caught between the riffles, while the gravel and sand is discharged from the lowest box at the tail of the sluice. The riffles are raised and taken out from time to time, and while a small quantity of water is allowed to flow through the boxes, the gold is carefully separated with wooden paddles and brushes from the gravel caught with it in the riffles.

Dredging.—In 1900 a dredge was installed on the Cassiar Bar, on the Lewes river, twenty-seven miles below the mouth of the Teslin, and was operated for a year or two without success, apparently because there was not sufficient gold on the bar, or because the gold did not descend to any considerable depth into the gravel. In the following year it was brought down to

Bonanza creek and set up on Claim 45 below Discovery, where it operated for a short time and whence it was removed to the Discovery group of claims, where it finally operated with great success. This was a ladder and bucket dredge with bucket stacker, and though too small for the work, it proved to be the correct type. Dredges of such type, if properly managed, save very nearly all the gold at a very much lower cost than the material can be handled in any other way. However, they labor under the disadvantage of not being able to work in frozen ground. So far this difficulty has been overcome by thawing the ground in front of the dredge with a steam-thawer, which, however, adds greatly to the cost.

Since this dredge was installed many others have been added, so that during the summer of 1911 there were working on the river bottoms in the Klondike in all about seventeen dredges, most of which were digging in frozen ground, though in a few cases, on account of local conditions, the ground proved not to be frozen. The absence of large boulders makes the gravel very easy to handle with these dredges, after it has been thawed or when it is free from frost, and the dredging industry should prove one of the most profitable of the mining industries of the country for many years to come.

Hydraulic mining was begun early in the history of the camp, but with comparatively little regard to the expense of obtaining the large quantity of water that is necessary for this method of operation. The first hydraulic plant was started on Hunker creek by George Johanssen, who spent a large sum of money in buying a number of hill claims. He operated by pumping up water from the creek at an enormous cost. Other similar operations were then begun on Bonanza creek, but, in most if not in all cases, without financial success, even though a very large quantity of gold might be recovered. Gradually all these pumping plants were



One of earliest attempts at hydraulic mining on Bonanza creek

abandoned, and water was taken from the small creeks and tributaries of the larger streams and was used at a low head against the gravels, cutting them down, the gold being recovered from them in sluices.

The Great Ditch.—About 1906 a large impounding dam was built near the head of Bonanza creek, forming a reservoir with a capacity of three hundred and fifty million gallons. The water from this reservoir is taken through ditches, flumes, and pipes, with a total length of nine miles, and is used on the hill claims in the valley of Bonanza creek, near the mouth of Eldorado creek. In the same year the Yukon Gold Co. also undertook to bring water to Bonanza and Hunker creeks from the upper waters to the Twelvemile river, which flows into the Yukon eighteen miles below Dawson, and has its source in the Rocky mountains to the northeast. This great artificial waterway has now been completed to carry 125 second feet, or five thousand miner's inches of water, at a cost of more than $3,000,000. It has a total length of 70 miles, made up as follows: Ditch, 38 miles long and 9-20 feet wide, with

J. B. Tyrrell's camp, Claim 39. Hunker creek

3½ feet depth of water; flume, 19.6 miles long, 6 feet wide and 4 feet deep; pipe, wooden stave, steel bound, 8.8 miles in total length and 42-54 inches in diameter; pipe, steel, 3.8 miles in total length, 42-49 inches in diameter, the steel varying from ¼ to 11-16 inch in thickness.

The water enters the ditch at an elevation of 3,320 feet above the sea, and is delivered from the pipe on the south side of the Klondike valley at an elevation of 2,240 feet above the sea, or 1,040 feet above the level of the Yukon river at Dawson. The water from this great ditch is being used to break down and wash the gold from the extensive deposits of white terrace gravel that occur along the Klondike river and its tributaries.

Chief Producing Creeks.—In the Klondike the chief producing creeks have been Bonanza, Eldorado, Hunker, Bear, and Dominion with its tributaries Gold Run, Sulphur and Quartz.

In 1906 R. G. McConnell, of the Geological Survey of Canada, made a careful estimate of the past production and future possibilities of the gold-bearing gravels and the following figures are taken from his report to the Canadian Government.

Speaking of the gravels of the Third Cycle, or Creek gravels, he says: "The Eldorado paystreak has a length of about four miles, and its production up to the present is estimated at $25,000,000, or about $1,200 a running foot for the bottom of the valley." But some of the claims 500 feet in length yielded more than a million dollars, or more than $2,000 to the running foot of valley bottom. "Upper Bonanza creek, the portion above Eldorado forks, proved rich up to Victoria gulch, a distance of about four miles. The paystreak in places rivalled that on Eldorado creek in richness, but the general average grade was considerably lower. The past production is estimated at $15,000,000," or more than $700 to the running foot. Lower Bonanza creek has a length of about ten miles, and with the tributary gulches has produced about $11,000,000. Klondike river flat has produced $1,000,000. Bear creek has produced $1,000,000. Hunker creek

with its tributaries has produced $14,000,000. Dominion, with its tributaries Gold Run, Sulphur and Quartz, has produced $24,250,000.

Some of the gravel on the creeks was phenomenally rich. One pan of gravel weighing about fifteen pounds, taken from undisturbed deposits on Bonanza, and washed in the presence of the writer, yielded forty and a quarter ounces of gold, the largest nugget in the pan weighing an ounce and a half.

In speaking of the terrace gravels of the Second Cycle of erosion, McConnell says: "The gravel in the paystreak of all these Upper Bonanza (and Eldorado) hills proved rich everywhere, and in places the values returned appeared almost fabulous. Whole claims are reported to have averaged from $60 to $100 per square yard of bed-rock. Portions of French, Gold, Chechaco and Magnet hills were particularly rich, and yields of a dollar a pan, or $150 per cubic yard for the lower four or five feet of gravel, are stated to have been obtained from small areas of these hills." A number of cases of much higher values than the above have been credibly reported. On both French and Gold Hills men have taken out with a rocker as much as five thousand dollars a day, and as the men probably would not handle more than two and a half cubic yards apiece, the yield would be about two thousand dollars a cubic yard. The yield of these gravels from Boulder hill upwards is placed at $24,000,000. The terrace gravels on Bonanza Creek below Boulder hill yielded $750,000. The similar gravels on the hills of Hunker creek produced $2,500,000. At the same time (1906) McConnell placed the estimated future output of all the Klondike gravels at about $63,000,000, since which time, up to January 1st, 1914, the country has produced a total of $31,311,012.

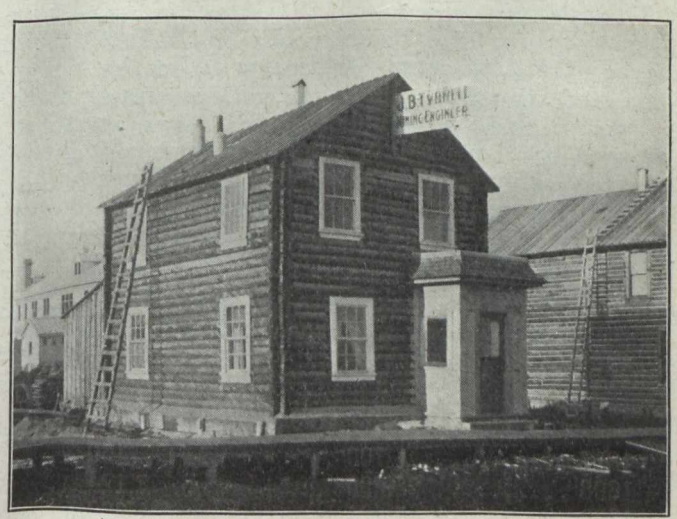
Gold Production of Yukon.—Up to January 1st, 1914, gold mining in the Yukon has produced gold of the following quantities and values:

Calendar Year.	Oz. (fine).	Value.
1885-1886.	4,837	$100,000
1887	3,386	70,000
1888	1,935	40,000
1889	8,466	175,000
1890	8,466	175,000
1891	1,935	40,000
1892	4,233	87,500
1893	8,514	176,000
1894	6,047	125,000
1895	12,094	250,000
1896	14,513	300,000
1897	120,937	2,500,000
1898	483,750	10,000,000
1899	774,000	16,000,000
1900	1,077,553	22,275,000
1901	870,750	18,000,000
1902	701,437	14,500,000
1903	592,594	12,250,000
1904	507,938	10,500,000
1905	381,001	7,876,000
1906	270,900	5,600,000
1907	152,381	3,150,000
1908	174,150	3,600,000
1909	191,565	3,960,000
1910	221,091	4,570,362
1911	224,197	4,634,574
1912	268,447	5,549,296
1913	282,838	5,846,780
		$152,350,512

These are the official returns as given by the Geological Survey and the Bureau of Mines of Canada and computed from the returns of the American Mint and the banks and Government offices in the Yukon, with reasonable allowance for gold that could not be accounted for through these channels. Some people are inclined to add largely to these figures for gold lost and unaccounted for, but a residence of seven years among the miners of the Klondike convinces the present writer that such enlarged figures are mostly gross exaggerations and that the official estimates are quite high enough to account for every ounce of gold that has come out of the country.

Silver.—The production of silver has been confined, with the exception of a very small amount taken from the prospects in the Southern Yukon, to the quantity occurring with the gold and extracted from it when it is reduced to bullion.

Copper.—Copper occurs in the southern portion of the Yukon territory in a belt extending from near the



One of the oldest homes in Dawson, occupied by J. B. Tyrrell

town of Whitehorse westward to the international boundary line. In the vicinity of Whitehorse the ore is in the form of sulphides and is found in more or less extensive contact veins along the contact of limestone and acid intrusives. A large number of claims have been staked, and from these some ore has been shipped southward to the smelter on Vancouver island, but the high cost of transportation and the consequent excessive cost of labor and supplies has militated very strongly against the successful operation of these properties.

Near the international boundary line at the head waters of the White river and its tributaries native copper is found in some abundance in the gravel along the stream, and in time the recovery of this copper may prove to be a productive and successful industry.

Tin.—As yet tin has not been found in commercial quantities in the district, but rounded particles of cassiterite or tinstone were constantly found in the sluice-boxes in the Klondike with the gold, and it is possible that in some places it may be discovered in paying quantities.

Tungsten.—Scheelite, one of the ores of tungsten, was found in some abundance associated with gold in the sluice-boxes on Duncan creek near the head-waters of the Stewart river, but so far it has not been discovered anywhere in commercial quantities.

Antimony.—Some veins rich in antimony ore have been discovered in the mountains on the Wheaton river southwest of Whitehorse, but up to the present they have not been worked.

Coal.—In rocks of Lower Cretaceous age, at about the same geological horizon as the Kootenae rocks in which coal is so abundant in the Rocky mountains in Alberta, coal is found at a number of places in the Yukon territory, varying in character from anthracite in the Wheaton district to lignite at many places on the Lewes and Yukon rivers. In the reports of the Geological Survey the area known to be underlain by coal is given at four hundred square miles, and the estimated quantity available is given as follows:

	Tons.
Anthracite	32,000,000
Bituminous coal, often making excellent coke	32,000,000
Lignite	850,000,000

But further examination will doubtless add largely to these figures.

Some coal from the Tantalus mine on the Lewes river has been used to supply the steamers on the Yukon river, and some from the mines on Coal creek, north of Dawson, is being supplied to the Dawson market, but the quantity used in the territory is not large. However, as industries of various kinds increase in number, this great reserve of fuel and potential energy may prove to be one of the greatest natural assets of the country.

Movement of People into the Yukon Territory between Years 1897 and 1900 inclusive.

Prepared by Col. A. B. Perry, Supt. R.N.W.M. Police.

	Men, Women and Children.	Boats, Scows, etc.
1897	700	150
1898	28,000	7,124
1899	5,434	880
1900	8,452	973
Total	42,586	9,127

HOIST RECORDERS.

Within the past few years recorders for almost every purpose have come on the market, the latest of which has been brought to our attention being the Johnson Hoist Recorder, made at Ishpeming, Mich. This machine is for use at shaft mines of every description.

These recorders will furnish a complete record of the movement of the skip for each shift of twelve hours or less, showing the time taken in moving same from one point to another, showing all delays, the length of same and just where these delays occurred; also the number of loads hoisted from each level and the total amount hoisted daily. This record will also furnish valuable evidence in the case of accidents connected with the skip, delays and mistakes which occur from time to time, and which record will eliminate conflicting reports between men underground and engineer in charge of hoist, and a record which may be filed and referred to at any time.

These machines are neatly and substantially constructed, case being of metal, nickel plated with sides and doors of bevel plate glass. They are easily attached to any type of hoist and will take care of a depth up to ten thousand feet.

BASIC PRINCIPLES OF MINING COST*

By James R. Finlay.

The total cost of operating a mine can be divided into at least three independent items, namely: (1) labor, (2) power, (3) supplies. It is important to make this classification for two reasons: first, because the three items do not enter in the same proportions into the cost of operation at all mines; and second, because the variation in the cost for one item, from place to place, may not be in the same ratio as for another of the three items.

In general, the cost of mining in a given locality will vary with the expense and facilities for obtaining labor, power and supplies. Of all the mining regions in North America, I believe that the most favorably situated in found in Western Pennsylvania. Between Pittsburg and Lake Erie is a vast fertile country, capable of supporting a large population; food is abundant, climate excellent, and sociologic conditions are favorable. Hence labor is cheap and, what is of even greater advantage, can be carefully selected with a view to fitness. For power, the immense bituminous coal fields, and the areas yielding both oil and gas are close at hand. Finally, the district is surrounded and dotted with great manufacturing centres, whence mining supplies are available in great variety and at small expense of transportation.

When we seek to compare mining costs in so favorably situated a district with those prevailing in another part of the country, for example, Alaska, or the desert parts of Nevada, strict allowance must be made for the changed environment. In both the localities just mentioned, and in many others as well, labor must be imported, and it is not so easy to exercise discrimination in its selection. Furthermore, in a remote locality, food is often poor and usually expensive, and many of the ordinary comforts of civilized life, sometimes even the decencies, are wanting. These hardships must naturally be compensated, in the form of higher wages. The cost of power is likewise generally higher, because of the expense for transportation of fuel. In some favored localities, the supply of wood may suffice for a while, and in others hydro-electric power may be available, but the great majority of mines rely upon coal, and in many cases it will be found that the cost of transport exceeds that of mining the coal. Thus, coal which sells at Pittsburg for, say, $1 per ton will cost $2.50 in the Lake Superior district, $4.50 in the Rocky mountains, and as much as $7 or above in more remote districts. The same holds true of supplies, to the original price of which must be added cost of transportation by boat, rail, wagon or mule-back. Since steel and dynamite, the two most used materials, are relatively high priced, the added cost due to transportation is proportionately less than in the case of coal.

As a concrete example of the preceding remarks, let us compare a mine in southeast Missouri, with one in Nevada, in both of which districts I have recently been so fortunate as to gain first-hand experience; in both cases we shall estimate that the output is at the rate of 4 tons per man per day. In southeast Missouri, labor (at $2.60 per day) costs 65c. per ton of ore mined and milled; power (coal selling at $2.25 per ton) costs 25c. per ton of ore; and supplies cost 15c. per ton of ore; total $1.05 per ton. Profit on this ore would then be about $1 per ton, out of which to deduct various general and interest charges. At a mine of the same character in Nevada labor (at $4.00 per day) would cost $1.00; power (coal at $6.75 per ton), 75c.; supplies (estimated at 20 per cent. higher than in Missouri) 18c.; total $1.93

*A lecture before a class of mining engineering students in the Columbia School of Mines, May 4, 1915, and published in School of Mines Quarterly, No. 3, 1915.

per ton of ore, or $0.88 more than in Missouri. If the ore had the same market value, the profit would be only $0.12 as against $1.00, and this difference would very probably be the deciding factor in determining whether or not to begin operations in the more remote district. In short, the extreme variability of operating conditions at different mines, and in different districts, must never be overlooked.

