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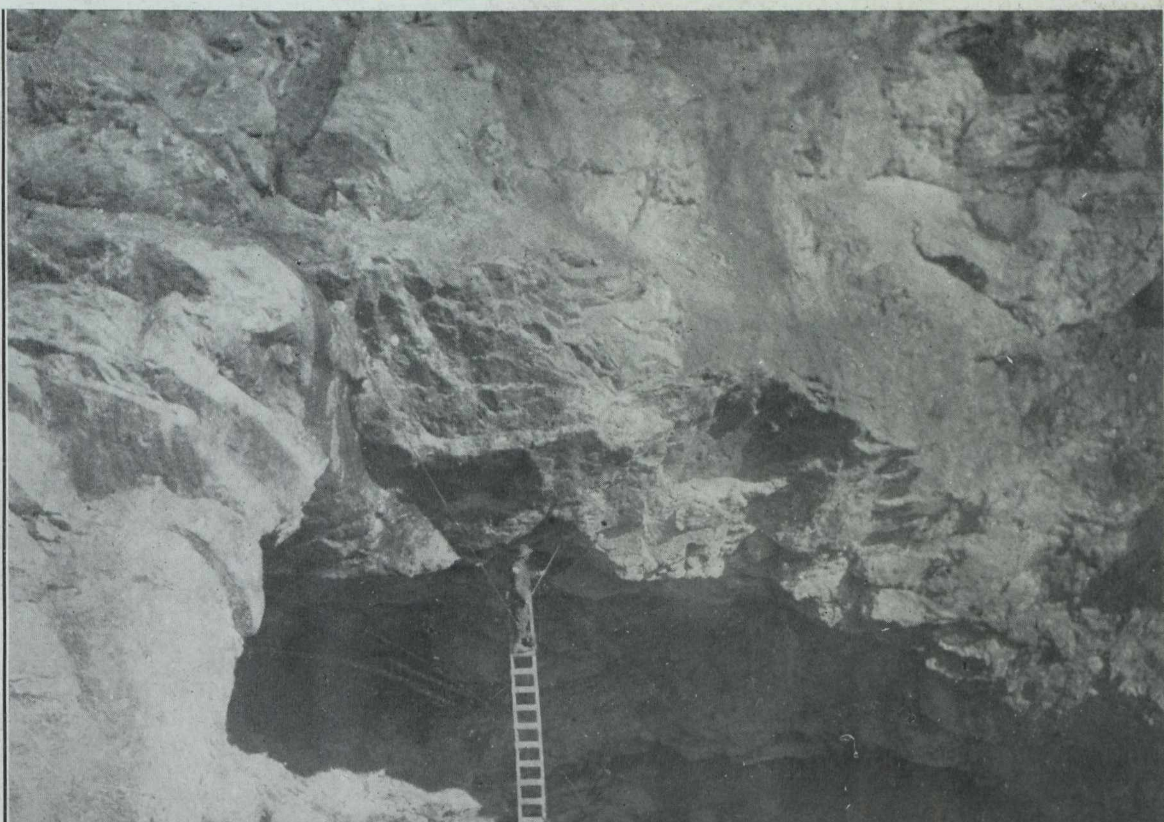

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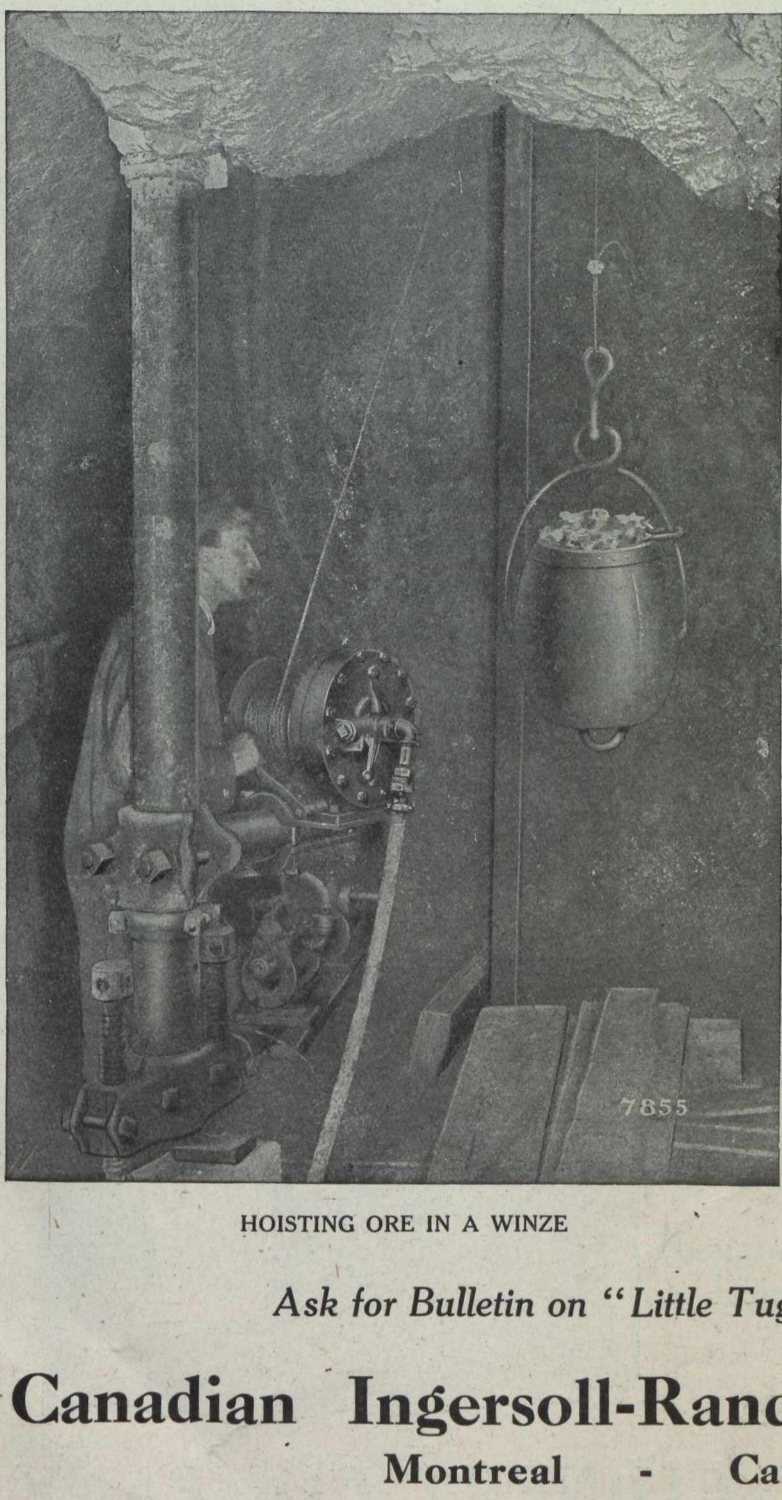

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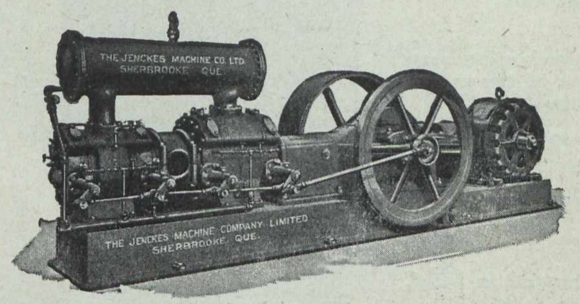

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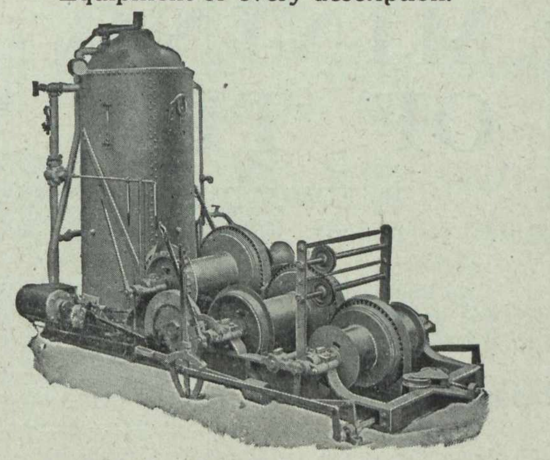

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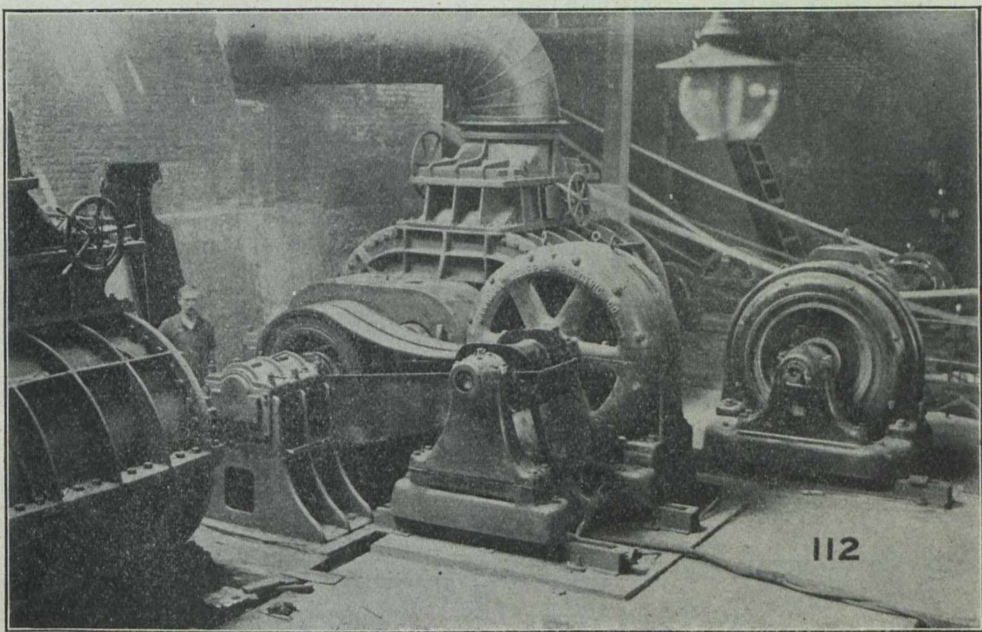

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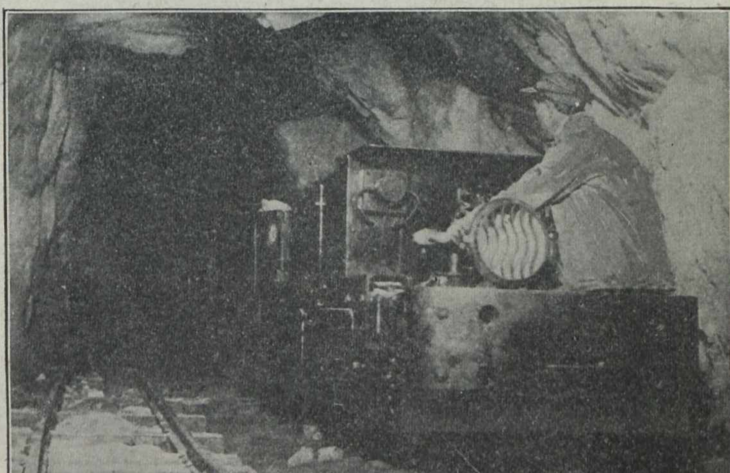

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THE CANADIAN MINING JOURNAL

VOL. XXXVI. TORONTO, June 15, 1915. No. 12

The Canadian Mining Journal

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REGINALD E. HORE

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CIRCULATION

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

ALIEN ENEMIES

According to a press despatch from Fernie, the Coal Creek mines of the Crow's Nest Pass Coal Company ceased operations on June 9, owing to the miners going on strike because the company refused to immediately discharge all German and Austrian employees.