It has been said that mining engineers do not know how to figure costs, as a contractor would figure them. This is not exactly true, because all successful engineers really do know how to do it, and the wider their knowledge of operating factors, the less liable they are to make mistakes. As a rule, careless or ignorant computations result in underestimates. An excellent practice is for an engineer to put himself in the position of a contractor, personally responsible for a loss; cost estimates then cease to be academic questions.

The most fertile source of mistake in cost estimates is to assume that the data relating to a short period, possibly during a stage of most advantageous operation, are a true average over the whole life of an undertaking. It should be remembered that the cost of an enterprise includes everything that has to be done from start to finish. To illustrate, suppose a shaft has to be sunk in New York City. If a practical miner were asked how much it would cost, he would first inquire how hard the rock is, and would then figure the cost merely as a job of rock breaking, at so many feet per shift. A contractor, on the other hand, would include in his estimate the necessity for installing hoists, compressors, shops and headgear, entailing maintenance, depreciation and interest on the cost of equipment during the whole period of operation.

In comparing one mine with another, the physical characters of the ore deposits are no less important than their geographical situations, a feature of the problem which is sometimes carelessly overlooked by those who ought to know better, and often purposely disguised by those who have some nefarious purpose in view. How often have we heard promoters calmly assert that a gold-bearing vein in Georgia, for example, could be mined at the same cost per ton as at the Homestake or the Alaska Treadwell?

The importance of careful comparison of geologic conditions was forcibly impressed upon me about three years ago when I had occasion to examine a silver mine in New Mexico, at which the cost of mining and milling was $8 per ton. The mine was controlled by residents of the Lake Superior district, who, reasoning from their immediate experience, thought that the cost ought to be reduced to $3 per ton, and wished to be informed why not. The reason is that a silver lode in New Mexico is not like a bed of copper rock or a basin of hematite in the Lake Superior region, and cannot be mined in the same way. Actually, the Camp Bird mine, of Colorado, offers a much clearer analogy, in width of vein, character of mineralization, and occurrence of ore shoots, the latter constituting only 25 to 30 per cent. of the whole vein and necessitating a relatively great amount of exploration and development. The cost at Camp Bird is from $7 to $8 per ton. My Lake Superior friends failed to be impressed by my reasoning, and proceeded to capitalize and equip their mine on the assumption of $3 costs; they are now sorry they did so.

While a careless reasoning from analogy may lead to disastrous failure, as in the case just noted, on the other hand, if geologic conditions and working environment at a new locality be reasonably similar to those at an older and established mine, this fact offers a quick and serviceable means of estimating the probable working cost at the mine about to be developed. In fact, a simple comparison, provided that all conditions are closely parallel, or provided that allowance is made for divergent conditions, is much more useful, and accurate, than any amount of independent figuring.

Hamilton Smith's Rule.—In this connection, it is often possible to make use of certain formulas and standards of comparison which are not so well known as they deserve to be. Hamilton Smith, a distinguished engineer about 30 years ago, suggested the advantage of comparing mines on the basis of yield per unit of stoping area, and gave as his opinion that, with gold ore of good quality, no mine would be profitable which yielded less than $3 per square foot of stoping area, equivalent to $130,000 per acre. Applying this formula recently to a fairly profitable gold mine in Nevada, having a vein 1 ft. thick, of ore averaging $40 per ton, I was interested to observe, allowing 13 cu. ft. per ton, that the yield of that mine was almost exactly $3 per sq. ft. of stoping area. Actual stoping width was about 4 ft. and profits were about 20 per cent. of the gross yield.

Smith's factor is important to bear in mind, regardless of other estimates of cost obtained by calculation, comparison, or otherwise, especially for checking over-estimates of net profits. A mine alleged to yield net profits of 75 per cent. of the gross output should be approached cautiously, because such mines are very rare. The Goldfield Consolidated, for example, for considerable periods yields at the rate of $20 per square ft. of the whole area of vein explored, not merely shoot or stoped area; yet the net profits of this mine for the past five years have averaged only 58 per cent. of the gross yield, under particularly competent management.

Cost Per Ton.—Some people are inclined to attach too much importance to "cost per ton," as though this unit possessed some sacred functions. It may often happen that some other unit, as Smith's yield per unit of stoping area, is more serviceable and relevant. Cost per ton is merely the value of the work that has been done on that ton, and may bear a very indefinite relation to the profitableness of the operation. As an extreme case, 1 ton of gold, worth $600,000, might be mined for $450,000, or 75 per cent. of its value, yielding a profit of $150,000. A ton of silver, worth $15,000, is mined at Cobalt for $6,000, or at $600 per ton of ore, assuming it to contain 10 per cent. silver; yet, rightly considered, this should not be called expensive mining. At Grass Valley, Cal., it costs about $5 to mine and mill 1 ton of ore; at the Michigan copper mines it costs only $1.25; yet applying Smith's unit, we find that the cost per acre of stoping area is nearly alike in these two places, namely $100,000 at Grass Valley and $70,000 to $120,000 in the copper country. In southeast Missouri, the cost is almost exactly $100,000 per acre for mining and milling. We thus see that **the really important factor is not how many tons are mined, but how much area must be excavated.**

Finally, before making comparisons of cost, it is important to note the relative difficulties arising from different positions of an orebody; it makes a great difference whether a deposit is horizontal, vertical or inclined. A horizontal deposit is always the cheapest to mine because when the shaft is sunk there is only one level, one shaft, one pump station. A vertical deposit requires many levels, each exploited separately, each requiring a shaft station, and sometimes an independent pump station. Inclined deposits, if not steep enough for broken ore to slide, involve all the disadvantages of a vertical vein, with the added expense of handling ore in stopes.

ELECTRO-PLATING WITH COBALT*

By H. T. Kalmus, C. H. Harper and W. L. Savell.

Results obtained in electroplating with cobalt solutions prepared at the laboratory at Queen's University were thought by the authors to be so unusual and of sufficient importance to warrant verification and further development under standard commercial conditions. We therefore, arranged with the Russell Motor Car Co., of Toronto, Ontario, and particularly with Mr. W. S. Barrows, foreman electroplater, with the same company, to have a plating tank operated under standard commercial conditions at their plant.

Salts identical with those used in this laboratory were sent by the authors to Mr. Barrows, with instructions for making up two solutions, identical with those used by us.

Mr. Barrows has had some twenty years of experience with all sorts of electro-plating work, to which he has particularly devoted himself. He has considered these two solutions entirely from the point of view of commercial practicability and value.

The authors take great pleasure in expressing their thanks to the Russell Motor Car Company, and to Mr. W. S. Barrows, for their collaboration, and particularly to Mr. Barrows for the careful, vigorous and painstaking manner in which he has subjected the solutions and plates to the various tests that were required, to establish their commercial importance and value.

Cobalt anodes were cast at this laboratory of the size required by Mr. Barrows for his tank, and sent him for use in these experiments. They analysed as follows:

Co.	98.75
Ni.	none
Fe.	1.35
As.	none
P.	0.0067
S.	0.052
C.	0.061

The anodes used in a bath had a surface of approximately 1 square foot area.

Mr. Barrows, in collaboration with the authors, tested solution I B (cobalt ammonium sulphate) for plating purposes, during the months of August and September, 1914. The plating was accomplished under standard commercial conditions on copper, brass, iron, steel, tin, German silver, lead and Britannia metal. Various articles, such as brass castings, sheet brass, steel stampings, skates, automobile hubs, etc., etc., articles of very different shapes and sizes, were plated under exactly the same general conditions as for nickel plating practice at the Russell Motor Car. Co.

The tests were made in a still solution, that is without agitation of any kind, and the resulting plates were subjected to the most severe practical tests. This work was regarded by Mr. Barrows purely from the commercial viewpoint, and with this in mind, he particularly tested and studied the following points—the color of plate, the uniformity and freedom from defects of the plates, the allowable speed of plating without pitting or burning, or the maximum allowable current density, the solubility of the anodes, the required voltage, the "throwing" properties of the bath, that is, its ability to cover the deeper parts of the object in a satisfactory manner, the solubility of the salts, the hardness of the plates, the ease of "coloring" the plate on a buff, the efficiency of the plating solution, the time required for ageing of the bath, the adhesiveness of the plate to the cathode under bending and hammering tests, the general cleanliness of the bath, the corrosion of the plate, besides many other special features.

In a letter to one of the authors, dated November 2nd, 1914, Mr. Barrows gives a very complete report of his commercial tests of solution I B. This letter follows in full as received, and serves admirably to cover this portion of the work.

628 Dovercourt Rd., Toronto, Nov. 2nd, 1914.

Dr. Herbert T. Kalmus,
Queen's University, Kingston, Ont.

Dear Sir,—After preparing a cobalt plating solution according to your formula for bath I B, and having used this bath daily during the past eight weeks, plating a great variety of copper, brass, iron, steel, tin, German silver, lead and Britannia metal articles of different shapes and sizes under exactly the same conditions as met with in general nickel plating at the factory of the Russell Motor Car Co., West Toronto, and after regarding the characteristics of this particular solution absolutely from a commercial viewpoint, I can heartily confirm any statement you have made to me regarding this remarkable solution. This bath was equipped with cobalt anodes, 98.75 per cent. cobalt, which were sent to me from your laboratory.

The runs made have varied from five minutes to 24 hours, and in each case the bath has proved wonderfully efficient.

The cobalt plates obtained were smooth, white and fine grained, very adherent and uniform. In fact the surfaces of these deposits after several hours' run were so very smooth and uniform, that a 4-inch cotton buff colored them to a mirror finish quite easily. We use 14-inch and 16-inch buffs to color 3-hour deposits of nickel.

To test the hardness of the cobalt as compared with nickel, with reference to either buffing or polishing with emery, we plated strips of brass, one-half the surface with cobalt and one-half with nickel, always giving the nickeled portion the thickest plate. Then buffing or polishing across the two deposits we found invariably that the nickel was removed from the brass before the cobalt, and in some cases in one-half the time.

Though so hard and firm, these plates color beautifully with little effort, and require the use of much less buffing composition than comparatively thin plates of nickel. Automobile parts of irregular shape were plated from 10 to 20 minutes, and finished on a 6-inch buff operated at 3,000 r.p.m. without the slightest evidence of a defect in the plating. To accomplish this with our fastest nickel baths would require at least 60 minutes of plating.

As a protective coating for iron or steel surfaces I am convinced that a comparatively thin plate of cobalt will prove equally as effective as a thick plate of nickel from an ordinary double sulphate nickel bath, and the time and power required for the production of such plates is decidedly in favor of the cobalt.

The deposits are also very adherent, no difficulty having been experienced in this respect, although tests

*Extracts from a report by H. T. Kalmus, C. H. Harper and W. L. Savell, on researches conducted at Queen's University, Kingston, for the Mines Branch of the Department of Mines, Ottawa.

were made repeatedly by bending, hammering and burnishing.

One of the weak points of several so-called rapid nickel plating solutions which we have tried commercially, is their poor "throwing" powers, i.e., they do not deposit the nickel readily in the indentations or cavities of the cathode. The cobalt solution I B meets this requirement in a most efficient manner, the deposits on the distant portions of the cathode withstand the tests imposed in every case.

Another most important feature of this solution, which should commend itself to every practical plater and manufacturer of plated wares, is the extremely high current density at which this solution may be employed without danger of pitting the plated surface. I have plated with this cobalt solution I B satisfactorily and under commercial conditions, at a current density of 42 amperes per square foot. This is four and one-fifth times the speed of our fastest commercial nickel solutions.

As a further test we plated steel tubes of 1-inch diameter for two hours, with a current density of 27 amps. per square foot, and then drew the tubes down to 5/8-inch diameter without injuring the deposit. Though extremely hard, the ductility of the deposited metal proved remarkable.

All of our tests have been made in a still solution, without agitation of any kind, and the plates were subjected to the most severe treatment considered practical for high grade metallic coatings on the various metals heretofore mentioned.

We are also of the opinion that the anodes in the cobalt bath I B will remain free from coatings, such as characterize average anodes used in nickel baths, and that the cost of maintenance will be practically nothing compared to double sulphate nickel solutions.

I can assure you that my experience thus far with these cobalt solutions has been intensely interesting, and I sincerely believe that their use commercially would revolutionize the art of electroplating such wares as are now nickel plated.

The simplicity of its composition, its self-sustaining qualities, the remarkable speed of deposition, together with the several points mentioned previously, should appeal to the commercial requirements of this progressive age. I remain,

Very truly yours,

(Sgd.) WALTER S. BARROWS,
Foreman Electroplater,
Russell Motor Car Co.,
West Toronto, Ont.

After the completion of the tests on solution I B by Mr. Barrows, salts identical with those used by the authors were sent to him, with instructions for preparing solution XIII B (cobalt sulphate, salt and boric acid).

The anodes used were identical with those used for solution I B.

Tests were made of this solution in the manner and from the same point of view as those for solution I B.

In a letter to one of the authors, dated December 1st, 1914, Mr. Barrows gives a complete report of his commercial tests of solution XIII B. This letter follows in full, as received:

628 Dovercourt Rd., Toronto, Dec. 1st, 1914.
Dr. Herbert T. Kalmus,
Queen's University, Kingston, Ont.

Dear Sir,—After thoroughly testing cobalt plating bath XIII B, made according to your formula, I take pleasure in submitting the following report:

I found the bath very simple to prepare and at once began to operate the solution with high current densities. The results obtained were exceedingly gratifying. Evidently bath XIII B will require no prolonged ageing treatment, as splendid, white, hard, perfect deposits were obtained with extremely high current densities within three hours after bath was prepared.

The experiments have been varied and the tests of plates severe and deliberate, the results have invariably been such as to cause me to regard cobalt bath XIII B the greatest achievement in modern electroplating improvements.

The operation of the bath is positively fascinating, the limit of speed for commercial plating is astonishing, while the excellence of the plates produced is superior to those of nickel for many reasons.

The efficiency of the freshly prepared solution, together with the self-sustaining qualities of the bath are without a parallel in any plating solution of any kind I have ever used.

Thin embossed brass stampings were plated in bath XIII B for only one minute, then given to a buffer who did not know the bath existed and who was accustomed to buffing 1¼-hour nickel deposits on these same stampings. This man buffed the cobalt plates upon a 10-inch cotton buff wheel revolving at 3,000 r.p.m. The finish was perfect with no edges exposed. These stampings have been plated in two dozen lots for one minute and from a total of 500 stampings we have found but three stampings imperfect after buffing. Each stamping is formed to a spiral after finishing without injury to the deposit. Grey iron castings with raised designs upon the surface were plated one minute in cobalt bath XIII B, then burnished with 400 lb. of 1/8-inch steel balls for ¼ hour without the slightest injury to the cobalt coating, as was proven by a 36-hour immersion in 15 oz. of water acidulated with 1 oz. of sulphuric acid.

While attempting to reach the limit of current densities which would be practical with this bath XIII B, I have plated brass automobile trimmings with a current density of 244 amperes per square foot. These pieces were plated in lots of 6, and a total of 100 were plated, buffed and ready for stock in 1 hour's time. No unusual preparation was made for the run and the work was performed by one man. Size of piece plated 1½ x 5 inches.

Automobile hub caps were plated three minutes in cobalt bath XIII B and buffed to a beautiful lustre of deep rich bluish tone by use of a 7-inch cotton buff revolving at 1,200 r.p.m. The deposits were ample for severe treatment usually received by such articles. Comparative tests of these deposits were made as follows. Same style castings plated in double sulphate nickel solution one hour were suspended as anodes in a solution of equal parts muriatic acid and water, sheet lead cathodes were used and a current of 200 amperes at 10 volts passed through the bath. The nickel was removed from the castings in 30 seconds, while 45 seconds time was required to remove the cobalt plates.

The above mentioned plating tests were made with still solution, no form of agitation being employed. By

aid of mechanical agitators these current densities could be greatly exceeded with highly satisfactory results.

These cobalt plates were very hard, white and adherent and colored easily with slight effort.

Several plates were produced upon sharp steel surgical instruments, these instruments finished perfectly and owing to the hardness of the cobalt plate only a thin deposit was required to equal the best nickel deposits which we received as samples. Cobalt deposits should prove especially valuable for electroplating surgical instruments for this reason, nonadherent thick deposits being very dangerous for this class of work.

Owing to the unusual mild weather in this locality during the past month, I have not concluded test with cobalt plates on highly tempered nickel steel skate blades, but judging from appearances and various severe indoor tests we do not hesitate to report success in this direction. A three-minute deposit from bath XIII B resists corrosion equally as long as a one-hour nickel deposit, the finish is even superior to nickel, while every test employed during the process of manufacturing the nickel plated article has proven equally ineffective with cobalt plates, therefore by reason of the effectiveness of thin cobalt deposits we believe cobalt plates should prove wonderfully efficient on skates, or any keen edged tool requiring a protective metallic coating.

The runs made with bath XIII B have varied from one minute to 15½ hours, and in each case the results were remarkable. Electrotypes were reproduced 1-16 inch thick. Electro dies were faced with cobalt ⅛ inch thick, the electrotypes being graphite covered wax and lead moulds, while the dies were made on oxidized silver faced Britannia metal.

The deposits from cobalt bath XIII B were very adherent and pliable; by proper regulation of the current beautiful white, hard, tough plates may be produced quickly on any conducting surface.

The "throwing" powers of cobalt bath XIII B make possible its employment for plating deeply indented or grooved articles such as reflectors, channel bars or articles with projecting portions.

We also obtained the best plates with extremely high current densities, although plates finished with 75 amperes per square foot were of good color and easily buffed. The production of excellent plates with a current density of 150 amperes proved particularly easy and densities in this neighborhood were employed for the greater portion of our tests.

Cobalt bath XIII B will produce excellent hard, white, tough plates absolutely free from pits or blemish at a current density of 150 amperes per square foot and under ordinary commercial conditions. This is 15 times the speed of our fastest commercial nickel solution.

Furthermore, the anode tops and hooks remain free from creeping salts. The solution retains its original clean appearance and the anodes dissolve satisfactorily, no slime or coating formed, brushing or cleaning anodes therefore will be unnecessary. The anodes used with this bath were 98.75 per cent. cobalt which were sent me from your laboratory. The bath at the commencement of our tests was strongly acid to litmus, and has remained unchanged throughout our experiments. The specific gravity of the solution when freshly prepared was 1.24 and is the same to-day.

The rich deep bluish white tone of the cobalt plates upon polished brass surfaces is particularly noteworthy, this feature should assist greatly in making cobalt deposits very popular for brass fixtures, trimmings and plumbers' supplies.

My experience with cobalt bath XIII B is by no means at an end. I intend to continue its use until present supplies are exhausted and then equip a larger bath if supplies are obtainable. As a commercial proposition I am satisfied it is wonderfully efficient and economical.

Taking into account the difference in cost of cobalt as compared with nickel, I am satisfied the metal costs for plating a given quantity of work with cobalt would be considerably less than for nickel plating a like quantity.

Furthermore the use of cobalt bath XIII B equipped with automatic apparatus for conveying parts through the bath would reduce the labor cost 75 per cent., such apparatus would be practical for a greater variety of wares than is now the case with nickel.

We cannot speak too highly of cobalt bath XIII B, and confidently believe its future history will surpass the history of any electroplating bath now in general use.

In conclusion, please accept my warmest congratulations upon your successes with cobalt solutions, and heartily appreciating the opportunity of testing these solutions, I desire to sincerely thank you, kind sir, for the benefits derived therefrom.

Very truly yours,

(Sgd.) WALTER S. BARROWS.

General Conclusions from Commercial tests on Cobalt Plating Solutions.

Several cobalt solutions have been found to be suitable for electroplating with cobalt under the conditions of commercial practice. Best among these are the following:

Solution I B.

Cobalt-ammonium-sulphate, $CoSO_4.(NH_4)_2SO_4.6H_2O$, 200 grams to the litre of water, which is the equivalent of 145 grams of anhydrous cobalt-ammonium-sulphate, $CoSO_4.(NH_4)_2SO_4$, to the litre of water. Sp. gr.=1.053 at 15 degrees C.

Solution XIII B.

Cobalt sulphate $CoSO_4$...	312 grams
Sodium chloride NaCl....	19.6 "
Boric acid	nearly to saturation
Water.	1,000 c.c.

Sp. Gr.=1.25 at 15 degrees C.

Cobalt plates from these solutions, on brass, iron, steel, copper, tin, German silver, lead and Britannia metal articles, of different shapes and sizes, deposited under conditions identical with those met with in general nickel plating practice, are firm, adherent, hard and uniform. They may readily be buffed to a satisfactorily finished surface, having a beautiful lustre, which, although brilliantly white, possesses a slightly bluish cast.

The electrical conductivity of these solutions is considerably higher than that of the standard commercial nickel solutions, so that other things being equal, they may be operated at a lower voltage for a given speed of plating.

Solution I B is capable of cobalt plating on the various sizes and shapes of objects met with in commercial practice at a speed at least four times that of the fastest satisfactory nickel solutions.

Solution XIII B is capable of cobalt plating on the various sizes and shapes of objects met with in commercial practice at a speed at least fifteen times as great as that of the fastest satisfactory nickel solutions.

Plates from both of these solutions on various stock pieces, satisfactorily withstood the various bending, hammering and burnishing tests to which commercial nickel work is ordinarily submitted.

These two very rapid cobalt solutions are remarkable for their satisfactory throwing power. That is, they readily and satisfactorily deposit the cobalt in the indentations of the work.

These two rapid solutions operate at these high speeds in a perfectly still solution without agitation of any kind.

These solutions are both cleaner, that is free from creeping salts and precipitated matter, than the standard commercial nickel baths.

The cobalt deposited at this rapid speed is very much harder than the nickel deposited in any commercial nickel bath. Consequently a lesser weight of this hard cobalt deposit will offer the same protective coat as a greater weight of the softer nickel deposit. Considering solution XIII B, operating at 150 amperes per square foot, on automobile parts, brass stampings, etc., etc., a sufficient weight of cobalt to stand the usual commercial tests, including buffing and finishing, is deposited in one minute. With the best nickel baths, it takes one hour, at about 10 amperes per square foot, to deposit a plate equally satisfactory. Therefore, the actual weight of metal on the cobalt plate must be approximately one-quarter that of the nickel.

For many purposes, under the condition of these rapid plating solutions, one-fourth the weight of cobalt, as compared with nickel, is required to do the same protective work. Consequently, if nickel is worth 50c a lb., in the anode form, cobalt could be worth nearly $2 a lb., in the same form, to be on the same basis, weight for weight of metal. In addition there are other advantages of cobalt in saving of labor, time, overhead, etc.

With cobalt a smaller plating room would handle a given amount of work per day than with nickel.

With these very rapid plating solutions, by the use of mechanical devices to handle the work, the time required for plating, as well as the labor costs may be tremendously reduced. Solution I B, and particularly solution XIII B, are so rapid as to be revolutionary in this respect.

Obviously the cost of supplies, repairs, etc., would be less with cobalt plating than with nickel plating, as the size of the plant for a required amount of work is less.

The voltage required for extremely rapid cobalt plating is greater than that for most nickel plating baths; it is not so great but that the machines at present in use may in general be operated. For the same speed of plating, the cobalt solution requires much the lower voltage.

For a given amount of work the power consumption for this rapid cobalt work is less than that for nickel. This is obvious, because the total amount of metal deposited in the case of cobalt is very much less, whereas the voltage at which it is deposited is not correspondingly greater.

Ornamental work on brass, copper, tin, or German silver would require only a one-minute deposit. Even wares exposed to severe atmospheric influences, or friction, could be admirably coated with cobalt in solution XIII B in fifteen minutes. The tremendous possibilities of this solution are not to be completely realized unless mechanical devices are applied to reduce hand labor to a considerable extent.

Thick deposits from these solutions are vastly superior to any that we have seen produced from nickel solutions. The tendency to distort thin cathodes is less pronounced, while electrotypes and electrodies have been given a superior thick deposit in a most satisfactory manner. The lines were hard, sharp and tough and the surface smooth. Nickel does not equal cobalt for excellence of massive plates.

Many of these tests were passed upon by uninterested skilled mechanics at the plant of the Russell Motor Car Co., who invariably reported in favor of cobalt as above.

Both solutions I B and XIII B are substantially self-sustaining, once they are put into operating condition, and the amount of ageing required to do this is very much less for them than that for the present commercial nickel baths.

ALUMINUM.

The Aluminum Co. of America controls production of aluminum in Canada and the United States with practically no opposition.

The $20,000,000 capital stock is understood to be held by a very few persons, the predominating interest being the Mellon family of Pittsburgh. The company makes no statement of earnings, nor will it give a record of its dividend payments. The latest available financial statement showed that an undivided surplus of $6,400,000 existed on January 1st, 1908, which compared with $3,300,000 in August, 1906.

There have been bids of $320 a share without bringing out any stock, against a nominal quotation of $250 a few weeks ago. What gave promise of furnishing competition to the Aluminum Co. of America was the activity of the Southern Aluminum Co. backed by French capital prior to the outbreak of the European war. Its construction programme has been greatly curtailed and production has yet to start.

CONIAGAS.

The directors of Coniagas mines have decided not to pay the dividend that is usually paid on November 1st. The reason officially given for this step is that as the result of prices that have ruled for bar silver, there has been little inducement to operate freely. The company has limited its output accordingly.

While the official statement of ore reserves and developments will not be made known for a month yet, when the annual meeting takes place, reserves have not been diminished. Up to October 31st, 1914, the company paid $7,240,000 in dividends on a capital of $4,000,000. This year to date it has paid 15 per cent., or 600,000. During 1913 41 per cent. was paid and 35 per cent. in 1914.

THETFORD.

Quebec, Oct. 21.—The striking miners at Thetford all returned to work this morning, following an agreement reached yesterday afternoon. The men have gained their point.

The labor trouble has not yet been settled at Robertson, where the men are still out, but definite arrangements are scheduled to be signed to-day.

THE BEAVER LAKE DISTRICT, SASKATCHEWAN AND MANITOBA*

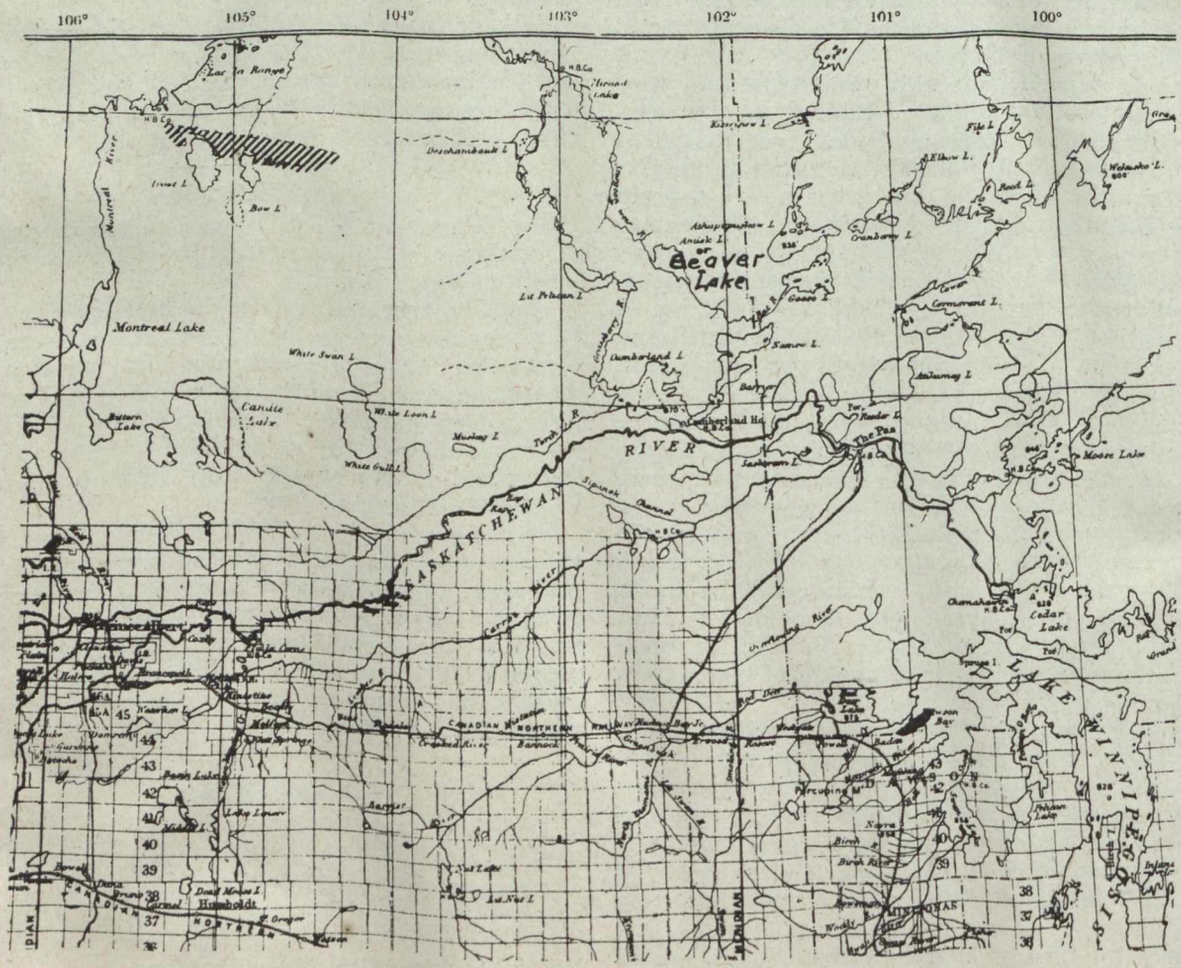
By Wm. McInnes.

During the summer of 1906 the writer descended Nelson river to Split lake and made an examination of the region lying between that lake and the Pas, on the Saskatchewan. During the course of the exploration Burntwood, File and Grass rivers were examined, also the lakes lying north of the Pas. In 1907, Carrot river was surveyed, and the northern and eastern slopes of the Paskwia hills were examined. In 1908, a survey was made of Southern Indian lake, which occupies a large basin in the Churchill valley in latitude 58 degrees, and the Churchill river was examined between that lake and Lac LaRonge. In 1909, Wapawekka lake was surveyed and a large part of La LaRonge; an examination was also made of Neweiben lake and part of Churchill river above the mouth of Rapid river. In 1910, Deschambault lake and river and Grassberry river were surveyed, and an examination was made of Amisk or Beaver lake and of Candle river and the western part of Cumberland lake.