We are not yet aware of all the facts which led up to this action on the part of the miners, and it is possible that the aliens may have made themselves so obnoxious that loyal citizens felt called upon to clear out the undesirables. If, however, the alien enemies were attacked simply because of their nationality, then the striking miners need not look for praise from fair-minded citizens.

Unquestionably the mining camps should be freed from the class of men who are unwilling either to be loyal subjects of the British Empire or to keep their German opinions to themselves. But a man may be a good citizen even though he be not naturalized. There are many decent, industrious men of German nationality in Canada who are a credit to the Dominion and who have earned the right to live and work here during war as during peace.

There are many loyal Canadians out of work in some of the mining camps in which alien enemies are employed. It is, therefore, natural that there should be complaints from certain quarters. Why should the companies employ Germans and Austrians, while others are idle? Why are these subjects of the mad war lords allowed in our midst? Why are they not dismissed by their employers? Why are they not interned? These questions are frequently asked and deserve an answer. That is why we venture to suggest that the alien enemies have rights which should not be lost sight of.

It is evident that some of the alien enemies in the mining camps are thoroughly in sympathy with the German Government. Of these some have been foolish enough to give voice to their joy at the successful accomplishment of criminal acts such as the sinking of the Lusitania. Avowed enemies such as these should be promptly interned.

On the other hand there are many Germans who are either not in sympathy with the German war lords or who take care to conduct themselves in a manner not hostile to the country in which they live. Such men we should not hastily throw out of work, for their labor is useful to the country as well as to themselves. Why should we make public charges of men who would otherwise be productive workers? And even if there were no economic loss, is it fair that these men who are striving to live as becomes decent citizens should be made to suffer because others of the same nationality have been unwise enough to openly approve of the mad policy of the Kaiser and his brood? The men employed in the mines have won their positions by their work, and so long as their work is satisfactory to their employers and their conduct satisfactory to the public it will be grossly unfair for anyone seeking personal interests to ask that they be refused employment.

In the case of those enemies whose conduct is unseemly, agitation for internment is the proper course. The companies should not be called upon to dismiss such men, however. The cases should be investigated by Government officials and the undesirables should be interned.

COPPER SMELTING IN CANADA

In connection with the manufacture of shells in Canada there is a popular demand that all the materials used be Canadian products entirely. It is stated that steps are being taken to encourage the smelting and refining in this country of all the metals used. It is to be hoped that as a result of such encouragement new industries will be established here.

Some curious misstatements of fact are, however, being made in this connection. One Toronto newspaper reports a member of the shell committee as stating that practically no copper is smelted in Canada. As a matter of fact, a very large amount of copper ore is smelted in Canada. The Granby Company alone in the year ending June 30, 1914, smelted, at Grand Forks and Anyox, B.C., 1,289,000 tons of copper ore. There was produced in Canada in 1914 about 26,276,000 lb. blister copper as well as 12,582,000 lb. copper matte and 92,772,000 lb. nickel-copper matte.

While Canada has in operation several large smelting plants, practically all the smelter products are sent to other countries to be refined. At present we produce and smelt more than enough copper ore for our own use; but are obliged to import the refined products. We exported in 1914 smelter products containing 75,411,623 lb. copper and imported about 28,280,810 lb. crude and manufactured copper and 1,143,039 lb. copper sulphate, besides other copper manufactures.

Copper, electrolytic, was marked up to 20 cents a lb. last week, the highest price since 1907, and lead sold at six cents. The demand for metals must eventually lead to increased interest in the development of mining properties.

At the Dome mill about two-thirds of the gold is recovered by amalgamation and one-third by cyanidation. The recovery by the two processes in the past financial year was respectively $671,054 and $384,442. This indicates that the ore milled is very similar in character to that mined in early operations, and that the practice decided upon after careful testing of the ore near surface needs no serious modification.

CALUMET AND HECLA.

Houghton, Mich., May 29.

A splendid testimonial of respect, of confidence and of regard was last evening paid to James MacNaughton, general manager of the Calumet and Hecla Mining Company and associated companies by the employees of those corporations when Mr. McNaughton was presented with an engraved gold watch and printed testimonial bearing the names of the 8,266 employees who contributed towards its purchase.

The presentation was made on behalf of the Calumet and Hecla and subsidiary companies' employees by James Sharpe of the Hecla machine shop. Mr. Sharpe read to Mr. MacNaughton the following letter, expressing the sentiment of the employees:

"The employees of the mines, mills and smelters of which you are general manager, wishing to show you and the general public, the esteem in which they hold their general manager, decided that a letter signed by each and every employee, would be the best testimonial of their feelings.

"We know that it was principally due to your attitude of "no compromise" that the copper country is not afflicted with the presence and under the control of the Western Federation of Miners.

"We know that from years of experience that any one of us having a grievance or thinking he has a grievance can have justice done him by bringing his trouble to your notice.

"We thank you and ask you to convey to the directors of the various companies our thanks for the wage bonus for the eight months prior to May 1, 1915.

"We have each contributed five cents towards the purchase of a token of our esteem, and know you will accept it in the spirit in which it is given, not considering its monetary value, but remembering that it shows the good will of 8,235 employees, each of whom contributed his mite towards its purchase."

Mr. McNaughton voiced his appreciation as follows:

"The greatest satisfaction any employer of labor can have is to know that his employees are happy and prosperous, and anything that he can do that will conduce to those conditions he is in honor bound to do. If I have contributed towards the prosperity and happiness of the employees of these companies I have only done what was my duty. The thanks of the employers are due to the boards of directors of the various companies and to the broad-mindedness and liberality of two men who guided the destiny of the Calumet and Hecla so many years; I refer to Mr. Shaw, Sr., and to Mr. Agassiz. Their spirit of fair-mindedness and fair dealing has been handed down to the present board of directors, who have only done what they would have done if they were still living.

"Loyalty and efficiency go hand in hand. Judging from the efficiency we are getting to-day, and it is the highest in the history of the companies, I know we are getting loyalty.

"I don't know how and can't thank you for this testimonial of your regard and feeling. Coming as it does so soon after a year of turmoil and trouble, your act is a notification to the entire world that the people of the copper country and employees of these companies who know the management of the companies best do not and never have taken any stock in the lies told during the year. I thank you from the bottom of my heart for this testimonial, but above all for the kindly feeling and good will that prompted this act."

THE CALL OF THE MOTHERLAND

(By Bernard Malcolm Ramsay, in the Financier, London.)

Over the lands and the waters, outsinging the song of the sea,
There comes to the ear of Britain the voice of her children free—
The sons who have wrought and fought for Britain and Liberty.

* * * * * * *

Back in the mists of the ages Britain was born to be blest,
Cradled and rocked by the ocean lapping her island nest:
The sea and the stars strove together to speed her behest.

So, at her time of fructition Britain bore venturous sons;
Boats were their bulwarks and bridges under the thunder of guns:
Never the sea and its sailors Attila dared with his Huns.

Fleets of envious rivals strove for the Sea Queen's fall,
Pitting their power against Britain. But, ready and quick to the call,
Drake and Rodney and Nelson vanquished the foemen all.

Storms came out of the heavens to fling the Armada far;
The fame of the bold Dutch rovers paled 'neath the new-born star;
And the blood of the greatest sea-lord bought the triumph of Trafalgar.

Thus were the seas swept surely. . . . . Britain arose in her might,
Proffered the pledge of freedom to all she had flung in fight,
And a pass to the paths of the oceans, under her light.

Then did she send her children over the seven seas:
Speeded and swung to the far lands, each by a fateful breeze,
Heat could not conquer their courage, and frost could not freeze.

So did they mould fair cities; fashioned their rails and docks,
Girdled the earth with cables, lighted the oceans' rocks,
Peopled and pastured the prairies, and tended their droves and flocks.

Thus was the Empire builded, based upon Freedom's Chart,
Thus was a story written of trade and many an art,
And the fame of the Sons of Empire, dear to the Motherland's heart.

* * * * * * *

Over the lands and the waters floated a clarion call.
Britain, the Mother of Heroes, summoned her children all:
"Here are the Huns at my gateway! Help, lest I fall!"

Swift to the sudden summons brave Sons of the Empire sprang:
"We're coming, we're coming, Mother!" loudly the answer rang;
While the salt sea heard and echoed the song that the soldiers sang.

And now the Sons of the Empire will show to the watching world
That the cause of the Mother is theirs; and ne'er shall her flag be furled
Till the Huns from the gate of Britain back to the Pit are hurled.

STANDARD SILVER-LEAD MINING CO.

The following information relative to the operations in 1914 of the Standard Silver-Lead Mining Co., owning a group of mines situated near Silverton, B.C., and a concentrating mill situated on the eastern shore of Slocan lake at that town, has been obtained from the company.

Development work done during the year totalled 9,059 ft., this consisting chiefly of drifts and crosscuts, with a few raises between levels.

The quantity of ore milled was 44,806 tons, beside which there was mined and shipped crude 4,914 tons, together with 49,720 tons.