The remaining portions of the region covered by map sheet 38A, compiled by the writer, have been examined more or less closely by many different explorers, including Bell, Cochrane, McConnell, Tyrrell, Low and Dowling, all of the Geological Survey.

The southern part of the area mapped may now be reached by the Prince Albert branch of the Canadian Northern railway, and by a branch constructed from the main line to the Pas on Saskatchewan river. (Motor boats ply between the Pas and Cumberland Ho and the northern end of Namin lake, from whence there is a wagon road to Beaver lake.)

The proposed Hudson Bay railway when built will make the northern part more accessible, but the greater part of that area will, even after the building of the railway, be reached only by means of canoes and York boats or other craft suitable for navigating swift rivers, where numerous falls and rapids necessitate many portages.



Map showing location of Beaver lake, near Saskatchewan-Manitoba boundary.

Except a small part of the southwest which lies in the half wooded country, the region under consideration is too densely forested to be easily accessible by cart or pack train. The rivers and lakes form the highways of travel during the season of navigation which, over most of the district, extends from early in May to late in October. Owing to the steep gradients, rapids, and falls of most of the rivers, and to the necessity, on many of the routes, of crossing by portages from one watershed to another, boats must be used that are convenient-

*Extracts from Memoir No. 30, Geological Survey of Canada, "The Basins of Nelson and Churchill Rivers." By Wm. McInnes, 1913. The district is now being surveyed by Mr. E. L. Bruce, of the Geological Survey. Mr. Bruce's preliminary report was published in the August 1st, 1914, issue of the Canadian Mining Journal.

ly carried or dragged overland. For light travel, the bark canoe of the Indian, or its improved form, the cedar, basswood, or canvas-covered canoe of the white man, is best suited, since it is manageable in rapids and is easily carried on men's shoulders. For heavy transport the more strongly built and larger boat, known as the York boat, used generally by the fur brigades, is well adapted. It is propelled by sweeps or by sails on smooth water, and is poled or towed with a tracking line up the swift currents of the rivers. Where portages must be made the boat is dragged overland with the help of skids and rollers.

In the winter season snowshoes and dog-trains offer a means of travel, that though somewhat laborious, is fairly expeditious.

Saskatchewan River.—The river is navigable, except during periods of low water, by shallow draught, high power river steamers, from the head of the Grand rapids, at its mouth, to Prince Albert and beyond. Rapid current, tortuous channels between islands, and shifting sandbars make the services of a skilled pilot necessary for safe travel in the present unimproved state of the channel. Improvements, that are now under contemplation by the government, will remove many of the difficulties of navigation and make the river a fairly good water route.

The trip downstream on the river by small boat or canoe is an easy and delightful one. The continuously rapid current makes the labor of paddling light, and all the rapids may be run with ease except Grand rapids, just above Lake Winnipeg, which is passed by means of a tramway 3½ miles long, or by running part of the way and making a portage 87 chains long. The ascent of the river, on the other hand, is most laborious; the current is too strong for paddling and the water is too deep generally for poling; tracking must be resorted to for almost the whole distance between the Pas and Prince Albert. For tracking, which is the method used in ascending all swift flowing rivers in the northland, a long, light tow-rope is used; it is manned by part of the crew, one remaining aboard to guide the boat; the trackers trudging along the rough shore and climbing many obstacles, tow the boat upstream at the rate of a fast walk.

A very large part of the area under consideration is underlain by a complex of old Pre-Cambrian rocks, most of which have the lithological characters and associations of the Laurentian which covers so large a portion of northern Canada. Included in the Pre-Cambrian complex, however, are rocks which from their lithological character and general aspect and composition seem to correspond to the Grenville series of eastern Canada; others which correspond in like manner with the Keewatin of the east, and others, involved with the Keewatin in the general folding, which seem to be lower or middle Huronian.

No part of the region has been closely prospected, and most of it has not yet been even visited by the prospector. There are various belts of Keewatin and Huronian rocks, which from the experience gained in areas of similar rocks elsewhere in Canada, for example in the Cobalt and Porcupine areas, in the Thunder Bay and Rainy River districts, and in other localities, must be looked upon as affording promising fields for the search for valuable minerals. In the newer rocks, the oil-shales of the Pasquia hills are of some promise, and the discovery of the occurrence of coal, north of Prince Albert, may be followed by the finding of seams of commercial importance.

Keewatin Rocks.—Many small areas of rock that, from their lithological character and relationship to the granite gneisses, are considered to be referable to the Keewatin, occur throughout the area mapped. A number of these areas are situated at the southern edge of the Pre-Cambrian area where it is overlapped by Palæozoic sediments. They are roughly triangular in shape, the base of the triangle being formed by the edge of the overlying sediments and the apex by the tapering end of the belt which fades into the gneisses. The shapes of the areas are such as to make it seem probable that they are tongues extending northward from larger areas or perhaps from a continuous area of these rocks, concealed beneath the flat-lying sediments and protected by them, from the denudation that, during much of the time that has elapsed since their deposition, was active in the northern area.

Enumerated in order of their occurrence, from west to east, the areas that are considered to be referable to the Keewatin are: A narrow belt, extending easterly from the south shore of Wapawekka lake; an area 50 miles wide which appears from beneath the limestone cover at Beaver, Athapapuskow and Cranberry lakes; similar areas at Reed and Wekusko lakes; one crossing Grass river below Wekusko lake; a small area at Pipe lake, Burntwood river; an area of very irregular outline at Cross lake on Nelson river, which is probably continuous with a more extensive belt crossing Oxford and Knee lakes; and, in the southeast corner of the district mapped, a number of small tracts about Gods lake and Island lake and a long, narrow belt, which has been traced for upwards of 100 miles along the upper courses of Severn river.

The belt on Wapawekka lake is a little less than four miles wide and trends east and west. To the south it is overlapped, in its western part, by the flat-lying sandstones of the Cretaceous, and in its eastern part is cut off by a bright red intrusive rock, which has the composition of a quartz-diorite, the bulk of the rock being composed of plagioclase feldspar, quartz being abundant and biotite occurring in quantity amounting to about 10 per cent. of the whole. The rock has the aspect of a granite.

The rocks of the belt are mainly massive dark, greenish-black quartz-diorites, sheared in places to form schists; hornblendites, hornblende schists, and quartz-diorite schists and fine gneisses. Along the south shore of the narrows a very highly altered rock, which is used by the Indians for the manufacture of pipes, crops out in low cliffs. In appearance it is a soft, light colored, greenish-grey rock dotted with small, bright red spots. It seems to have consisted, originally, almost entirely of hornblende, with accessory feldspar and magnetite, but is now strongly chloritized. To the north, it is difficult to fix the edge of the belt. Quartz-diorite schists and schistose rocks having the appearance of dacites are interbanded with fine gneisses, the gneissic structure in the rocks giving place, apparently somewhat gradually, to a granitoid structure until the gneisses assume the appearance of so-called Laurentian gneisses.

The Beaver lake belt, where the rocks are exposed about the shores of that lake, is made up of various forms of schists that are characteristic of the Keewatin, for the most part hornblendic and chloritic, and massive diorites, with, in smaller volume, rocks of the quartz-porphyry type and soft, grey, calcareous schists. The schists are generally standing nearly vertically and strike, fairly uniformly, north and south. Where the rocks of this belt are exposed farther to the east, in

Cranberry and Athapapuskow lakes, they have been described by Tyrrell* and Dowling.† On Athapapuskow lake, Dowling found mainly chloritic and hornblende schists and massive diorites, the general trend of the rocks being about northeast. Towards the more northerly extension of the area, along the outlet of the lake, quartz porphyries cut the schists and there occurs a band, west of the quartz porphyries, of well marked conglomerate with pebbles of red jasper, that is probably of lower Huronian age. Acid intrusives cut the basic rocks at many points.

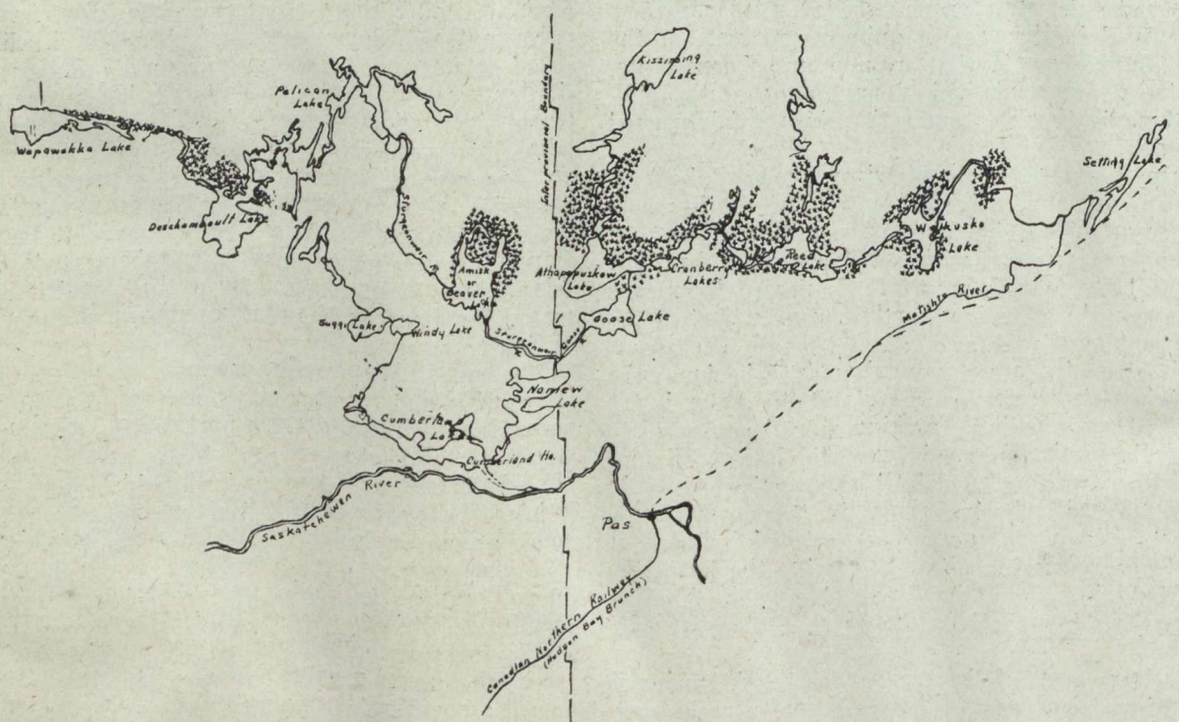
On Cranberry lake, Tyrrell describes the rocks as consisting mainly of "chloritic and sericitic schists, altered from diabases or clastic slates, cut by massive diorites and gabbro."

The Reed Lake area and its extension down Grass river and about Wekusko lake are, like the tract to the west, underlain mainly by various dark colored schists and diorites, but include quartz-porphyries and other acid intrusives.

relationships of the conglomerate were not made out. It seems to be invaded by the felsites which form a marginal phase of the main granite mass, and which are in places quartz-porphyries, but includes pebbles that seem to be quite similar to the felsites and quartz-porphyry.

The matrix of the conglomerate is made up of rounded particles of quartz-porphyry and felsite, cemented by interstitial crystaline quartz and chlorite; associated with the conglomerate and apparently merging on the one hand into it and on the other into quartz-porphyry is a breccia composed of irregular masses and smaller fragments of quartz, feldspar, aplite, felsite and quartz-porphyry, arranged in a promiscuous manner in a ground-mass of the same composition.

The conglomerate in its extension along the strike northerly becomes schistose in structure, and passes upwards into a fine grained, quartz epidote rock, containing carbonate, which may originally have been a limestone.



Sketch map showing Keewatin areas (marked xx) in Beaver Lake District

The exposures about Reed lake are for the most part hornblende schists and massive, altered, dark green diorite-like rocks. On Grass river, below the lake the Keewatin is represented by massive quartz gabbros and coarse diorites which cross the river, in a belt about a mile wide, at the falls. At the first lake-like expansion of the river, which occurs about 6 miles below Reed lake, the Keewatin rocks form a very narrow belt with intrusive red granites on both sides of it. From a point opposite the inlet, northerly, for several miles, the rocks of this belt form a narrow fringe along the shore, the granite which lies to the east, or a red felsite which seems to be a marginal phase of the granite, coming to the shore from place to place in masses and tongues. An interesting conglomerate, which holds pebbles of red felsite, quartz-porphyry, white quartz, granite, and banded red jasper, forms part of the belt, indicating that, probably, Huronian strata are folded in with the Keewatin. The conglomerate on the Pineroot river, described by Dowling,‡ seems to be of similar character. The exact

This narrow belt, which skirts the sides of the lake expansion and continues down the valley of Grass river, forms a connecting band between the Keewatin area of Reed lake, referred to above, and the larger area of these rocks exposed about Wekusko lake.

The rocks about Wekusko lake are, for the most part, diorites and schists derived from them, but embrace also many other rock types characteristic of the Keewatin, including hornblende and staurolite schists and nacreous, silvery schists derived from acid intrusives. The rocks of this area are cut by a great number of quartz veins, which vary in width from mere gashes to veins several feet wide. None was observed to carry valuable minerals.

The belt which crossed the river below Wekusko lake is separated from the lake area by a broad band of granite and granitoid gneiss. The surface is here largely drift covered, and few exposures are seen along the river. Those which outcrop are hornblende and chlorite schists and diorites.

*Geol. Survey., Canada, Annual Report Vol. XIII., 1890, Pt. F.
†Geol. Survey., Canada, Annual Report Vol. XIII., Pt. FF.
‡Geol. Surv., Canada, Annual Report Vol. XIII., p. 33 FF.

Like the last named, the small area crossing Pipe lake and extending easterly, just south of Burntwood river, is made up mainly of chloritic and hornblende schists, and has apparently a trough-like structure, infolded in the enclosing granitoid gneisses.

Pipestone lake and part of Cross lake, Nelson river, lie in the western extension of a long belt of Keewatin rocks which extends eastward to Echimamish river and beyond, for a long distance down Hayes river. The rocks exposed about Pipestone and Cross lakes are principally chloritic and hornblende schists, diorites and a conglomerate with schistose paste and pebbles of granite and diorite principally. The rocks of the belt are described in greater detail in the portion of this report dealing with Nelson river and the Hayes River route. They seem to occupy, towards the granite gneisses, the same relationship generally observed in northern Ontario, that of areas infolded in the granitoid rocks but also invaded by them.

Of the areas in the vicinity of Gods lake and Island lake, our knowledge is derived from notes made by A. S. Cochrane, accompanied by a set of specimens and a map. The information is not sufficient to allow of the exact mapping of the areas. The rocks seem to consist mainly of hornblende and other schists and diorites, and they seem to have a very irregular distribution, but whether they occur in a number of small unconnected tracts or form two principal areas, it is not possible to say. Mr. Cochrane noted the occurrence of serpentine on the north shore of Island lake, and found very strong magnetic attraction at an island which he calls Iron island in the same neighborhood.

The belt of Keewatin extending from Favourable lake to Sandy lake and down Severn river, was mapped by A. P. Low, who describes the rocks as consisting mainly of chloritic and altered hornblende rocks, with talc and hydro-mica schists. They were found in several places to be highly magnetic and to contain large quantities of pyrite.

Huronian Rocks.—Included in the areas of Keewatin rocks mapped, are certain conglomerates, which from the fact that they hold pebbles that seem to have been derived from the Keewatin—for example, pebbles of banded jaspar—are deemed to be younger than Keewatin; they are folded in with those rocks and no attempt has been made, on the accompanying map, to separate the two.

Beaver (Amisk) lake is a roughly rectangular body of water 18 miles long by 12 miles wide. The southern half is broken by only a few islands, but the northern half is nearly all occupied by one large island around which the lake wraps in a narrow belt. This is one of the numerous class of lakes which are strung along the edge of the Palæozoic sedimentary rocks, lying partly in them and partly in the Pre-Cambrian. All the northern shores of the lake are well wooded, principally with spruce which over certain areas is of good size. The south shore and part of the east shore are underlain by magnesian limestones, which in many places show cliff faces fronting the water. The rest of the shore lies in the Pre-Cambrian and shows generally smoothly sloping surfaces, though a part of the country adjoining the east shore, which is underlain by massive diorites, is rugged and rises abruptly from the water with steep slopes and in places precipitous walls.

The forest, over all the region surrounding the southern portion of the lake which is crossed by the main boat route, has been repeatedly swept by fires; but to the north a large area is still covered by spruce of good size.

Whitefish and lake trout are plentiful in the lake.

Reed lake is about 12 miles long and 6 miles wide. It combines the features characteristic of the lakes of the Pre-Cambrian area and those of the limestone area.

The northern portion of its basin, lying in an area of Keewatin rocks, has a deeply indented shore-line and many islands, while the southern portion, bordered by limestones, has a much more even contour and very few islands. The land surrounding the lake is generally quite low, and to the south is covered by a mantle of drift with occasional low ledges of limestone. The northern part is characterized by rocky shores with many irregular points and bays and a great number of small islands.

The forest about the shores includes poplar, white birch, jack-pine, spruce and tamarack of 35 years' growth, with a few small areas of older trees. Fish are plentiful in its waters and of good quality.

Routes to Reed lake and Grass river.—Reed lake is most easily reached from Cumberland by way of Goose river and lake and the Cranberry Lake route. Although it is necessary to make one long portage leading to Cranberry lake and to pass a number of rapids on the rivers traversed, this route is not a bad one for canoes. A shorter but more difficult route leaves the Saskatchewan opposite the Pas by a good road 13 miles long leading to Atikameg lake, from which a short portage leads to Cormorant lake. From Cormorant lake, the inlet, Cowan river, is followed to its head. The stream, in its lower part fairly large, becomes gradually smaller and eventually is lost in a broad swamp which must be crossed to Reed lake.

Grass river flows from Reed lake as a river of considerable size. To the first expansion, a distance of 6 miles, the current is generally swift and in places rapid; two portages are made past falls of 10 and 5 feet respectively. Ten miles of quiet water, where the river has the character of a long, narrow, rock-bound lake, lead to a river-like portion where the current is strong, terminating in a rapid, down which the river descends 48 feet to **Wekusko lake**: a broad expanse of moderately clear water with bold, rocky shores, which at its southern end touches the base of the high escarpment; marking the northern edge of the belt of Ordovician limestone. Below the lake for nearly 20 miles the river has again the character of a narrow lake, with high, rocky shores and an almost straight course. Just below the end of this lake-like portion, three heavy rapids occur where a belt of schists crosses the valley.

Below these rapids the banks for a mile and a half are formed of a more or less open terrace from 10 to 15 feet above the water. Then the river turns sharply and flows for 5 miles southward on the east side of a high ridge of dark green schist, probably altered diabase. From the foot of the ridge it swings round again in an easy curve towards the northeast, passing some hills of dark green, highly altered diabase which rise in the middle of a wooded valley.

At Pipestone lake, there is a broad belt of chloritic and hornblende schists, diorites, and conglomerates infolded in the gneisses, to which it conforms in strike. The conglomerates are made up of a chloritic, schistose matrix enclosing well rounded pebbles principally of granite but including diorites. Near the northern edge of the belt, ledges of a very highly altered chloritic rock, probably derived from a hornblendite, occur. This is the rock used by the Indians for pipe bowls, and gives the lake its name.

Climate.—The best proof, perhaps, that the climate of this region, at least as far north as Churchill river, is not too severe for the pursuit of agriculture, lies in the experience of those who have made the experiment. Of the Saskatchewan valley, there is no need to write, since it is well established that in it the climatic conditions are quite suited for the growth of ordinary cereal crops.

In the part of the region which is still mostly wilderness there are necessarily few examples of actual cultivation to cite. At the posts of the Hudson's Bay Co., which are scattered through the country, some attempt is usually made, by the officer in charge, to cultivate at least a kitchen garden; and at a few of the posts, as well as at missions of the Anglican and Roman Catholic churches, in some cases more ambitious attempts at farming have been made. Thus, at Stanley, on Churchill river, wheat, oats and barley have been successfully grown; in the Nelson River valley, wheat has been grown at Norway House and at Cross lake, and barley has been grown at Oxford House. Ordinary garden vegetables are grown annually at all the above-mentioned localities, as well as at Nelson House on Burntwood river, at Pukkatawagan on the Churchill, and at the posts on the shores of Hudson bay.

THE SILVER SIDEWALK.

Cobalt, Oct. 22.—The famous "silver sidewalk," which in the early days of Cobalt provided one of the principal sights of the camp, is being removed. On account of the rarity of such a specimen, the Ontario Government has decided to purchase it from the La Rose company and the work of removing it is proceeding under the direction of Mining Inspector MacMillan, of Toronto. In order to preserve the richest portion of the famous "sidewalk" in its relative state, with the flat, scratched surface showing the effects of glacial action, great care is being exercised in the work of removal. Instead of blasting it, as in ordinary mining, drill holes are driven close together in a row under the portion being removed, and these are filled with unslaked lime. Before these holes are plugged tightly with wooden pins, they are filled tightly with unslaked lime, and a small quantity of water poured in. The slaking of the lime will within a few days expand sufficiently to slowly force the portion upwards. Only about one foot in depth of the vein in being taken, and this is in two separate pieces, which, when broken out, will weigh approximately 900 to 500 pounds respectively.

GRANBY CONSOLIDATED.

For the first time in its history the Granby company monthly production reached the 4,000,000-lb mark in August at 4,047,421 lbs.

This was due entirely to a record-breaking output from Hidden Creek—2,557,362 lbs., against 2,264,615 lbs. in July.

Four furnaces, comprising the entire battery, were in operation at the new smelter in August, it having been decided by the management to blow in the new furnace which had been built primarily as a reserve stack.

The old smelter at Grand Forks turned out 1,489,059 lbs. of copper in August, against 1,624,782 lbs. in July.

Operations at the two Granby smelters compare:

August:	Hidden Creek	Grand Forks
Copper, lbs.	2,557,362	1,489,059
Silver, oz.	35,602	21,189
Gold, oz.	1,230	4,019

ALUMINUM.

Sixty cents a pound has been paid for aluminum on top of the most sensational rise the metal ever had. Two months ago aluminum was quoted nominally at around 30 cents a pound, but a sudden demand has since carried the metal to a new high level.

Extraordinary conditions surround the advance—a diminishing supply to meet a heavily increasing demand. Prior to the European war aluminum was imported from England and France, but in the early stages of the conflict each of these countries placed an embargo against further exportations, shutting off outside supplies to the United States.

The Aluminum Co. of America dominates the production of the United States, as no competition worthy of the name has yet materialized. Before the embargo from France and England became effective there was brought into this country a fair tonnage by two importing interests. This has been fed out on an advancing price scale, and has now been practically cleaned up, leaving the Aluminum Co. in sole control.

Between January 1st and July 31st, 5,842,129 lbs. were brought into this country, against 9,087,575 same time last year and 17,260,222 lbs. two years ago.

War orders have been largely responsible for the big increase in demand for aluminum. Canteens, numbering many thousands, have been ordered in the United States for European armies to be made from this metal. Time fuses have also been a big factor in the consumption of aluminum, while the demand from automobile manufacturers has been of extraordinary proportions.

The Northern Aluminum Co., operating a plant at Shawenegan Falls, Quebec, a subsidiary of the Aluminum Co. of America, is a large producer, exporting 14,510,000 lbs. in 1914.

STANDARD SILVER-LEAD MINING CO., SILVERTON, B.C.

A statement has been sent to shareholders of the Standard Silver-Lead Mining Co., operating the Standard silver-lead-zinc mine and concentrating mill, situated near Silverton, Slocan lake, British Columbia, from the company's head office in Spokane, Washington, giving particulars of receipts, expenditures, etc., for July last.

The statement shows the receipts to include: Preliminary settlements for 1.512 tons of ore, $123,223.54; boarding house, $2,850.50; store supplies, $2,447.75, making a total of $128,521.79. From this is deducted disbursements as follows: Ore production, including supplies and labor, $11,792 47; tramming, $668.63; milling, $2,537.32; power, $341.15; general expenses, $627.51; shipping and selling, $627.60; boarding house, $2.315.23; taxes. $1,800; insurance, $159.35; casualty insurance, $286.50; salaries, $300; a total of $21,500.76, which leaves a relative operating profit of $107,021.03.

Further disbursements for development and experiments amounting to $3.301.36 and home office expenses of $337.07 are deducted, leaving a net profit for July of $103,382.60, which with the balance on hand on July 1 makes a total of $105,063.84.

A recapitulation of the balance reads: Cash in banks, $39.081.68; ore shipped but not settled for. $84.722.96, making a total of $123.804.64. From this is deducted: Vouchers, payable, $5.641.75, and pay roll, $13,099.05, a total of $18.740.80, leaving a balance of $105.063.84.

The statement further states that there were 1.100 tons of lead concentrate, 400 tons of crude lead ore and 1.400 tons of zinc concentrate on hand on July 31.

ORES OF WORTHINGTON MINE, SUDBURY DISTRICT, ONTARIO*

By T. L. Walker.

The Sudbury copper-nickel orebodies, as is well known, occur in connection with basic igneous rocks. The rock in the fresh form is norite, but frequently it is so altered that it can be best described as epidiorite or diorite. The orebodies commonly occur on the basic border of the eruptive which becomes more acid and lighter in color as the distance from the ore bearing border is increased. This transition from basic at one border to acid at the other border of the nickel bearing eruptive was first pointed out by the writer† who attributed the variation to magmatic differentiation. The later workers on the geology of the Sudbury region have generally approved this interpretation and have usually claimed that the orebodies are due to magmatic differentiation.‡ Since the chief nickel mineral is nickeliferous pyrrhotite, the copper-nickel ore is referred to as pyrrhotite norite.

The chief mass of nickel-bearing norite forms a continuous band bordering a great ellipse, 35 miles long and 15 miles across. In width this eruptive varies from two to four miles, the outer part of the band being basic and frequently marked by important orebodies, while the inner part is acid and devoid of such deposits. The central part of this great ellipse is occupied by pre-Cambrian sedimentary rocks. The whole complex forms a great syncline, the lowest member being the nickel eruptive which Coleman regards as a great intrusive sheet.

Apart from the main nickel bearing eruptive just referred to there are several more or less irregular masses of the same petrological type. Sometimes these masses are connected with the main mass and project outwards from the ellipse, while in other instances they show no direct connection with the large mass. They are sometimes only a few hundred feet across and several miles in length. Some important nickel-copper orebodies have been found in connection with these smaller, irregular norite masses. The igneous mass with which the Worthington deposit is connected is of this type. It attains a length of four miles without exceeding a few hundred feet in width.

The ore mined at the Worthington mine occurs in a hornblende plagioclase rock in which there is abundant evidence of alteration. In some of the nickel mines of the region fresh norite occurs, but generally the pyroxene is more or less altered to hornblende. Owing to the presence of all stages in the alteration it is reasonable to conclude that the epidiorite associated with the nickel ores results from the uralitization of pyroxene. In the case of the Worthington ore this is the chief type of rock observed.

The sulphides prominent in the Worthington ore are pyrrhotite and chalcopyrite, through which are scattered pentlandite in the form of lustrous cleavable phenocrysts of a pale, brassy color and nickeliferous pyrite with subordinate amounts of polydymite and rarely sphalerite, niccolite and molybdenite.

The masses of pentlandite vary in size from particles to be seen only with the lens to masses two inches in diameter. It was in ore from this mine that the writer first recognized the presence of pentlandite in the Sudbury ores. In the Worthington mine the pentlandite is most abundant in the pyrrhotite, but it is also frequent in the chalcopyrite and pyrite. In the other nickel deposits of the district the pentlandite particles are usually microscopic in size. It is now generally maintained that the nickel values of the pyrrhotite are due to the presence of small particles of pentlandite scattered through the pyrrhotite rather than to the isomorphous replacement of iron by nickel. In the Worthington mine the pentlandite is exceptional in that the individual masses of the mineral are microscopic in size. The octahedral cleavage of the pentlandite is such that a fragment examined on the reflecting goniometer gives good reflections for the various octahedral surfaces.

A chemical analysis of some of the purest pentlandite gave the following result:

	Per Cent.			
Fe	30.68 ÷ 55.9	=	.5495	1.1582
Ni	34.48 ÷ 58.7	=	.5870	
Co	1.28 ÷ 59.	=	.0217	
S.	32.74 ÷ 32.06	=	1.0212	
Insoluble.	.56			
	99.74			

From this analysis it should be observed that the bases are present in proportions too large for the chemical formula [Ni, Fe]S usually given for this mineral. This was first observed by Dickson who suggested that according to a great many analyses made by him the composition was nearer to $[Ni, Fe]_{11}S_{10}$.

An unusual type of ore found at the Worthington mine consists of massive pyrite containing rounded masses of pentlandite. The ore has a conglomeratic appearance and is so abnormal for the Sudbury region as to merit further consideration. The mineral composing the nodules is somewhat dissected by veinlets and stringers composed of ferruginous calcite, while the outermost zone of the nodule is darker in color and weathers very quickly when exposed a few weeks to the air, giving rise to sulphates and in this way suggesting polydymite. It is slightly darker in color and not so lustrous as is usually the case with pentlandite, while the cleavage is rudely cubic, rather than octahedral. A chemical analysis of a sample from one of the purest nodules (S. G. 4.638) gave the following result:

	Per Cent.
Fe.	27.64
Ni.	32.13
Co.	.90
Cu.	.30
S.	34.82
CaO.	1.58
Insoluble.	.78
	98.15

*Extracts from a paper published in Sept.-Oct., 1915, issue of "Economic Geology."

†T. L. Walker, Quart. Journ. Geol. Soc., Vol. LIII. (1897), p. 40.

‡Coleman, A. P., "The Nickel Industry," Mines Branch, Ottawa, 1913. Barlow, A. E., "Nickel and Copper Deposits of Sudbury, Ontario," Geol. Survey of Canada, Ottawa, 1901.

After deducting the iron and sulphur required to combine with the copper to form chalcopyrite the atomic ratios of the four chief constituents are as follows:

Fe	.490	1.052
Ni	.547	
Co	.015	
S	1.075	

Accepting Dickson's formula for pentlandite $[Fe, Ni]_{11}S_{10}$ it would appear that this nodular material is pentlandite with a small amount of polydymite. The deficiency shown in this analysis is probably due to undetermined magnesia and carbon dioxide. In view of the preceding observations the writer is inclined to believe that these nodules are largely composed of pentlandite pseudomorphous after polydymite.