Average metal recoveries were as follows: From 4,714.47 lb. of crude silver-lead ore, an average of 49.17 per cent. lead and 86.65 oz. silver to the ton. From 4,154.47 lb. of silver-lead concentrate, an average of 65.75 per cent. lead and 103.31 oz. silver to the ton. From 5,618.50 lb. of silver-zinc concentrate, an average of 43.84 per cent. zinc and 35.23 oz. silver to the ton.

There was left on hand at the close of the year about 200 tons of crude ore of shipping grade, 1,300 tons of silver-lead concentrate, and 30 tons of silver-zinc concentrate.

No important additions were made to mine or mill plant and machinery during the year, both having been previously adequately equipped. An experimental unit of the Minerals Separation flotation process plant was put in but results were such as to lead to its abandonment.

Since the close of the year to which the foregoing particulars relate, development work has been continued in the Standard mine, and quite recently a crosscut was being driven from the raise that connects Nos. 6 and 7 levels, this constituting an intermediate level; No. 4 adit was also being extended. The Alpha mine, situated higher up the hill than the Standard, is being further developed by the extension of three of the adits opened years ago by the former owners. The work of driving No. 8 adit, which is on the old Emily Edith property, below the Standard, is to be resumed shortly. More men are being employed in the mines as work is advantageously found for them, and the concentrating plant is being operated one shift daily. Gradually mine and mill will be got back to work at full capacity.

HEDLEY GOLD MINING COMPANY.

A quarterly dividend of three per cent. and an additional dividend of two per cent. has been declared on the outstanding capital stock of the Hedley Gold Mining Company, payable Wednesday, June 30, 1915, to stockholders of record June 19, 1915.

CORRESPONDENCE

UNJUSTIFIABLE ATTACKS.

To the Editor of the Canadian Mining Journal:

Sir,—In the Coast cities of Victoria and Vancouver, British Columbia, persistent attacks have lately been made on Mr. Thos. Graham, Chief Inspector of Mines for the Province, and since the rules of the Provincial civil service do not permit of officials defending themselves in the public press, he is placed at a most unfair disadvantage. Now, since a number of newspapers have given publicity to misstatements and some have made serious reflections on Mr. Graham in regard to the way he has carried out his official duties, such reflections being based on false allegations, I ask you to be good enough to publish the following information, with the purpose of endeavoring to influence those who read it to suspend their judgment until such time as the findings of the Royal Commission lately appointed by the Government to make a thorough investigation of the circumstances surrounding the flooding three months ago of the South Wellington coal mine, on Vancouver island, and the resultant death of nineteen men, is arrived at and made known.

More than twenty years ago there was filed with the Department of Mines, Victoria, B.C., a tracing of a plan of the Southfield mine, then being operated by an Old Country company, whose engineers and surveyors followed the English custom of making plans on the scale of two chains—132 ft.—to the inch. In 1907 or 1908 a provincial syndicate or company undertook the development of a coal property adjoining the long abandoned Southfield mine. Its officials had free access to the tracing filed with the department and, as well, to the original plan in the offices at Nanaimo of the company that in 1902 acquired from the English company all its property in the Nanaimo district. Some years ago a law was passed in British Columbia requiring all coal mine plans to be on a scale of 100 ft. to the inch.

Mr. Graham took office as Chief Inspector of Mines on January 1, 1912, after having been for several years general superintendent for the Western Fuel Co., Nanaimo. The Coal Mines Regulation Act he has to administer, neither requires the Government mine inspectors to check up the surveys of mine operators nor does it give them power to do so under ordinary operating conditions. The responsibility for the accuracy of plans exhibited to the mine inspectors or filed with the department lies entirely with the operators. In the case of the South Wellington Company it is supposed that some one overlooked the difference in the scale of the old plan as compared with that of the plans of late years. This, however, has not yet been proved. In any case the mistake, if made, was not made by a Government official. This notwithstanding, a charge has been made by a lawyer, active in opposition to the political party in power in the province, according to reports printed in opposition newspapers, that the chief inspector brought into court two maps marked as on the same scale, when they were on different scales. As a matter of fact those maps were not produced by any Government official; on the contrary, the chief inspector had taken with him from Victoria to Nanaimo to produce at the inquest, if required, the tracing filed 23 years previously with the Department of Mines. Having at the outset of the inquest announced that it was the intention of the Government to hold a full investigation after a resurvey of the mine had been made, he did not think it necessary to call the attention of the jury to maps that were not official. So it is that the political lawyer, opposition newspapers (particularly the labor publications), and strikers who failed in their fight against the coal mine operators, have combined in their denunciations of the chief inspector, whom I believe to be the most efficient and thoroughly conscientious man available for the responsible duties of his office

To show the nature of the misrepresentation that has taken place, the following excerpts from reports of a Coroner's inquest are submitted:

From Opposition newspapers—

"Mr. Farris: 'You have known for over two months that the company had been working on plans drawn to different scales?' "

"Mr. Graham: 'Yes.' "

Mr. Farris: 'And when you posted up these two blueprints in court here, both marked 100 ft. to the inch, you knew that one of them was on a scale of 132 ft. to the inch?' "

"Mr. Graham: 'Yes.' "

"Mr. Farris: 'And you knew that everyone here in court was misled by that fact?' "

"The witness answered in the affirmative."

From sworn Stenographer's Report of Evidence taken:

"Q.: You knew this morning that the two plans did not agree, and yet you did not disclose it with us and the jury; how is that? What is your reason for not disclosing the difference between these plans—instead of leading us to believe they were the same?"

"A.: My reason for not doing so is because I did not see that it was necessary at a Coroner's inquest, since there will be another inquiry as soon as a re-survey is made."

"Q.: You think that is an obvious explanation?"

"A.: An obvious explanation."

"Q.: You intended to be silent during this inquest?"

"A.: I had no reason to bring it out."

"Q.: You thought it your duty as a Government official?"

"A.: Yes, sir."

The Vancouver Trades and Labor Council sent a delegation to the acting Premier of the province to ask for immediate removal from office of the chief inspector and that proceedings be taken against him for complicity in causing the deaths of 19 miners. These requests, pending the investigation of a Royal Commission, were refused.

Yours, etc.,

Victoria, B.C., June 1, 1915. E. JACOBS.

OSCEOLA.

The report of Osceola Consolidated for the year ended Dec. 31, 1914, shows net earnings of $352,586, or $3.66 per share, which compares with $381,967, or $3.97 per share in previous year. Production amounted to 14,970,737 lb. of copper against 11,325,010 lb. in 1913. Cost of production was 10.79 cents per lb. against 12.30 cents in the previous year; rock yielded 13.5 lb. refined copper per ton against 15.4 lb. in 1913.

GLACIERS OF THE ROCKIES AND SELKIRKS

By A. P. Coleman.

The traveler going westwards from the Canadian prairie finds the way blocked by a grim wall of cliffs rising 7,000 or 8,000 ft. above the sea and justifying the name of the "Rockies" given to our greatest chain of mountains. Toward the end of the summer these desolate precipices are snowless and except for a glimpse of white peaks through some pass there is scarcely a suggestion of the glacier region within. Then the train enters the "Gap" and before long the summits around show fields or patches of midsummer snow; and as one draws nearer to the heart of the Rockies there is blue ice to be seen clinging to the cliffs or reaching as glaciers down into the wooded valleys, and one is thrilled with the wild charm of alpine scenery.

However, engineers are strict utilitarians and always choose the lowest pass for a railway, so that the passenger in the observation car catches only tantalizing glimpses of the wonders and beauties of the ice world a few miles away and a few thousand feet above the valley. One must stop at some place like Lake Louise in the southern Rockies or Tete Jaune in the north or Glacier in the Selkirks to come into real contact with snow fields and glaciers. What a joy it is to get rid of the hot and dusty everyday world of cities for a while and come close to Nature in one of her wildest moods! It is not only the mountaineer who feels the seduction of the cool, clean solitudes where glaciers are born and do their wonderful work. Every healthy man or woman must yield to the delight of living in these inspiring surroundings.

It is worth while to put on warm strong clothes and hobnailed shoes and fill your lungs with mountain air in a scramble up to the snow fields to see how the glacial machinery works, machinery which some thousands of years ago shaped almost the whole surface of Canada, doing its work on the plains as well as the mountains and leaving it the splendid land of lakes and rivers and fertile prairies and rolling hills which it is to-day.

Snowline.—To reach the snows generally means some miles of walking and climbing, often, at first, through forest covered slopes, where the outside world is lost. Then the trees begin to thin and grow stunted, revealing between the trunks blue valleys with a lake or two and far off cliffs and mountains. At last the trees cease at 7,500 ft. and you are at timberline. Here the three Rocky Mountain heathers spread soft thick carpets between stiff bushes only a few feet high but with trunks a foot through, so buffeted have they been by the storms of centuries. The rows of dwarfed spruces leaning back against some rock ledge give fine shelter for the mountain goats, wisps of whose white wool cling to the stubborn branches.

Then come cliffs and rocky slopes and grassy or sedgy uplands (the true Alps as the word is used in Switzerland) where mountain sheep or goats pasture and wild flowers grow by the million, blue ones such as lupines, gentians, fox-gloves and forget-me-nots; yellow ones such as adder-tongues, columbines and a multitude of starry composite flowers; the red or orange Indian paint brush; and white flowers innumerable. You have reached the edge of the snow rapidly melting on a July day under a sun that is hot even on high mountains. The plants just freed from their winter covering are all bursting into bloom together, bees are humming, butterflies lazily flutter past and a humming bird poises over a blossom; for it is spring at these altitudes and there is a whole season's work to be done, seeds ripened and all, before autumn comes in September with its snowstorms burying all under the white silence of a nine-months winter again.

It is a thrilling experience to set foot at last on midsummer snow sweeping upwards gleaming toward the higher summits, snow that never entirely melts and that is so dazzling in the July sunlight that one needs dark or colored glasses to avoid snow blindness if the tramp is to be a long one.

We have no special word in English for these perpetual snow fields and so the French term *neve* is commonly used. Snowline is not nearly so definite as timberline and varies with latitude, exposure and snowfall. In the eastern Rockies of Alberta, where only a few feet fall in winter, the line is scarcely below 9,000 ft.; while in the western Selkirks, which catch the full brunt of the Pacific winds laden with moisture and have a snowfall of 40 or 50 ft. in a year, snowline is depressed almost to timberline, about 7,500 ft. This accounts for the bareness of the eastern Rockies as compared with the splendid Alpine features of the Selkirk range, which is the lower of the two.

While one gazes entranced at the array of lakes and valleys, of snowfields and dark cliffs, the wind rises and mountains to the west put on a cap of cloud. This grows and darkens and presently a mantle of mist sweeps up with the wind, the sun is dimmed and in a few minutes the wide world is shut out by a blizzard. We must make our way down to lower levels where sleet whitens the closing flowers, and then through a belt of rain swept hillside into the valley where the sun may still be shining hotly.

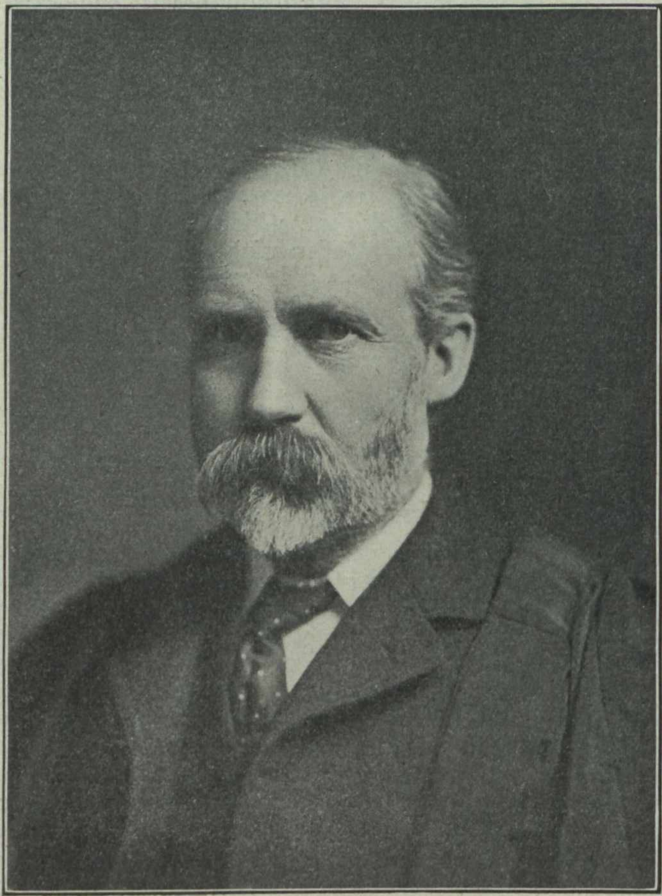
Since snow falls every month in the year on the *neve* fields and never melts away one might expect thte mountains, especially the Selkirks, to grow as snowheaps into the sky; but of course this does not take place. Under the increasing load of snow the lower beds are compressed into ice; so that the *neve*, beginning as loose or hard drifted snow above passes downwards into ice banded with blue and white layers, the whole sometimes hundreds of feet in thickness.

The snow accumulates only on the gentler slopes or in the higher valleys. On cliffs it cannot lodge but piles up on the *neve* beneath; and on steep slopes it may lie for a time but now and then, especially toward spring, it breaks loose and thunders down into the valley as an avalanche.

The Motion of Glaciers.—The final disposal of the snowfield, turned to ice in its lower parts, comes by a slow creep downwards. That the *neve* is actually in motion can be seen by following the slope of snow to its upper edge against some mountain wall where a "*bergschrund*" generally yawns between the snowfield and the cliff. This may be several feet wide and may go down many feet to obscure depths. No amount of snow can fill the chasm permanently, though it may be bridged with fresh snow for a time, making a risky passage for the climber.

The *neve* is always pulling away from the rocks at its upper border, and its general motion follows the direction of the lowest depression beneath, finally extending below snowline as a tongue of ice which reaches down into the valley until it is melted by the increasing warmth of the lower levels. Thus a glacier is born. Unless whitened by recent storms the glacier is bare of snow in summer with a rough uneven surface of a dirty blue green color, partly covered with rocky debris, and its volume diminishes downward by thawing until at a definite point the whole is melted and flows away as a river of water instead of ice. The lower end is sometimes called the "tongue" or "snout" or "foot" of the glacier—a bad case of mixed metaphors.

Remembering that ice is a hard and brittle solid, it comes as a surprise to find that it can flow like a plastic body under the pull of gravity; but this can be easily proved. A row of stakes or of metal plates put across a glacier gradually gets out of line, the middle parts moving fastest as in a river; but the motion is very



A. P. COLEMAN, Ph.D.

slow, even in the middle, seldom more than a few inches a day in our mountain glaciers, though some of the great Alaskan and Greenland glaciers are reported to move several feet a day and in one or two cases as much as 60 or 70 ft.

At a sudden descent, where a river would leap as a waterfall, a glacier simply breaks across in what are called *"crevasses,"* fissures which may be several feet wide and hundreds of feet long, going down to blue black depths appalling to the inexperienced climber. As the glacier advances these crevasses are bent out of shape and may be crossed by fresh crevasses, splitting up the ice into wild lumps and pinnacles called *"seracs."* Seen from a distance across some valley such an ice fall looks like a cascade or a violent rapid covered with breakers. Below these steep descents the crevasses and seracs disappear by the pressure of the moving ice and the glacier becomes a solid mass again. Small glaciers hanging from cliffs may send down avalanches of ice which combine to make a lower glacier, the masses being welded together once more. It is evident that one cause of glacier motion is the power which ice has to break and then to freeze together again.

Since glaciers are often the easiest way up a mountain, climbing parties make use of them, starting at dawn so as to have a long day and following up the rough and rigid slope, zigzagging round crevasses and avoiding regions of seracs. Toward the upper end there may be fresh snow bridging the crevasses and the party should be roped together and travel in single file, the leading guide thrusting his ice axe into the snow at every step to make sure of safe going.

When the sun shines warmly on the glacier melting begins and water trickles down the ice ridges, and towards afternoon torrents of pale blue water are racing downwards in ice channels, here and there plunging into a crevasse. This becomes hollowed into a tube like the penstock of a water power and the foamy torrent springing into the blue chasm is called a "moulin," or mill. In this way the waters thawed from the surface reach the bottom and there roar along through an ice tunnel to the end of the glacier, bursting into daylight as a full fledged river.

Glacial streams are capricious. On a frosty morning scarcely any water flows and one can go far into the ice cave, but in the late afternoon there is a raging torrent loaded with mud and stones spreading into half a dozen channels on the broad floor ground. On a rainy or snowy day when the sun is hidden the glacial river almost goes out of business, but comes to life again when the clouds vanish and the sun shines. At those heights with a clear sky the heat of the sun may be intense though it is freezing a few feet away where some rock casts a shadow.

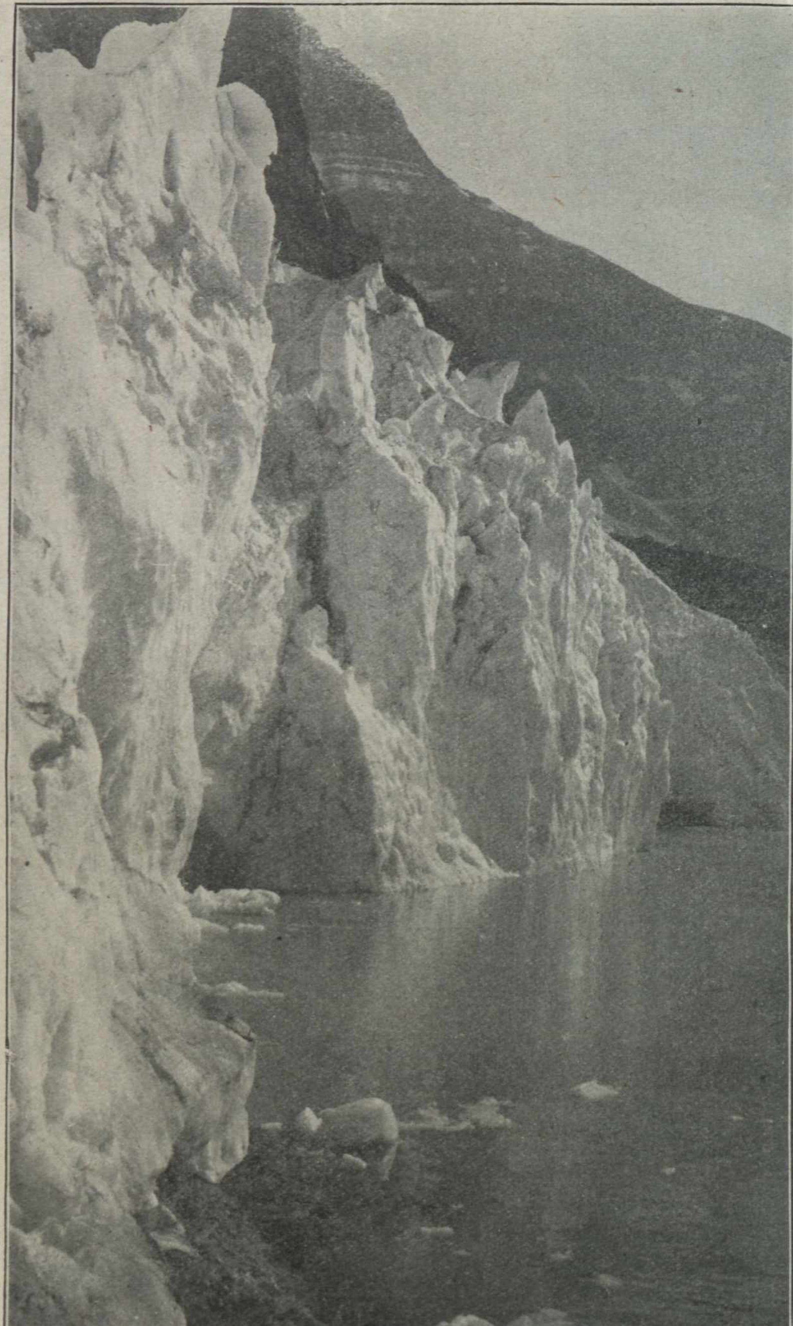
The Work of Glaciers.—One of the most interesting points in a glacier is its carrying power. Though it is in motion like a plastic substance it is solid and strong enough to support any weight loaded upon it. Debris quarried by frost from the mountain side buries its edge so that often one may walk 50 yards out before the ice can be seen. This fringe of broken rock carried on the edge of the glacier is called a marginal moraine. When two glaciers join, the marginal moraines between them unite to form a medial moraine, and when several tributaries combine to make a large glacier the dark lines of the medial moraines can be followed by the eye for long distances upwards to rocky peaks rising out of the *neve*, the source from which the train of rocks was derived.