The pyrite is light in color and when acted upon by dilute acid betrays the presence of a considerable amount of carbonate. Thin sections of the pyrite mass show that it is quite porous, being composed in part of solid compact pyrite in part of strings of tiny pyrite crystals cemented by calcite or quartz. Throughout the pyrite mass there is also a very small amount of chalcopyrite. The pyrite upon analysis gave the following result:

	Per Cent.		
Fe	44.57 ÷ 55.9	= .797	.839
Ni	2.44 ÷ 58.7	= .042	
S	51.83 ÷ 32.06	= 1.617	
	98.84		

The carbonates, the constituents of which were not determined, probably account for the deficiency in this analysis. The atomic ratios show that the mineral is too basic for pyrite. It is probably a mixture of pyrite and pentlandite. A similar mineral was reported by the writer from the Murray mine in 1894.§

The type of ore here described is exceptional for the Sudbury nickel deposits. It is difficult to avoid the conclusion that the ores as they are now found at the Worthington mine have been subject to rearrangement by aqueous agencies since the solidification of the rock and sulphides from the original magma. The writer believes it important to emphasize the fact that it is now generally admitted that magmatic segregation alone will not account for all the phenomena observed by the students of the Sudbury orebodies.

McINTYRE AND JUPITER.

President Alex. M. Hay, of McIntyre-Porcupine Mines, Ltd., has issued the following letter to shareholders:

The directors have pleasure in announcing that after protracted negotiations, they have entered into an agreement for the purchase of a controlling interest in the property of the Jupiter Mines, Limited, subject to ratification by the McIntyre shareholders.

The acquisition of a controlling interest in the McIntyre Extension Mines, Limited, reported on August 6th last, was part of a general plan to strengthen the position of the McIntyre company by extending the limits of its operations on orebodies now being worked within its own boundaries, which are known to exist on the adjoining properties.

The McIntyre Extension shaft has now reached a depth of over 700 feet, and it is expected that sinking to 1,000 feet will be completed before the end of the year. This shaft is situated 400 feet from the Jupiter line, and about 301 feet from the McIntyre line, so that it can be utilized as a main working shaft to economically develop and handle ore mined on the north side of the lake from all three properties.

Recent developments on the 500-foot level from McIntyre No. 5 shaft, have opened up a body of high grade milling ore to the east towards the Jupiter line. This vein is in the contact zone which traverses the Jupiter property for a distance of over 2,000 feet from west to east, where, in the Jupiter workings ore of an estimated value of between three and four hundred thousand dollars has already been developed and is available for stoping. McIntyre No. 5 shaft has been completed to the 700-foot level, and cross-cutting will be started this week both on the 600 and 700-foot levels to tap this orebody at these depths.

The price agreed to be paid for a controlling interest in the Jupiter property is $152,000. Of this sum approximately—but not exceeding—$60,000 will be paid to the Jupiter company to enable it to pay off its bonded indebtedness and other liabilities, so that the Jupiter property and assets, consisting of 79 acres with buildings, plant and equipment, will be turned over to the new company, free from all encumbrances. As an offset against this payment, $12,000 worth of mining machinery purchased and paid for by the Jupiter company, but not yet delivered, will be turned over to the new company.

The remaining $92,000 will be available for working capital, and is to be furnished to the new company over a period of eighteen months at the rate of $5,000 per month. This expenditure will be offset by the profit to be realized from Jupiter ore. This ore will be treated at the McIntyre mill at a rate per ton which will leave the McIntyre company a further profit on the operation.

In the erection of the new mill-addition, which is now under way, provision will be made for the treatment of Jupiter ores, and it is expected that the extra revenue to be derived from this source and from the larger operations now contemplated, will more than take care of the expenditures to be incurred in the purchase and development of the new properties.

Production for the months of August and September has been as follows:

August—Tons milled, 9,135; value per ton, $7.24; gross value, $66,193; recovery, $63,371=95.7 per cent.; operating costs per ton milled, $36,553=$4.00; operating profit, $26,817.

September—Tons milled, 8,395; value per ton, $8.37; gross value, $70,268; recovery, $67,143=95.4 per cent.; operating costs per ton milled, $34,419=$4.10; operating profit, $32,723.

UNITED STATES MINING LAWS.

A convention that will act on recommendations regarding a general revision of the Federal mining laws of the United States will meet in Washington, D.C., on December 16th. All the known mining societies in the United States have been invited to send delegates, and it is hoped that the mining industry will be so well represented that the action of the convention will be regarded as expressing the wishes of the industry.

§Walker, T. L., Am. Journ. Sci., April, 1894.

A PAIR OF OLD SNOWSHOES

By J. Harmon Patterson.

(How a white man and two Indians found themselves in a winter wilderness without food or shelter, and how they fought their way out.)

"I have information," so the letter ran, "which I consider reliable, of a large deposit of iron ore lying at the head of the lake marked on enclosed sketch. This plan is only approximate. The lake may easily be twenty miles from the point at which I have shown it, however there is a trapper's cabin on it which may help.

"If you are not now engaged, you will proceed to this place at once, taking such assistants as you may require. With a dip needle you will locate the extent of the orebody, making plan of same, showing readings. Gather such information as may be possible and bring samples."

This letter was from a very prominent mining man in New York, for whom I had done exploring work and who was the owner of large mining interests in Northern Ontario.

It was the middle of January, and the winter had been one of exceptional severity. Nevertheless I decided to make the trip.

On a winter expedition Indians are preferable to white men as guides. They are experts with snowshoes and toboggan and know exactly how to make a comfortable camp even at fifty below. They have a knowledge gained by experience of conditions against which a white man is powerless.

I was fortunate enough to secure the services of the two best men I knew. Indian Charley, tall, straight as an arrow and with the endurance of a wolf, was thoroughly proficient in all matters relating to camp or trail and one of the few Indians I knew who was completely trustworthy. He had been out with me before and I knew his worth. Joe, Wabi-amick, or white beaver, was also a good man, much younger than Indian Charley, but almost his equal in strength and endurance.

I handed the map to Charley who scanned it carefully.

"Oh, yes, I know the place," he said, "Old Paul's shack there, old stove in it. Start from here, maybe get there in seven days. Paint Lake we call it."

"All right then, we get away to-morrow morning," I decided. "We'll take thirty days' supplies on a toboggan."

"Very good," was his reply.

In the midst of a driving snowstorm and with the temperature forty below we left the little hamlet and were soon swallowed up by the forest. The snow was about five feet deep and very light, so progress was slow. It was nearly dark when we halted for the night, having covered about ten miles.

While I dug a hole in the snow, using my snowshoe as a shovel, the Indians cut a large quantity of wood and brush. A fire was then made and logs about six feet long were piled on. The brush was carefully laid for our bed beside the fire and a large piece of canvas called a fly spread in a semi-circle over the bed and leaning towards the fire. It was held in place by small poles and the snow was banked up behind it. Thus all the heat from the fire is secured and it is much more comfortable than a tent.

After supper, beans were boiled for the next day. Then putting on an extra sweater I crawled under the blanket.

We had an uneventful trip to Paint Lake which we reached about noon on the seventh day. We found the little shack in good repair; but the sheet iron stove had evidently seen its best days. However, by the use of all the tinware we could find we managed to patch it up.

Next day I set to work to locate the iron ore and for five days we traversed the country around the lake. In a cliff along the shore was a very small deposit and the color had evidently given the lake its name, but it was of no commercial value. Nowhere else could we find even a trace and it was evident that my employer had been the victim of the imagination of some prospector.

Joe had found an old net in the shack. It was in very bad repair, but every evening he had spent some time in mending it. One morning we cut holes in the ice and set the net, as Charlie had informed us that trout were very plentiful in the lake.

After supper we all went down to pull in the net. I had often laughed at Joe about his net, for I did not think it strong enough to hold anything, but to my great surprise he had seven fine trout—a welcome change from the salt pork which we had served up three times a day.

Coming from the lake we noticed a bright red light in the window of the cabin. We ran forward as fast as possible. On opening the door Joe was met by a dense cloud of black smoke. The whole interior seemed a mass of flame. The stove had evidently fallen over during our absence. Both Charley and Joe did their utmost to save the blankets, but they were on the far side of the room. Soon a tongue of flame shot out the door and compelled them to retreat.

Charley saved one axe, and the other had fortunately been left at the lake. Joe brought out a pair of old snowshoes with broken frames, and as we each had a good pair I wondered what he wanted with them.

The logs of the old shack burned bravely, and though we stayed nearly all night it was a case of having your face scorched while your back was freezing. However, no one thought of arranging a bed or trying to sleep. For me the dawn was most welcome.

Conditions and circumstances change values. Cut off by the wilderness as we were, without food and exposed to the intense cold without shelter of any kind, I would have given a thousand dollars for one good pair of Hudson Bay blankets. Of food we needed little, for by fast travel we could reach civilization before we actually starved. But from the cold we must have shelter. We had plenty of matches and could have fire, and though you stand beside it all night turning round and round you get no rest or sleep, I knew by bitter experience just what we were up against.

"Well, boys," I said, "let us see just what we have in the way of outfit. There are our snowshoes, two axes, a tin pail, plenty of matches, an old net, and seven trout, and each of us have a knife."

"And one old pair of snowshoes," supplemented Joe.

"Now," I continued, "we are a long way from food and shelter and we can count on nothing less than forty below. What are your plans?"

The silence was broken only by the crackling of the smoldering logs.

"The trail is now broken," said Charley at length, "and we can make our way back in three or four days by going hard, but we must have food and shelter. You wondered why Joe saved those snowshoes. It may be that on the string in them our lives will depend. With it we can make snares and so catch rabbits. With it we can sew birch bark together and make a shelter to take the place of our fly. We have matches and our axes. We have also the net with which we may catch more fish. I have often gone far on less."

"If all this can be done," I replied, "we may yet see our friends again."

The morning was cold and cloudy, but as soon as it was light Joe slipped on his snowshoes and disappeared. Charley was busy preparing breakfast which consisted of grilled trout. He had the pail full of boiling water when Joe returned with a large bundle of what is known as Labrador tea which he had noticed on one of our excursions. When well boiled it had much the flavor of green tea. We drank it from dishes fashioned from birch bark, and I must confess that it was a very creditable substitute for the real article.

After breakfast we again drew the net, but secured only two small fish. Several large ones had evidently broken away, as the holes attested.

Then Charley and Joe set out to gather birch bark, and I spent most of the time until their return in digging among the ashes in the hope of retrieving something of value. I had the luck to find a can containing a good handful of salt.

After another lunch of trout we set to work at the birch bark. I trimmed the sheets while they sewed. They worked quickly, considering the fact that they had no needles, and soon the screen assumed considerable dimensions.

Joe then set to work on the rabbit snares. Supplemented by some twine he had in his pocket he was able to make up twenty. We then set out for a swamp in which we had noticed many tracks. We cut small branches which we stuck in the snow to form a rude fence and in convenient openings we set the snares. This occupied us till late.

On our return we found that Charley had made a comfortable camp in front of a wall of rock a short distance from the shack. We got nine fish that night, and glad we were to get them.

On our return we found a cheerful fire blazing and the heat reflected from the rock and by the screen made cozy and warm the deep brush bed. Then with our feet to the fire we lay down and were soon asleep, but not for long. The cold seemed to come in from beneath, and I awoke chilled to the bone. After getting thoroughly warmed by the fire I lay down again and I repeated the process four times before morning. Not so the Indians, however, for I never saw a movement from one of them.

We got away at earliest dawn taking with us ten trout and six rabbits. Enough Charley said to last us for two days, but we would catch more rabbits, as we would set the snares every night.

I failed to keep up with the Indians, and at noon was far behind. Lunch was ready when I arrived. This consisted of the same unvaried menu—grilled trout and Labrador tea.

"Have big feast to-night," remarked Charley, "boil much rabbit."

"I thought you fellows were never going to stop," I remarked.

"Want to reach swamp to-night." Charley replied. "Plenty rabbit there. We go on very fast, make good camp, set snares. You catch up then."

Throughout the afternoon I travelled fast, but as darkness fell I became very tired and my pace was slow, and I eagerly watched for the gleam of the camp fire.

Suddenly far behind me I heard a low tremulous sound. It grew in volume then wavered and fell. Again it came louder and louder till it ended in a wild yell. It was the gathering call of a wolf and soon it was answered from far and near.

I was out on a small lake and lost no time in reaching the other shore. Half-way across the portage I came to the camp. Both men were cutting wood, as though their lives depended on their work. Tired as I was I helped them draw the logs up to the fire.

"Need plenty of wood to-night," remarked Joe. "Maybe have company."

When a sufficient supply of wood was cut and piled, the pot was put on and the frozen rabbits gotten ready. All the while the fierce cries of the pack sounded nearer and nearer. Still the two men went on with their work undisturbed.

"What about those wolves?" I asked, after an outburst of awful howling.

"Keep us awake all night most likely," replied Charley, wrathfully. "Scare rabbit away or steal any that get caught and spoil good snare."

"Well, if that is all I guess I can stand it," I said, somewhat relieved, "but I thought they were after us."

"They won't come near the fire," he assured me, "just stay around and howl." And that was what they did all night. And howl they certainly could. One would make a start as though trying to get some chord. When he reached a certain pitch the others would join in. And an awful chorus it was. Sometimes I could see shadowy forms outside the circle of light, but they never came close.

It was very little sleep I had all night. Charley and Joe took turns at watching and keeping the fire burning brightly, and it was a long dreary night. But as the gray dawn came stealing over the trees the howling grew less and our unwelcome company slunk away.

When Joe returned from gathering his useless snares he was dragging a great gray, shaggy brute with him. One of the wolves had got into a snare and failing to break the tough rawhide string had strangled.

The men were greatly pleased. "He keep you awake last night," said Charley to me. "You sleep warm in his hide to-night you bet."

While skinning the animal Charley informed me that we had covered all of twenty miles, and if the wolves did not bother us he hoped to do as well to-day.

"Surely they won't trouble us during the day?" I asked.

"Not likely," was his reply. "Still we will have to keep together and make camp early. Then if we get no rabbits we must go hungry and hungry man can't travel fast."

The cold was very keen and a sharp wind caught us in the open while the lowering clouds threatened snow. Noon passed and still no sign of a pause. "How about lunch?" I inquired.

"Guess we won't stop to-day," replied Charley, "have to quit early you know, and not much to eat anyway."

I was utterly spent when we reached the jackpine grove in which they had decided to camp. As we had heard nothing of the wolves Joe went out to set snares while Charley and I did the work. Soon a dismal howl informed us that our attendants were not far away. With some haste I made up the fire, and Joe coming

in assisted. The brutes were soon all around us. Drawn by the smell of the cooking rabbits two of them came so close that I thought they meant to attack us, but as Joe threw a blazing fire brand they fled howling away.

In spite of the warm wolf skin I did not get much sleep. Once, after a fitful sleep I awoke with the cold and sought the fire. Joe was on watch. Ranged in a semi-circle, not a hundred feet distant, I counted eight dim shadowy forms.

"How many in the pack?" I asked.

"Eleven," he replied. Picking up a blazing brand, he threw it towards the wolves which scattered with frightened snarls.

"Wish I had my rifle," remarked Joe. "You bet wolves soon go."

"One rabbit left," remarked Indian Charley, after our meagre breakfast next morning. "Must travel fast to-day and get out to-morrow."

And travel fast we certainly did. Late in the afternoon, when about the middle of a lake some three miles wide Charley, who was in the lead, suddenly sank into an air hole. He instantly threw himself forward, but the damage was done. His feet and ankles were soaking wet. He ran with all speed to the shore followed by Joe. With all possible haste a fire was kindled, and his frozen socks removed, but both feet and ankles were severely frozen, so intense was the cold. We took out the frost with snow, and though I knew that they must pain him severely he made no complaint.