Blocks even as large as cottages now and then roll down upon the ice and are transported without trouble. Medium sized blocks a few feet across called "glacier tables" are left standing on pedestals of ice, as thawing goes on all round them, since they protect the ice beneath from the sun.

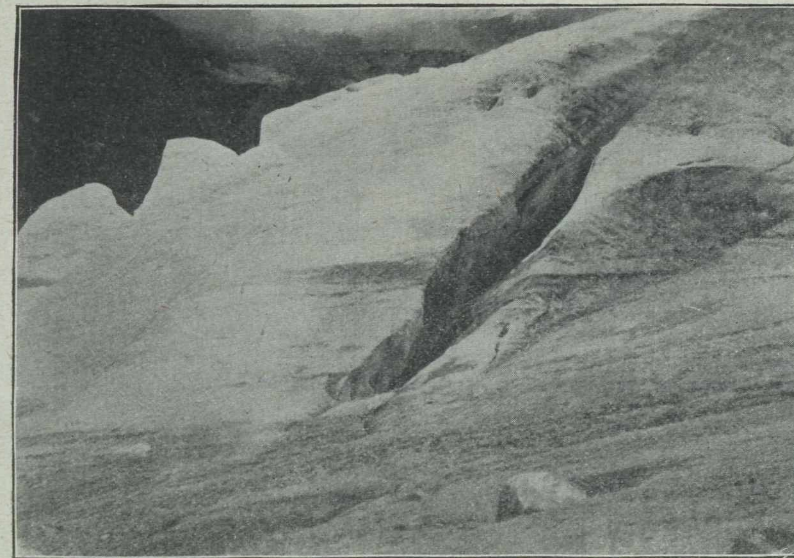
The whole mass of stony material is carried steadily onwards until the end is reached where melting is complete and no more burdens can be borne. Then a terminal moraine is piled up, a steep and rugged crescent of loose blocks by no means easy to scramble over.

Work just as important is going on out of sight beneath the glacier, where fragments of stone frozen into the bottom of the ice form tools for gouging, carving and scouring the rocky floor, both tools and rock being ground up into the "rock flour" that makes the glacier streams so milky and opaque. The ground up material mixed with stones of all shapes and sizes without any assortment is left behind when the glacial thaws as "boulder clay." A little search in this clay shows stones with polished and striated surfaces, well worn tools, often called "soled boulders" and the rock surface beneath the boulder clay is seen to be rounded, smoothed and grooved in a very striking way.

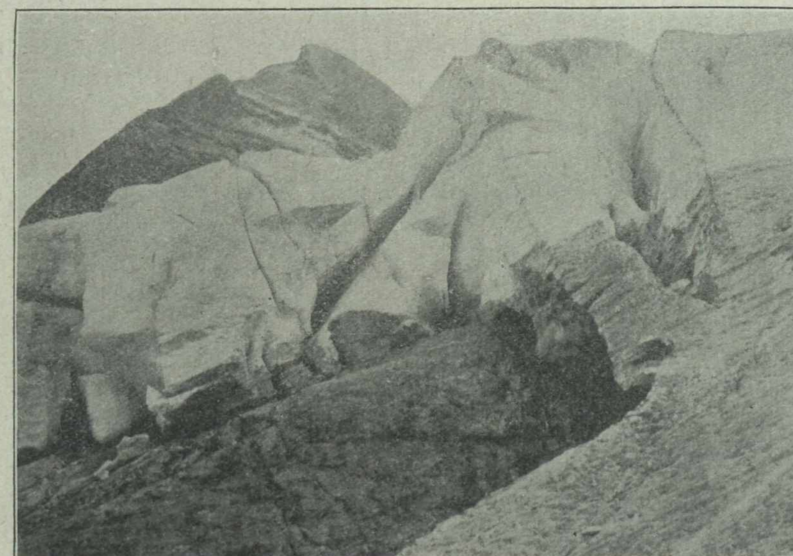
The Retreat of Glaciers.—Our glaciers, like those of other countries, are now almost all in retreat, either



Front of Tumbling Clacier on Berg Lake



Crevasse on Great Glacier



Ice Bridge on Illecillewaet Glacier

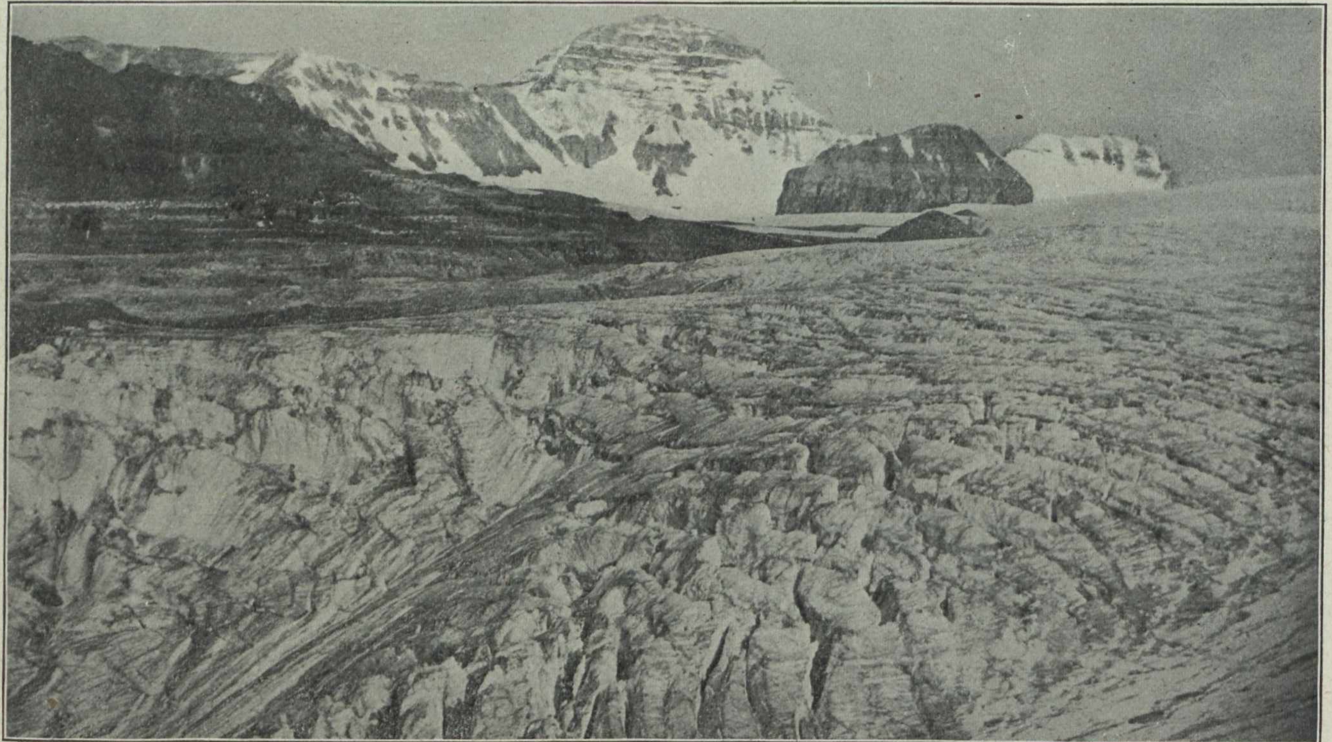
because the climate is slowly growing warmer so that thawing goes on faster or because the snowfall is lessening so that the *neve* fields no longer feed the glaciers as substantially as before. On this account one can often see several terminal moraines down the valley below the one now forming. The nearest to the present end of the ice is almost bare, the next, a few hundred yards away, may have bushes growing on it, and others a mile or two away may be covered with ancient forest.

Glaciers once filled all the mountain valleys and even pushed out through the passes into the prairies and through the fiordes to the sea, for everywhere one finds boulder clay and moraines and valleys with U shaped cross sections that can only be accounted for by glacial action on a large scale. This work was done during the Ice Age, and one may truly say that the higher mountains are still in the Glacial Period.

One of the most beautiful results of former ice action is to be found in the "cirques," half Kettle or arm chair valleys, high up among the mountains overhanging the main valleys and enclosed by vertical cliffs on all sides except in front. These are the deserted nests of cliff glaciers, hollowed out by ice itself and often deepened so that a turquoise blue lake lies within rock rims. If not too high up these cirque lakes are surrounded by evergreen forest, behind which rise the grey or purple walls of rock with some snow in the ravines above, the whole mirrored in the lake, until some catspaw of breeze shatters the reflection. Lake Agnes in the mountains behind Lake Louise is an easily reached example of a cirque basin, and there are hundreds of others scattered through the fastnesses of the mountains, all gems in their way, many not yet seen by the eye of a white man. The higher cirque lakes, above timberline, enclosed only by cliffs and snow, have an austere beauty of their own, but lack the graces and the wild flowers of their sisters below in the forest zone.

Often the walls of such valleys are leaped by streams from some melting snowfield falling hundreds of feet and reaching the bottom as mere threads of spray.

Rocky Mountain Park.—There are very few parts of the world where fine glacial scenery can be found so close to a great railway as in our mountain parks. If one stops at Lake Louise, in Rocky Mountain Park, the splendid Victoria glacier is in view doubled by reflection in its waters, which get their exquisite color from the last remaining particles of mud brought down by the glacial stream. Two miles walk or ride along a good trail brings one into its presence, and often great masses of ice may be seen avalanching down from cliff glaciers above to the surface of the lower glacier. From Lake Louise as a centre one can reach the well named Paradise valley by ten miles ride or drive over a good road and visit the fine Horseshoe glacier at its head. The valley of the Ten Peaks farther to the southeast requires a somewhat longer ride or drive, passing the splendid front of Mt. Temple, the highest summit in sight from the railway (11,626 ft.). Moraine lake, eleven miles from Lake Louise, lies near the entrance of the valley, but farther up can be seen the great Wenkchemna glacier, and several small glaciers lying between the Ten Peaks. Beyond the Ten Peaks to the south there is a broad snowfield and glacier leading over to Prospector's valley and Vermilion Pass, but for an excursion of such length and difficulty one should be equipped for serious climbing and have a light camp outfit.



Crevasses, Glacier Southeast of Ten Peaks

From any high point west of Lake Louise one can catch glimpses of a much larger snowfield towards the north near Mts. Daly and Balfort, but the glaciers flowing from it are not so easily reached as those to the south of the railway.