Fortunately we heard nothing of the wolves, so we made camp. One rabbit made a very small supper when divided into three, so we went hungry to bed.

It was about midnight when I was awakened by Joe. The snow was beating in upon us and a fierce storm was raging. We changed the shelter to the other side of the fire, but still the gusts of snow laden wind eddied in upon us. Tired, sleepy and cold, we sat by the fire for the remainder of the night. How many times I consulted my watch I do not know, but each hour seemed interminable.

"Any chance of making it to-day?" I asked anxiously.

"Afraid not," replied Charley. "Don't think I will be able to walk. Joe pull me on toboggan. Joe get hungry and can't go fast."

As soon as it was light Joe looked at his snares. He had two rabbits. One we ate for breakfast. What a small morsel it was! Then with Charley on the toboggan we set out.

Towards evening the storm ceased, but the cold increased in severity. We ate the last rabbit, but it did not stay the fierce hunger which gave us no peace. There was no sleep that night. It was all we could do to keep from freezing. We were told next day that it was fifty-five below zero. One thing alone stayed me up—we were only five miles from warmth and food. Never was night so long. The heat from the fire did not seem to reach the bed at all. It was necessary to stay close and continually turn around.

It was late in the afternoon when our little procession reached the boarding house at the railway. Indian Charley was helped into the house and as soon as possible a good meal was ready. It would not have appealed to an epicure; but to us it was all that could be desired. I ate sparingly, but I think that Charley and Joe made up for nearly all the meals they missed. The next train bore Charley and me to the nearest doctor, under whose care he soon recovered.

PERSONAL AND GENERAL

Mr. R. B. Lamb has removed from Toronto to New York, where his office is at 43 Exchange Place.

Mr. W. F. Green, of Crystal Falls, Mich., in in Toronto.

Mr. George T. Holloway, chairman of the Nickel Commission, was the guest of honor at a meeting of the Toronto branch of the Canadian Mining Institute on October 9.

Mr. P. B. McDonald has joined the editorial staff of Mining and Scientific Press, San Francisco.

Mr. Chas. J. Curtin, of Brockville, is superintendent of the Kingdom lead mine at Galetta, near Arnprior, Ont.

Mr. T. F. Sutherland has returned to Toronto from Sudbury.

Mr. Percy E. Hopkins is again at Kowkash for the Ontario Bureau of Mines .

Mr. Cyril Knight is in Toronto.

Mr. A. G. Burrows is at Goodfish lake, Ont.

Mr. J. C. Houston is in Alberta.

Mr. A. M. Bilsky is at Cobalt.

Mr. F. L. Steenman, manager of the Genessee Mining Company, Cobalt, is recovering from an operation for appendicitis.

Mr. M. J. O'Brien is convalescing at Renfrew.

Mr. E. V. Neelands will leave for Georgetown, British Guiana, about November 1.

Mr. F. L. Culver is in California.

At a meeting of the Toronto branch of the Canadian Mining Institute, held on Oct. 9, Dr. T. L. Walker, of the University of Toronto, was elected chairman for the ensuing year. Mr. R. E. Hore was re-elected secretary.

Mr. R. B. Watson has returned to Cobalt from Le Pas.

Mr. Jack Hammel has returned to Toronto.

Mr. Selwyn G. Blaylock, assistant general manager for the Consolidated Mining and Smelting Co., Trail, B.C., was a recent visitor to Victoria.

Mr. Randolph R. Bruce, of Wilmer, East Kootenay, B.C., who some years ago was manager of the Paradise silver-lead mine in that neighborhood, is mourning the death of his wife, Lady Elizabeth, daughter of the Earl of Iddesleigh, to whom he was married in January, 1914. Lady Elizabeth died at Invermere, B.C., on Sept. 27.

Mr. Henry Clark, of Victoria, B.C., representative in Canada of the Head, Wrightson Co. of England, manufacturers of mining and other machinery, will shortly make a business trip to Japan for that firm.

Lieut. Graham Cruickshank, of the 54th Kootenay Battalion, which has been in training for some time at Vernon, Okanagan district, B.C., prior to volunteering for active service had been for several years on the staff of the Consolidated Mining and Smelting Co. of Canada, Ltd., in charge of concentration operations. For a while he was superintendent of the company's concentrator at the St. Eugene lead-silver mine in East Kootenay; latterly he directed the experimental work done at the company's concentration test plant as Rossland, West Kootenay, B.C.

Mr. S. Duncan Ellis, a graduate in mining engineering from Toronto University, who last year went from Toronto to the Braden Copper Co.'s mines in Chile, and some months ago resigned his position there and proceeded to England to volunteer for service in the European war, has been gazetted a lieutenant in the Royal Engineers, England.

Mr. Peter Creek Fernie, who between thirty and forty years ago was indirectly associated with the dis-

covery of good coal in the Crowsnest district of British Columbia, and in earlier years had been a sergeant in the British army in the Crimean war, died in Victoria, B.C., early in October, in his 85th year. About 1880, or a year or so previously, when in charge of a trail-making party then working in Southeast Kootenay, he found some excellent coal that had come down the mountainside in a rockslide. He took samples to his brother, Mr. Wm. Fernie, then Provincial Government Agent at Fort Steele, East Kootenay, and later these were seen there by Dr. Geo. M. Dawson, who had just passed through the Crowsnest district, and had noted indications of the occurrence there of coal, but had not found any seams so large as that from which it was manifest the samples in Mr. Fernie's possession had come. Some years afterward Mr. Wm. Fernie did much prospecting on the Crowsnest coal measures, and eventually interested men in Victoria, B.C., to organize a company, which finally was absorbed by the Crow's Nest Pass Coal Co. of Toronto, and to the operations of which latter are due the establishment of the important coal mining and coke making industry of the Crowsnest district of British Columbia.

Mr. Charles Graham, superintendent of the Corbin Coal and Coke Co.'s colliery at Corbin, in the Crowsnest district of British Columbia, was in the Coast cities of Vancouver and Victoria early in October, attending a meeting of coal mine operators and visiting relatives.

Mr. E. Jacobs, of Victoria, B.C., is traveling in the Kootenay and Boundary districts of British Columbia this month, obtaining data relative to the progress of mining in that province during 1915, for annual review purposes. He went via Seattle and Spokane, Washington, to Fernie and Michel, about the middle of October, and afterward visited parts of East Kootenay in which metalliferous mining is being done. Now the several more important mining divisions of West Kootenay—Ainsworth, Slocan, Nelson and Trail Creek (Rossland)—are having his attention. Later he will visit the larger mines of Boundary and Similkameen districts, and then return to the Coast.

Mr. Dudley Michell, of Victoria, B.C., instructor in First-Aid and Mine-Rescue training for the British Columbia Department of Mines, was at Rossland in October, in connection with the instruction of more of the employees of the Consolidated Mining and Smelting Co. in First-Aid and Mine-Rescue work. The company is giving much attention to the mine-safety movement and is affording its mine employees at Rossland every facility for familiarizing themselves with measures for the protection of themselves and others about them.

Mr. P. L. Naismith, of Calgary, Alberta, general manager of the Canadian Pacific Railway Co.'s Department of Natural Resources, together with several members of his staff, has been investigating conditions affecting the company's mineral, water-power, timber and other holdings in parts of the Fort Steele region of East Kootenay district.

Mr. W. Patterson, of the office staff of the Motherlode Sheep Creek Mining Co., of Sheep Creek, Nelson mining division, British Columbia, has left that province for Ontario, where, it is stated, he will be chief accountant in connection with mining properties in Cobalt district, in which Mr. John McMartin is largely interested.

Mr. H. D. Quimby, who some time since, during the absence in England of the general manager for the Jewel-Denero Gold Mines, Ltd. (Mr. Chas. A. Banks), was in charge of the company's gold mine and 15 stamp mill at Long lake, in Greenwood mining division, Boundary district of British Columbia, has returned to that district. It has been announced that he will be field engineer for the British Columbia Copper Co., which has large mining and smelting interests in Boundary and Similkameen districts of the province.

Mr. Frank A. Ross, of Spokane, Washington, was one of a number of mining and financial men who recently went from that city to Nelson, Slocan and Ainsworth divisions of West Kootenay to visit mining properties which Spokane men are operating. Much was seen during a three days' journey, and the visit proved so instructive and enjoyable that it is proposed to make such an excursion an annual event.

Mr. Anthony J. McMillan is about to return to England after having spent several weeks in the West where, in the capacity of liquidator of the Le Roi Mining Co., Ltd. (in liquidation), he has been in connection with the sale to Coeur d'Alene mining men of the smelting works at Northport, Washington, owned by the Le Roi Co. He left Spokane, Washington, on October 13 for Nova Scotia en route to England.

Mr. J. D. Galloway, of Victoria, B.C., assistant to the Provincial Mineralogist, after having spent several weeks in the Windermere and Fort Steele mining divisions of East Kootenay, has been visiting a number of mines and mineral occurrences in Nelson mining division.

Mr. J. Cleveland Haas, of Spokane, Washington, was again in the Coast district of British Columbia last month, where he is developing a copper property under option of purchase.

Mr. Andrew G. Larson, who now makes Spokane, Washington, his headquarters, was in the Slocan district of British Columbia about the middle of October, arranging for a resumption of production at the Lucky Jim zinc-lead mine.

Mr. W. Yolen Williams, of Spokane, Washington, who from 1896 onward, until the time that control of the Granby Consolidated Co. passed to New York men, directed mining operations at the company's big copper mines in Boundary district of British Columbia, recently made a three days' trip through Nelson, Slocan and Ainsworth mining divisions of that province. Among the properties he visited were the Slocan Star, near Sandon, and the Bluebell, on the eastern shore of Kootenay lake.

Mr. F. R. Wolfle, of Spokane, manager for the Florence Mining Co., was at the company's mine near Ainsworth, B.C., for about a week in October. Shipment of both crude silver-lead ore and concentrate from the mine to the smeltery at Trail is shortly to be commenced.

Mr. J. K. Cram, of Kimberley, B.C., superintendent of the Consolidated Mining and Smelting Co.'s Sullivan Group lead mines in East Kootenay, is on a vacation, during which he is visiting Eastern Canada.

Mr. W. R. Wilson, of Fernie, B.C., general manager of the Crow's Nest Pass Coal Co., has recovered from a severe cold which for a short time threatened to develop into pneumonia.

Mr. Thomas Russell, colliery manager at Michel, Southeast Kootenay, for the Crow's Nest Pass Coal Co., spent the latter part of October with his family at Vancouver, B. C.

SPECIAL CORRESPONDENCE

COBALT AND GOWGANDA

The party representing the Fasken and Earle interests which went out to a point 100 miles west of La Pas to look at a gold property there has returned. Samples were carefully taken and these are now being run. Until such time as results from these have been determined, it is premature to say anything more than that the prospect is promising. It is a large sulphide orebody with a mixture of basic metals as well as some gold and silver. It is situated on a small lake about half way between Beaver and Herb lakes. The trip is by water up the Saskatchewan river for 100 miles and then back to the west for about three days' journey up a string of streams and lakes. The property was found by prospectors with whom Jack Hammel is associated and it was Mr. Hammel who brought the prospect to the attention of Mr. Fasken in Toronto. The whole of the country for about 125 miles running east and west between Herb and Beaver lakes is reported to be of good prospective value as a mining section. The rock is similar to the formation of the Northern Ontario rock carrying the ore producing veins of the district. It is not anticipated that the ore will run high, but if its gold and silver contents are only relatively low the size of the deposit should make it attractive.

The Crown Reserve Mining Co. has decided to take up their option on the Globe Consolidated mine in Trinity county, California. Operations under Mr. Burnett, of the Crown Reserve staff, have already commenced. Under the agreement the Crown Reserve Mining Co. will spend $50,000, at the rate of $4,000 a month. This will be returned out of the gross ore receipts, 60 per cent. going to the Crown Reserve until the amount is paid. After this is paid the profits will go to liquidate debts which amount to $140,000 on a mortgage and $112,000 in notes. For this expenditure the Crown Reserve gets a 55 per cent. interest in the company on a thirty-year lease. Some three years ago Sherbrooke business men took over the Globe Consolidated from the Globe Mining Co. They paid $300,000 for the property and agreed to return this on the basis of 50 per cent. of the gross returns. As the ore only runs $9.00 a ton this agreement left small profit per ton for the operating company. Some months ago the output became so low that the company decided to try and induce outside capital to help them. With this, they approached the Crown Reserve Mining Co. and after some negotiations obtained the assistance they desired. The Southern Pacific runs within 27 miles of the property; railhead being at Reading. Transportation is by automobile. The mine is fully equipped and working has not ceased. There is a cyanide mill with a capacity of 125 tons a day. There are two known ore vein systems; one of these is the Globe vein, which is six feet wide with a known ore shoot of 1,500 feet. The other is the Bailey which can be seen 500 feet below. The idea of the management is that if raises can be put through from the adit level of the Bailey vein the orebody of the Globe can be mined at much lower cost. After some work development money ran out before any ore was struck. To-day the Crown Reserve is sinking a winze from the Globe vein and working is still in ore at twenty feet down.

The Rochester mine now being worked by the Trethewey Mining Co. has found a little ore on the 300-foot level. This ore is very patchy so far and consists of bunches of smaltite with quite a little native silver in it, running well over 2,000 ounces on the average. It will be followed still further in the Rochester territory and a raise will be put upon it.

The Miller Lake O'Brien Mining Co. at Gowganda has just completed a shipment of a high grade car of concentrates. This car will run to about 25 tons of 2,500-ounce ore.

Ore shipments for the month of September were about 400 tons higher than for the previous month. This is almost entirely due to the shipments from the Buffalo mine. This property has been shipping out a large tonnage of low grade concentrates which formerly would have been treated by the cyanide mill.

PORCUPINE, KIRKLAND LAKE AND MUNRO TOWNSHIP

Refining of Gold.—It is a remarkable fact that while nearly $800,000 in gold is being shipped every month from the Porcupine camp, none of this is being treated at the Ottawa Mint where it was stated semi-officially that the new refinery has been completed and can now handle raw bullion. Careful inquiry elicited the fact that no very strenuous effort had been made by the Ottawa mint officials to obtain the Porcupine bullion for treatment and that returns on which such bullion can be taken and treated at Ottawa were such as no business men would care to consider. The Hollinger ship to New York and many of the other companies to Denver, where very prompt and fair settlement is made for gold. Settlement from Denver is made about twelve days after the bullion has been shipped express. In New York the company is credited with the amount of the shipment about seven days after it has been shipped. The advantage of the refining of the gold in Canada appears so obvious that it is a subject of comment that no effort is being made to keep it in the country and not to ship it to United States mints and refineries.