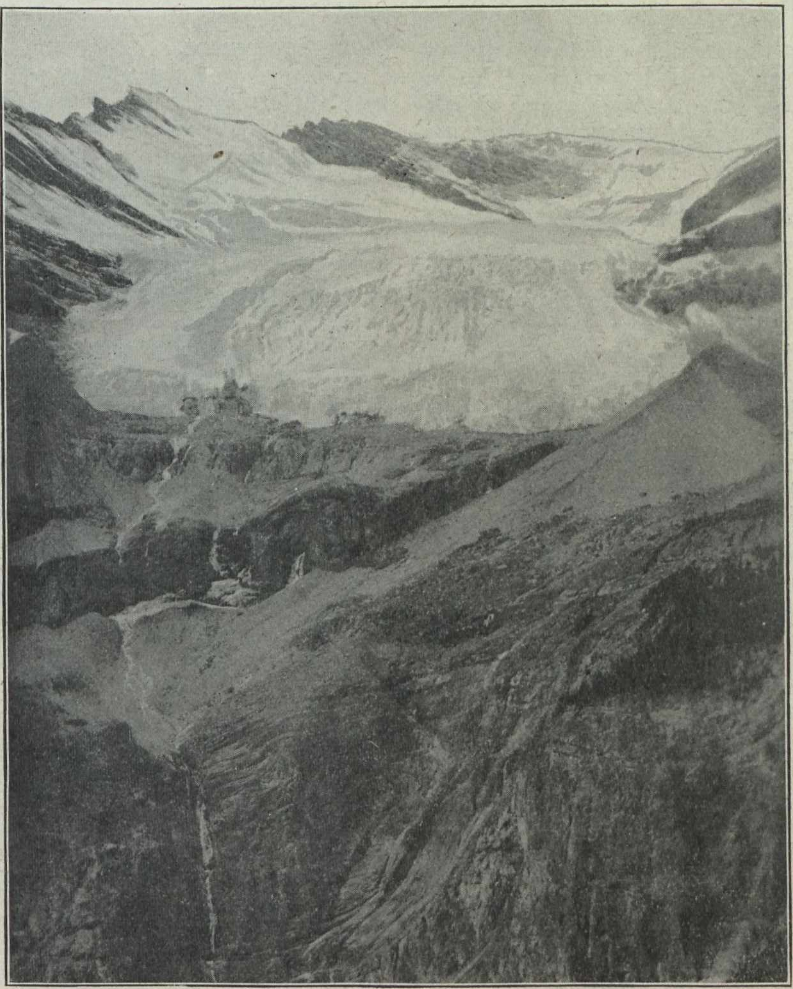
There are glaciers in sight during most of the descent by rail from the summit of the pass through the wild Kicking-horse valley to Field, in the Yoho Park, from which the Yoho valley may be visited with Yoho glacier at its head. Descending beyond this into the warm depths of the Columbia valley the Alpine type of scenery is lost for a time. As the railway climbs laboriously westwards out of the valley into the Selkirks, Glacier Park is entered. Here the scenery grows more striking until at Rogers pass one is once more surrounded by snow peaks—hidden, alas! too often by the long snowshed. The five mile tunnel now being pierced to avoid the heavy grades of the pass will cut out many a ravishing view of snow peak and ice tongue; but a stay at Glacier, just beyond the pass, gives an unrivaled chance to study a fine glacier with the least possible trouble.

The Illecillewaet or Great glacier is only a mile and a half from Glacier station, and as its foot may be reached with very little climbing, more travelers visit it than any other glacier in Canada. A climb to Mt. Lookout just west of the glacier gives a magnificent view over the Illecillewaet gacier and *neve* and over the grand mountains surrounding it. This region was the first part of our snowy mountains to be carefully explored and mapped by a skilful climber. The Rev. W. Spotswood Green made Glacier his headquarters for this work in 1888 and published his interesting book "Among the Selkirk Glaciers" in 1890.

There are still finer snowfields and glaciers in the little explored region to the north around Mt. Sir Sandford, the highest point in the range (11,634 ft.), though these are out of reach for the present; but any of the higher peaks near Glacier give a marvelous view over a wilderness of snow and ice broken by cliffs too steep for snow to lie.

Some of the lower points of the Selkirks, just west of the Columbia valley, though not more than 7,000 or 8,000 ft. in height, face the opposite Rocky Mountains with 100 or more glaciers in sight at once, the view beyond the wide and deep valley sweeping 150 miles of the main chain on its snowy western side. Unfortunately up to the present no path has been made to such a lookout point, and the dense forest makes the ascent difficult.

The greatest *neve* in Canada, so far as known, is the Columbia snowfield covering 100 square miles and sending tongues of ice down into a dozen valleys, but this is 80 miles northwest of Lake Louise and can only be visited with a camp outfit and pack train. Its northern limit will be within the new boundaries of Jasper Park and some day a good road will lead through the mountains past this splendid glacier region from the Grand Trunk Pacific to the Canadian Pacific opening up to the public the finest glacial playground in Canada.



Glacier on President Range, Yoho Park

The Robson Region.—The beauties of the Louise, Field and Glacier regions on the Canadian Pacific are well known to the public and have been seen by thousands; but the exceedingly impressive glacial surroundings of Mt. Robson near the Yellowhead Pass on the Grand Trunk Pacific have so far been little visited. Mt. Robson, rising 13,087 ft. above the sea, the highest point in the Canadian Rockies, is invisible, from the pass itself, hidden by the nearer Rainbow mountains; but bursts upon the view where Grand Forks river enters the Fraser. Only a few miles away at the head of the low valley its tremendous cliffs, mostly too steep for snow to lie, rise for 10,000 ft., crowned with a snowy pyramid. A trail leads up the Grand Forks through the valley of a Thousand Falls where the main river tumbles 1,500 ft. in a wild canyon and reaches the rear side of Mount Robson 5,700 ft. above the sea. From some low mountains to the northwest there is perhaps the most splendid view in North America of mountains, glaciers and lakes. The blue seracs of the Tumbling glacier seem to be rushing down thousands of feet from the Helmet and the main peak of Robson to plunge into Berg lake, which doubles them by reflection. To the left the main glacier, starting in great icefalls on the northeast of the peak, sweeps a curve of five or six miles round the dark rocks of the Rearguard. Behind the main glacier toward the south rises the unbroken snow slope of Mt. Resplendent ending with a projecting cornice of snow at 11,000 ft.

The water coming from the ice caves of the main glacier flows chiefly into Berg lake and the Grand Forks, but a smaller part reaches lake Adolphus and Smoky river, a tributary of the Mackenzie river, the same glacier sending tribute to the Arctic and the Pacific Oceans.

There are other striking mountains in the region, such as Mt. Geikie to the south of the Yellowhead pass and the Whitehorn to the north, though none rival Mt. Robson itself; but much remains for exploration and it will be years before this northern region of the Rockies, all the Alberta side of which is in Jasper Park, is thoroughly known and mapped. Trails are being rapidly built in the park, however, and with the erection of hotels at Jasper and other points it will soon be possible for the Alpine climber and the tourist to find easy access to this delightful region.

Some comparisons.—Much of the exploration of the Canadian Rockies and Selkirks has been done by Englishmen and eastern Americans who received their training as mountaineers in the Alps, and one naturally asks why they should travel thousands of miles to our western mountains when the Alps are so much more accessible. There is, of course, the charm of a virgin and unexplored wilderness in our Rockies and Selkirks, so seductive to one who loves adventure; but there are other attractions as well which make our mountains fully the equal of the famous European range. Every type of Alpine scenery is as well illustrated in Canada as in Switzerland and the area of snow mountains in Alberta and British Columbia is several times that of the Alps. The whole length of the Alps is less than 400 miles and its breadth from 50 to 80, as compared with a length of 1,200 miles and a breadth of 140 miles for the Rockies and Selkirks, not to mention the Gold ranges, the Coast range and the Vancouver Island mountains, all of which have their snow fields and glaciers. Stuttfield and Collie in their delightful book "Climbs and Explorations in the Canadian Rockies" say of the Rockies that "they have a remarkable individuality and character in addition to special beauties of their own which Switzerland cannot rival."

Though there are higher mountains in the Rockies of the United States, they rise from a dry and lofty tableland and most of them have little snow and no glaciers. But for the row of extinct volcanoes beginning with Mt. Baker, Mt. Ranier and Mt. Shasta, the United States has very little truly Alpine scenery except where our Rocky Mountain ranges extend for a degree or two south of the boundary. A great many of the mountain climbers of the eastern States come to Alberta or British Columbia when they want to use an ice axe or a glacier rope and most of their experienced climbers are members of the Alpine Club of Canada.

Canadians themselves are often not aware of the splendid scenery and the unsurpassed opportunities for climbing of all grades of difficulty offered by their own mountains. There is no more exhilarating sport than that of the mountaineer, and there is no more interesting region for the geologist, the botanist or the zoologist than the grand ranges of mountains that run parallel to the Pacific in our western territory. While tourists from all over the world are being attracted more and more to our glorious alpine region it is especially important that our own people should seek a delightful holiday and gain health and vigor in our mountain parks. As good roads and trails and cabins for shelter are extended to the wilder and more impressive parts of the mountains it becomes easier for the ordinary visitor to study the sublimities of valleys, glaciers and mountain peaks once out of reach without an expensive camp equipment.

A few good Swiss guides are available at the more important centres in the mountains and the inexperienced climber should not undertake any difficult glacier work nor bad rock-climbing without the aid of a guide. There is of course a wide range of less difficult walks and climbs that brings one without risk into the heart of the mountains where one may study the ways by which snowfields and glaciers and glacial rivers do their work of shaping the mountains.

The materials of engineering construction will receive special attention in the proceedings and discussions of the International Engineering Congress to be held in San Francisco, September 20-25 next.

The field will be treated under 18 or more topics, covering: Timber resources, preservative methods; brick and clay products in general; life of concrete structures, aggregates for concrete, water proofing, volume changes in concrete, world's supply of iron; life of iron and steel structures, special steels, status of copper and world's supply, alloys, aluminum, testing of metals, of full sized members, and of structures.

Some 25 papers are expected for this volume, prepared by authors representing five different countries. The list of authors includes many of the most eminent names in this field of engineering work throughout the world.

These papers, together with discussions contributed by leading American and foreign engineers, will be published as volume 5 of the transactions, and will be illustrated with charts, diagrams and half tones. The volume will form a most valuable acquisition to the library of all engineers and others who may be interested in these phases of engineering work. For full particulars apply to W. A. Cattell, secretary, 417 Foxcroft Building, San Francisco, Cal.

FIRST COAL DISCOVERED IN UNITED STATES.