Recruiting.—Very remarkable success has attended the efforts of the recruiting officers of the Pioneer Regiment in Northern Ontario. It was particularly so in Timmins where Lieut. Smith recruited over 100 men. The calibre of these recruits is excellent. Four or five of the hundred were graduated mining engineers and the great majority were miners and prospectors of some experience. There were but a mere handful that described themselves as having no technical knowledge of some trade or profession. The results obtained can be attributed very largely to the Hollinger mine officials and particularly Mr. A. R. Globe. Mr. Globe is a South African veteran and for the past two months he has been conducting what was really a training corps. Nearly all the men in this training corps joined the Pioneers and their example was so infectious that it was speedily followed by many of their friends. There was hardly a mine staff in Porcupine that did not lose one or two good men and the Hollinger staff is very much depleted. Considerable effect and considerable encouragement to recruiting was shown in the Porcupine camp since every mine manager in the camp agreed that he would take back any man that went with the Pioneers if they returned and desired to take up their old positions. The Hollinger went still further and declared that the loyal

service bonus would be continued as if the man had not left the country provided they came back to the Hollinger staff. This appeared to be a very great encouragement to the men who desired to go to the front. In addition recruiting meetings were held in Timmins, South Porcupine, Cochrane and Matheson, and everywhere met with great results. Capt. Allan will be in charge of the detachment from Northern Ontario and with him will be Lieuts. Smith and Tait, who have been recruiting in Timmins and Haileybury, respectively. It was the intention to raise 250 in the district between the National Transcontinental and the C.P.R., but it does not seem unlikely that the total number will be raised from the Timiskaming district alone. The men from the Porcupine district have been brought down to Haileybury, but expect to be moved very shortly to London, where mobilization will be completed. One of the inducements held out to recruits was that the need of the corps would not necessitate very long training and that they would be likely to get to the front in a very much shorter time than the regular infantry. A recruiting office has been opened in Cobalt. Capt. R. P. Rogers has just been placed in command of a detachment of the Royal Engineers. This Canadian detachment will be known as No. 1 Tunneling Company, C.E.F. It will be attached to the Royal Engineers and is an Imperial command. Mr. S. M. Thorne has been appointed recruiting agent and Mr. McMillan, Assistant Mining Inspector, will also take a commission in the same company.

Jupiter and McIntyre.—After many months of negotiations with various companies the Jupiter Mining Co. has decided to accept the offer of the McIntyre Porcupine Mining Co. for the sale of the control of the former company. The McIntyre has agreed to at once pay off the debts of the Jupiter, which now amount to about $60,000. The remaining $92,000 will be disbursed at the rate of $5,000 a month in the development of the Jupiter property. A new company will be formed which will probably be called the Jupiter Porcupine or a variation on the old name, and for their outlay the McIntyre will get control of this company. Once the outlay has been ratified by the shareholders' meeting on October 29th, preparations will be made to expedite the centralization of operations at the Pearl Lake shaft. It is proposed that the Pearl Lake shaft shall be the central hoisting shaft on the north side of the McIntyre property. The McIntyre is already mining remarkable ore along what is known as the contact zone. This zone runs across the corner of the Pearl Lake property and can be traced for 2,500 feet on the Jupiter. The McIntyre directorate believe that prospects are good of obtaining fine results on the Jupiter although assays are low on the surface, but so they were on the surface at the McIntyre. On the same vein system until such time as it is possible to make connections between the old workings and the Jupiter and Pearl Lake shaft under ground, the ore will be mined and drawn across to the McIntyre mill where an extension is already being prepared for its reception and treatment. An ore bin will be provided at the old Jupiter workings, from which the big wagons will be filled and the ore will be dumped down this and afterwards drawn out from that point. As the main Jupiter orebody is likely to be an extension of the McIntyre no serious metallurgical difficulties are anticipated in the treatment of the ore and the unit to be established will correspond very closely to that already installed at the mill. This unit it is expected will be ready by January 1st, at which date there should also be a considerable tonnage of ore broken at the mine.

Power at Porcupine.—An engineer on the staff of the Hydro-Electric Commission has recently been making an investigation into the power situation in Porcupine. The rate charged by the Northern Canada Power Co. varies very considerably, and it was desired to see what can be done to adjust the rates. In many of the smaller plants in Porcupine the cost per ton in power is a very prominent factor. Some of the companies are running half Hydro-Electric and half steam power; not because they desired it, but because the demand on the power in the camp usually exceeds the supply. This is not the case now because of the unusually wet season and it is probable that enough power will be available to safeguard them for the ensuing spring, but the increasing demands of the Dome and the Hollinger alone will make absolutely necessary the obtaining of more power. The present power company expresses its intention of obtaining more power by conserving the water flow on the Mattagami river.

NEWFOUNDLAND

Mr. J. J. McDougall, C.E., manager of the Dominion mine at Bell island, who returned recently from a visit to Sydney, brings the pleasing news that his company will operate on a specially large scale the coming winter at Wabana, working all the areas now opened and employing 1,000 men or more all through the winter months. The output will be stocked as removed from the mine, and held until the spring and then a large fleet of steamers will be employed to convey it to Sydney, where smelting operations on a large scale will be carried out as a result of the increase of iron and steel production due to the extensive manufacture of war munitions throughout Canada.

Report has it that the "Workington" iron mine in the district of Bay-de-Verde, which has lain idle for fifteen years, is to be re-opened in the early spring by a large and wealthy corporation. The property is owned by the Newfoundland Iron Ore Co., Ltd., and from 1897 to 1900 this property was looked upon to outrival the famous iron deposits of Bell island. Many shafts from 40 to 300 feet in depth were sunk on the property, and several hundred tons of ore was raised to the surface. At 150 feet in depth it was said that one-half million tons of ore was in sight.

The Newfoundland company spent considerable sums of money on the work. They erected a very costly plant at the workings, built seven miles of railroad from Old Perlican, which was to be the shipping port, and constructed a substantial loading wharf, besides building several houses for the workingmen. Why this mine was closed has never been known. Not only was it closed, but the plant and railway track with engines were all removed. The ore from this mine is a red hematite, of a higher grade than Bell island, averaging over 60 per cent. in metallic iron and freer from injurious ingredients such as sulphur and phosphorus.

The success of the British Empire and her Allies in the wars now raging to a large extent depends upon an adequate supply of iron and steel and other finer metals, and it should be the duty of all who desire the old Flag still to wave above us, to see that there shall be an unlimited and constant supply of the raw material for all purposes. Newfoundland is indeed rich in iron, copper, lead, manganese and sulphur ores and other minerals, and that her sons are patriotic enough to work day and night in the mines, to supply the fur-

naces of Canada and England with material for shells and guns, there is not the least doubt.

In addition to vast supplies of hematite ore, Newfoundland and Labrador possess vast deposits of magnetic ore, which up to the present has not been utilized. The recent favorable results attained in electric smelting may lead to solving the problem of satisfactorily reducing the class of ores which under the old methods of smelting baffled all the efforts of metallurgists. Should a satisfactory process evolve, it is certain that Newfoundland and Labrador will eventually become one of the largest iron ore centres in the British Empire.

A cargo of copper ore has just been shipped from the Tilt Cove mine; this is the second cargo this week. The discovery of Tilt Cove copper mine dates back to about 1857. Since 1864 work has been carried on uninterruptedly, and it is pleasing to know that after fifty years of mining and shipping, during which time many million pounds of copper were exported, the property gives no evidence of decay to-day. The property was originally owned by Messrs. C. F. Bennett and Smith McKay, two of Newfoundland's respected merchants, who, up until 1888, operated the property with a great measure of success. In 1888 the mine was leased to the Tilt Cove Copper Co., Ltd., whose capitalization was £20,000, with head offices at 9 Queen Street, London, and with John Taylor & Sons, managers, and Col. J. W. Young, chairman. The annual rental paid the owners was £4,400 and one-half of the net profits earned.

BRITISH COLUMBIA

While still early to estimate what will be the total value of the mineral production of British Columbia in 1915, there seems to be good reason for thinking that it will, on the whole, compare favorably with that of last year. This statement is made assuming that nothing will happen to seriously affect the output of ore and coal during the last quarter of the year. In regard to the latter, cheering accounts have come in, these indicating that the demand for coal is gradually increasing as the winter season approaches. The output of lode metals seems to be fairly well maintained, with a tendency toward larger production of both copper and lead than during the earlier part of the year. It is probable that the production of silver will be somewhat less than that of 1914, and zinc production, too, has been smaller owing to market conditions not having been good. Yet, taking things all round, there is no good reason to think that the total value of this year's mineral production will be as low as that of last year.

East Kootenay.

Coal mining has been fairly active lately at both the Coal Creek and Michel collieries of the Crow's Nest Coal Co., and it is known that the outlook for an increased demand is promising. Development of extensions of known coal areas of the fields in which are situated the mines of the two collieries above-mentioned can easily be undertaken whenever a market shall be found for a much larger output of coal than has been made during the last year or two. A gratifying feature is that big deposits of coal of excellent quality have been opened by recent developments, and as progress is made with further development and equipment of several new mines, the large productive capabilities of these properties becomes more evident. With much coal of good quality available for making coke, it follows that a corresponding improvement in the quality of the coke produced results. There is a larger market for coke now than during the last quarter of 1914, for with smelting works again in operation at Grand Forks and Greenwood, in the Boundary district, and the smeltery at Trail, in West Kootenay, treating more ore now than last autumn, the total quantity of coke used monthly at those several works is necessarily greater than when less ore was being smelted at them. In addition, Crowsnest coke is in demand for use at some of the Montana smelteries.

Some information was supplied recently relative to copper properties situated in Fort Steele mining division. Much interest is also being taken locally in gold claims in the neighborhood of Perry creek, which flows into St. Mary's river between Marysville and the junction of the river with the Kootenay at Fort Steele. Some of the lodes or veins on Perry creek are continuous for miles, generally without break or fault. The value they contain is in gold. Chief among the properties that have attracted attention is the Homestake group of ten claims, on which Mr. Geo. T. Carr has done work for seven or eight years. With Mr. Carr is associated in the ownership Mr. Wm. Duff Hanie, of Chicago, Illinois, who last year had a number of samples of the ore from this group assayed in Chicago, with the result that assay returns up to $19.20 a ton in gold were obtained, while the result of assay of an average sample over a width of 28 feet was given as having been at the rate of $9.60 a ton. The development work done on this group includes two shafts, each sunk to a depth of 60 feet, and a crosscut adit driven 400 feet to the vein with drifts 170 feet in one direction and 120 feet in the other. In addition, there has been much opencut work done on the various claims of the group. An idea of the renewed interest taken in the Perry Creek region when the results of Messrs. Carr and Hanie's assay tests were made public may be obtained from the authentic statement that more than 200 mineral claims have been located in the neighborhood and recorded at the office of the mining recorder at Cranbrook.

Metalliferous minerals produced in quantity in Fort Steele division over many years include gold, silver and lead. The St. Eugene mine, near Moyie, was long the chief lead-producing mine in Canada; now the Sullivan, near Kimberley, holds that distinction. The North Star, also near Kimberley, was at one time a well-known producer of ore, the chief valuable constituent of which was silver, with lead a less important content. There are great masses of lead-zinc ore in the neighborhood of Kimberley, but much of it is of a complex character not amenable to ordinary reduction processes. Another mineral, recently discovered in the St. Mary's region is molybdenite, samples of ore found on Baker creek, a tributary of St. Mary's river, having been sent to Victoria for identification and there determined to contain molybdenum.

The Florence Mining Co.'s mine, situated about two miles from Ainsworth, will shortly concentrate its ore at the Highland mill, under an arrangement with the Consolidated Mining and Smelting Co., which has not for several months used the plant to concentrate ores from its own mines in the neighborhood of Ainsworth. A report is current that another good shoot of ore has been opened in the Highland mine.

MARKETS

STOCK QUOTATIONS.

October 25, 1915.

New York Curb.

	Bid.	Asked.
Alaska Jun Gold	11¾	12
Braden Copper	9½	9⅝
Chile Copper	23	23¼
Kennecott Copper	53¾	54
Magma Copper	14¼	14½
Nipissing Mines	6¾	7
Tonopah Extension	2¾	3
Tonopah Mining	5⅜	5½
Yukon Gold	2¼	2½

Cobalt Stocks.

October 26, 1915.

	Asked.	Bid.
Bailey	4⅜	4⅛
Beaver Con.	30	29
Buffalo	65	45
Chambers Ferland	15	13½
Coniagas	380	350
Crown Reserve	42	41
Foster	..	3
Gifford	..	1½
Gould	⅞	½
Great Northern	3	2½
Hargraves	2	1¼
Hudson Bay	2200	2100
Kerr Lake	..	350
La Rose	50	45
McKinley Darragh	31	29
Nipissing	690	680
Ophir	2	1
Peterson Lake	22½	22¼
Right of Way	4¼	..
Seneca Superior	65	60
Silver Leaf	2	1⅞
Timiskaming	42½	42¼
Trethewey	18	15
Wettlaufer	7	6
York Ont.	2	1

Porcupine Stocks.

October 26, 1915.

	Asked.	Bid.
Apex	3¼	3
Dome Extension	27½	27
Dome Lake	20	19
Dome Mines	3000	2600
Eldorado	½	⅛
Foley O'Brien	..	40
Gold Reef	4	3
Homestake	..	16
Hollinger	..	2490
Jupiter	11½	11¼
McIntyre	53½	53
Moneta	7¼	7
Pearl Lake	⅜	..
Porcupine Crown	..	79
Porcupine Gold ex-r	½	..
Porcupine Imperial	5¾	5½
Porcupine Tisdale	1¼	1
Porcupine Vipond	84	83½
Preston E. D.	6¼	6⅛
Teck-Hughes	10	9
West Dome	9¾	9⅜

SILVER PRICES.

October—	New York. cents.	London. pence.
9	49½	23⅞
11	49½	23 15/16
12	..	24
13	49½	24
14	49⅝	24
15	49⅝	24
16	49⅜	23⅞
18	49⅝	23 15/16
19	49⅝	23 15/16
20	49⅜	23⅞
21	49	23¾
22	49	23 13/16
23	48⅞	23⅞
25	48⅞	23 15/16

TORONTO MARKETS.

Oct. 27, 1915—(Quotations from Canada Metal Co., Toronto)
- Spelter, 18 cents per lb.
- Lead, 6½ cents per lb.
- Tin, 37 cents per lb.
- Antimony, 40 cents per lb.
- Copper castings, 19 cents per lb.
- Electrolytic, 19 cents per lb.
- Ingot brass, yellow, 13c.; red, 15 cents per lb.

Oct. 27, 1915—(Quotations from Elias Rogers Co., Toronto)
- Coal, anthracite, $7.75 per ton.
- Coal, bituminous, $5.25 per ton.

NEW YORK MARKETS.

Oct. 22, 1915—Connellsville coke (f.o.b.) ovens—
- Furnace coke, prompt, $2.40 per ton.
- Foundry coke, prompt, $2.60 to $2.75 per ton.

Oct. 22, 1915—Tin Straits, 33.50 cents.
- Copper, Prime Lake, 17.75 to 18.00 cents.
- Electrolytic copper, 17.50 to 17.75 cents.
- Copper wire, base, 19.00 to 19.25 cents.
- Lead, $4.75 cents.
- Spelter, 14.12½ to 14.37½ cents.
- Sheet zinc (f.o.b. smelter), 16.00 cents.
- Aluminum, 54.00 to 56.00 cents.
- Platinum, soft, $50.00 to $54.00 per ounce.
- Platinum, hard, $54.00 to $58.00 per ounce.
- Quicksilver, $92.00 to $94.00 per 75-lb. flask.

CONSOLIDATED SMELTERS.

Consolidated Smelters' pronounced advance, which has been carried 50 points beyond the year's low levels, at this week's best prices, revives rumors that the stock will go on the 10 per cent. basis for which the Street has been looking. All the reports on the company's position for some weeks have been extremely optimistic. Whether or no directors take early action on the dividend it is considered by many that the present earning power of the company gives the stock the increased value. It is interesting to recall that the C.P.R. is a heavy holder of the company's stock; sufficient to bring in a yearly income of $209,520 in the past year.—Financial Times.