Up to the present time the first mention of coal in the United States has been credited erroneously to Father Hennepin in 1689. The credit for this first mention of coal does not, however, belong to Hennepin, for the first discovery of coal in the country which afterwards became the United States was made by Joliet and Marquette in 1673. Joliet's map of 1674 shows the location of "charbon de terre" (coal) near the present city of Utica, Illinois.

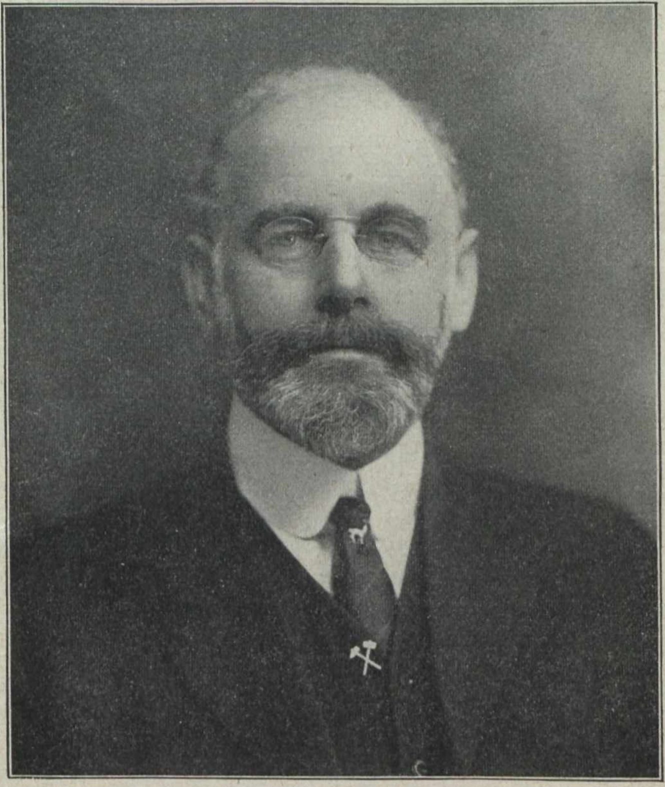
In Coal Mining Practice in District 4, Bulletin 12, of the Illinois Coal Mining Investigations, by S. O. Andros, copies of Joliet's and Marquette's maps are published.

This district produces about 15 per cent. of the coal output of Illinois and has the best accident record of any Illinois district. About half of the accidents occurring in this district are caused by pit cars.

THE MINING ENGINEER*

By James F. Kemp.

I do not feel like a stranger in the Copper Region. Nearly thirty-two years ago my class in the School of Mines at Columbia was brought to Houghton and Hancock for six or eight weeks in the mines. My chum and I put in our days at the old Albany and Boston mine, which was later known as the Peninsula. But we also made the acquaintance of a "man-engine" in the Quincy, and saw the close and successful work being done on the low grade amygdaloid of the Atlantic. In the years since I have been once or twice with classes in Houghton and recall with great pleasure one long morning with dear old Dr. Koenig and his mineralogical treasures. To his memory, greatly treasured by us all, let me pay this little word of tribute.



JAMES FURNAM KEMP

All of us who are interested in mining and its fundamental science of geology must feel that Keweenaw Point is classic ground. We are reminded of the early expeditions of the French, in parties from the lower St. Lawrence valley, consisting usually of a missionary priest, of a gentleman adventurer and of comrades not adverse to trading with the Indians. Probably you all have seen in Foster and Whitney's Report the reproduction of the early map prepared by the Jesuit Fathers in the seventeenth century and sent back to France. Lake Superior, or Lake Tracey, as they then called it, is very correctly drawn as regards all its larger features, so correctly in fact, that our admiration is greatly excited by the close and accurate work of these "voyageurs," so many thousands of miles from home in the bleak wilderness. We read of their reports of copper among the natives and of the hopes of a mining industry in future years. Copper on Lake Superior and lead in southeast Missouri and in the Upper Mississippi valley were no small influences in the early colonial days. But who can say how far back prehistoric mining by the native tribes began, or how many centuries ago the blows were struck with those stone hammers which now from time to time we find on the outcrops of the lodes.

We people to whom mining geology means so much cannot be unmindful of the early work of the Foster and Whitney Survey, nor above all and in particular of J. D. Whitney's contributions, since he was the forerunner and father of us all here in America. I wonder if you have read the fascinating book of his Life and Letters, published within a few years past. In it we are taken behind the scenes and actually see the struggles of scientific men amid the forest trails of the Point and the storms on the lake. We sympathize with their lack of maps, as they tried to prepare a good and accurate description of the geology. Whitney was storing up experience and with the spirit of an apostle to the ignorant was preparing the data for his monumental work, "The Metallic Wealth of the United States." Among his countrymen, ignorant as babes of mining, he sought to spread in 1854 sound information regarding their material resources and the proper and reasonable development of them. While Whitney had done some youthful geological work in New Hampshire and had studied abroad, we can readily see that the main courses in the foundation of his later work were laid in the copper and iron regions of the Lake Country.

We have had another book within the last few years that is of unusual interest to all concerned with mining on the Point, and I doubt not very familiar to you all. It is the Life and Letters of Alexander Agassiz. In it we learn of the tremendous struggle which was undergone in the early years to place the Calumet and Hecla on its feet. Far be it from us who have seen the later prosperous days of this queen of copper mines to be unmindful of the heroic years which marked its development, or of the courage, faith, persistence and devotion which carried it through the initial stages.

I mention these qualities because they are characteristics which must be possessed by an engineer to a degree hardly equalled in the sister professions, and by the mining engineer pre-eminently among the different types of engineers. I wonder if you have ever thought of the contrasts which our profession offers to other branches of engineering. Almost all of our colleagues, civil, mechanical, electrical, are set to accomplish definite tasks. They build a railroad, design an engine, construct a dynamo or a power station. A problem in construction is theirs, and the elements of it are usually well known and definite. But we often have to discover and develop ore as we go along. We do not always know where it is ahead of us in the rock, or indeed if it is there at all. We are much more like the physician diagnosing an obscure disease. Our medical friend looks the patient over, learns symptoms, and infers causes. The X-ray photographs may help him immensely and give him a look at hidden organs or bones, but after all, he needs a peculiar and keen intuitive reasoning power that is a rare and very great gift. The medical schools prepare him not alone by information and disciplinary training, but also by

*Address to the Graduating Class of the Michigan College of Mines, April 15, 1915.

clinics, wherein he sees just such cases as he is likely to meet, treated by skilful men who may even give him bedside practice.

We mining people have to deal with cases of abnormal conditions in mother earth. We have to treat stoppages of circulation and their results, strongly analogous to varicose veins in the suman subject. We must now and then solve compound fractures and dislocations, not of a half an inch, as in bones, whose sundered ends cannot slip very far past each other, but of tens or hundreds of feet into the unknown. Comparing our work with the surgeon's, we have the one comfort that only in our imaginations do we have to put the broken parts back in their old, united positions. We may have only a little stringer to guide us, or the "trail" of the fault in a fault zone, or a slickensides, or a gouge of clay. In treating these difficult cases we must call to our aid all the lore or ore deposits. You remember how those old German mining geologists centering about Freiberg and Clausthal have written of the "Lehre der Erzlagerstatten," of the "Lore or Ore Deposits," and how we English-speaking peoples from the days of the old workers in Cornwall to the present have passed along with successive additions the accumulating experience of the past. Always in the back of our minds, for the ordinary run of orebodies we have the belief that some sort of solution has found a line of circulation and has brought in the useful minerals. We try to reproduce in our minds the way the old solutions behaved and to explain why they followed the special channels that guided them. We constantly seek the cause or conditions that made them drop their burdens of dissolved minerals at some places and not others. Sometimes an intersection of fissures may have led solution and precipitant to mingle. Sometimes an open-textured, relatively soluble rock may have itself served as precipitant. Sometimes loss of heat and waning pressure seem to have influenced uprising heated solutions, which Agricola nearly four centuries ago called the "juice of the earth," and which we often call to-day the "juice of the magma." These or similar questions are in our minds when one orebody is exhausted and we have to look for others.

Some orebodies resemble troubles in the human system for which the physician prescribes in the ordinary run of practice. But there are other cases which call for the surgeon. Let us suppose that our orebody is cut off by a fault; we need then to know how faults customarily move and how we may decide where to look for the lost continuation. What are the trail, the drag, the slickensides, the gouge, the fault breccia and what do they mean? What do our old-time authorities tell us—Schmidt, the Swede, and Zimmerman and V. Carnal, the Germans, and in recent years Freeland, our fellow countryman? We must not be too much taken up by the machinery used in mining and its enormous development in later years, and be unmindful of the old accumulated experience of the fathers gained in many years of laborious underground work. Hoover's translation of Agricola's Metallic Wealth has placed at the command of all English-speaking peoples a wealth of ancient learning brought together by Agricola about three hundred and sixty-five years ago. You would be surprised, if you have not read the book, to note on looking it through how much the ancients were like the moderns, and how very acute they were in their observations and inferences. Even our devices for hoisting, pumping and ore dressing are foreshadowed in Agricola's pictures. The miners and metallurgists of his day had no steam power, nor did they understand chemistry as based on the atomic theory, much less the doctrine of ions; but they utilized the forces at their command with rare skill and they usually left singularly clean slags, when they had reasonably simple ores to smelt.

But I did not mean to digress too far in speaking of our predecessors nor to do more than to urge you to hold them in grateful and appreciative remembrance. We are living in the present and after the preparation in the professional schools we each have a man's work to do in the world.

In all our schools we have professors of the various sciences and of the arts involved in mining and smelting, and yet there is one professorship which we do not have, despite the fact that we might almost think it the chief chair of all. I have in mind a chair of that indefinite thing or body of personal experience or attitude of mind towards one's fellows and associates which we sum up in the term "Life." You see we are not machines whose horse-power can be calculated and which run on their monotonous round until they wear out. Back in the late eighties I passed five very happy years in the faculty at Cornell. My old friend and older colleague, Professor R. H. Thurston, the director of Sibley College in those days, used to rather enjoy defining a man as an engine who could consume a certain amount of fuel under his boiler and deliver a certain amount of work from his muscles and brain. But we know very well that this is only a half-truth. A man has a personality, a spirit, a disposition, a character, a sphere of influence, that are quite distinct from the number of shovelfuls of ore that he can heave into a car if he is mucking, or the numbers of traverses he can turn off if he is surveying. It makes no difference to an engine whether its nearest neighbor is ten horse-power or ten thousand, or whether it has a cut-off or a simple slide valve, or whether it was built by Nordberg or Leavitt or Lidgerwood. But it makes a world of difference in a community of people whether a man in power is considerate, just and sympathetic; or whether he is unscrupulous, selfish and faithless. Or whether again he who is a leader is easily discouraged, or is disposed to lie down on the job, shirk responsibilities and take duties lightly. All these matters are of exceptional importance to a mining engineer, who may as he gets on in the profession be not only in charge of the technical work, but if he is in a remote community, may be mayor, board of aldermen, school commissioner and provider of food and clothing.

In the summer of 1910 the eleventh International Geological Congress was held in Stockholm, Sweden. Our good friends in Sweden planned an excursion for the visiting delegates, which would take them northward through the most interesting of the pre-Cambrian exposures and would let them see the great iron mines at Kiruna, then under full headway, although about one hundred miles north of the Polar Circle in Lapland. You may not all know that you can travel every day of the year in a good standard gauge train, with sleepers and diner, from Stockholm north to far within the Polar Circle, and come out at Narvik on the coast of Norway, where the harbor never freezes. We delegates to the Congress found ourselves one day in Kiruna. We were conducted along several miles of outcrop of a great sheet of extremely pure magnetic iron ore with a general average of one hundred and fifty feet in thickness. The ore forms the backbone of a high ridge, but it is fully six hundred feet from wall to wall, where the ridge falls away to a cross valley and lake. On this broad end the chief mining is being done in terraces. The ore is generally believed to be an igneous sheet. Many who have seen it consider it the largest single mass of iron ore yet discovered. It is, moreover, very rich in iron, although also high in phosphorus.

The development of this ore body is chiefly due to one man, Mr. Hjalmar Lundbohm, formerly a member of the Swedish Geological Survey, and for many years a good friend of not a few of us here in America. Mr. Lundbohm is now the chief official in the company, which in good years ships four or five millions of tons of ore. For several years he had saved the very peak of the orebody to be blown down when the Geological Congress should be his guest. And one evening about nine o'clock, but in daylight as bright as noon, while we were having coffee on the lawn before his house, perhaps half a mile from the peak, President Van Hise of the University of Wisconsin pushed the electrical button and caused twenty or thirty thousand tons of ore to fall with a crash.

At noon, however, we had lunched on this very summit and for a little while I had sat down somewhat apart from the rest and had studied over the bleak expanse of lake and bog and low glaciated hills which stretched away from the foot of the ridge. Under ordinary conditions only Laplanders with their herds of reindeer could eke out subsistence in the land, and yet below me was a little city of eight or ten thousand souls. There were a thousand children in the schools. The long night of winter had to be overcome with light. The polar cold had to be fought with fuel, and the nearest coal is in England, or in Spitzbergen, where lately Mr. Scott Turner, one of your own graduates, has been developing it. I looked over Kiruna and thought of the manifold responsibilities which centre in Mr. Lundbohm, and how in other places the manager, or as you say on the Point, the agent of a mine, is the head of a little state. I could not help feeling that there are other sides to the profession than ore and rocks, sinking, stoping and concentrating, oil flotation and smelting. There is the care of men, women and children, and the oversight of their manifold needs and general good. Yet what I saw at Kiruna, Lapland, impressive because so far in the frozen north, could in earlier years be duplicated right here on the Point and in the iron ranges, and doubtless can be yet. In the little settlements of the West there are many cases where a mine supports an entire community, and as for Mexico and South America, any one of us of wide acquaintance can cite graduates of our mining schools who bear the same relations to their villages and towns that Hjalmar Lundbohm bore to Kiruna. He had established at Kiruna, with a singularly generous spirit, schools of the very best character, with cheery pictures on the walls and with the best of desks and apparatus. Comfortable homes were provided for the miners and their families and much kindly attention was given to matters of welfare.

Yet with all these provisions for material and intellectual welfare, there is one other side which we cannot overlook, and that is—amusement for idle hours. We never trouble our minds about a man when he is busily at work, but we are justly concerned about him when his day or night shift is over. For miners who are underground during their working hours in dark and often wet stopes and drifts it is of more importance than for other workers to have some sort of wholesome recreation available whereby to pass an enjoyable evening. If, as we all have seen in little remote settlements, there are only the boarding house and the bunks, we will find the miner storing up his craving for a change until the end of the week or month, and concentrating in a short, wild period what should have been taken in diluted and harmless instalments over days and weeks. The Young Men's Christian Association is taking up the matter vigorously and agitating the establishment of club houses which will supply social centres, often in charge of a specially qualified worker. In the American Institute of Mining Engineers we have during the past year been lending a very sympathetic ear to one of our officers, Fred Rindge by name, and an engineer by training, who is specially looking after the work in the mining communities. You will find in the papers of the last annual meeting a contribution by J. Parke Channing strongly favoring the movement.

And yet we must undertake these welfare movements prepared to be misunderstood and to find our best intentions regarded at times with suspicion and disfavor. Experience leads us to expect it, but we must be strong enough, and far-sighted enough, and persistent and unselfish enough to work discreetly and wisely for the good of a community depite the rebuffs.

I have endeavored to draw, and I hope you will feel with some justification, the parallel between the mining engineer and the physician. But there are other features of a mining engineer's work which we must not overlook. He is a sort of combination of overalls and dress suit and he has to be equally at home in either. He must put on the former if he is to know both what lies underground and what goes on underground. Several years ago I was out in Butte one summer with H. V. Winchell, one of your old-time Lake Superior men, and J. W. Finch, of Denver. We were looking over the geology of the Steward mine with great care. Now in the fault veins at Butte, through which, as channels, have certainly coursed great flows of hot waters, a soft clay gouge is very abundant. In old and wet workings it makes an emulsion or a thin syrup of fine particles that is first cousin to paint. We three had crawled through the old drifts of this character all day and had come up about four-thirty in the afternoon, so as to step off the cage just as the "Seeing Butte" car had deposited its load of eastern schoolmarms and various other kinds of tenderfeet, all in charge of an orator with a megaphone. The Steward was the mine to which they were customarily taken. "Ladies and gentlemen," said the orator, "this is the Steward mine where many of the wretched miners work far underground, whose little cabins I showed you out on the flat. It is wet and dirty underground and—" catching sight of us, "there's three of 'em now." We certainly looked the part and tried to keep straight faces until we could slip into the change house.

What we had seen, however, embraced three sets of remarkable faults, which had developed one after the other. We had seen the oldest vein displaced by the next, and it shifted off one side by the last. We had been so keen in the study of this geological structure that I do not believe it had occurred to one of us that our surroundings were wet or dirty. As my colleague in mechanical engineering at home once said in my hearing, "When we are working over an engine in our overalls and in the grease and heat, we never think of either of them. It's the idea that fills our minds. The design or plan that makes the engine go excludes all else." And so it is with us amid the discomforts of the work, if we may call them so. We forget them, our minds are so filled with the systematic attainment of results or with the study of the geologic structure of the veins, or with the forecasting of what will happen to our ore on the next level, or with the needs of the community of workers, or above all with satisfying the board of directors on whom, back in the central office somewhere, the manager must always have a wary eye.

With the last consideration, the dress-suit side of the profession comes in. Not only must our man in authority look out for his miners, but he must be just as ready to meet his directors on equal terms. He may live most of the months in the remote community, but with the revolving year comes around the time of annual reports, of conferences, of presenting in person the results of operation; it may be also of hospitalities extended and social courtesies, of meetings with the Institute of Mining Engineers and mingling with one's fellows. And then we have to shed the overalls in favor of the dress suit. One must guard against too much overalls, and not let the stiffly starched bosom choke too hard at the neck because of disuse. Some young engineers are a little inclined to overdo the overall phase of the profession, whereas we should be good companions with all sorts and conditions of men.

Commencement is a time of changes and of breaking old ties and associations. Perhaps you will not mind, if, as one not too far removed from his own experiences of the same sort, I touch upon them for a few moments. I am moved to do so from another bit of experience that was gained in those years at Cornell, earlier mentioned. It was the university's custom to have a Sunday afternoon sermon in the chapel. The most eminent ministers available were invited to preach. Now as we faculty people listened to the sermons Sunday after Sunday we could see that almost always the clergyman said to himself: "I am going up there to address a university community. I must prepare a careful essay on the problems of modern philosophy or science or human destiny. I must not disappoint that audience or fall below its expectations." But had we been given the opportunity, we university people could have said to him: "My dear man, we have all those themes six days in the week in the class room. Sometimes we like to forget them." One afternoon there appeared in the pulpit a clergyman from Louisville, well along in years. With no evidence that he was making the supreme effort of his life, he talked to us in a kindly pastoral way of the experiences which fall to the lot of every one of us. He obviously was animated by love of his fellow man and what he said came naturally and was welcomed in full measure by those who heard him.

I am far from being able to speak from any such ripe experience or in any but small degree to take the same position. We engineers, moreover, are men of quasi-military training, and we have a haunting dread lest our emotions get the better of our judgment—lest in moments of excitement or lack of attention we read our transits or compasses wrong and make a mistake. In engineering, whatever else we do, we must not make mistakes. Too much depends on our being right. Nevertheless, we can talk over the things that fall to the lot of us all.

To my mind the most trying time with all of us is at the start. Almost every young engineer has several unsettled years before he finds a permanent place. While this experience is not invariable, it is the rule. The entrant into the profession is getting experience and is taking a course in that subject of "Life" for which we have not and cannot have a professorship. In the long run, however, all the years total up their contribution to the final result and most men of maturity are loathe to admit that any of their experiences have been without final use. It is not a bad plan for a young engineer to look himself over and see what value he would really place upon himself to his company. It takes time to get broken in and to learn the routine. No harm is done in assuming the employer's point of view and seeing if, with conditions reversed, we ourselves would give any more for the service. Every one and especially the beginner may properly wish to give full equivalent for compensation received. A subordinate may often wisely in his imagination put himself in the position of his chief, live his daily round, think over his responsibilities and harassing cares, and then see what can be done to make them a little less burdensome. Most of the men whom we know, partly from individual characteristics, partly from the pull of outside influences, come to revolve in fairly definite orbits. If we secure and use a sufficient number of observations, we can calculate a particular orbit, just as do the astronomers in dealing with a planet. We can with a little study and foresight know where to find our man at different times of the year and under the circumstances produced by any conjunction of known forces supplied by outside influences. Can a junior thus forecast what his chief will need and be unostentatiously ready, and can he avoid asking too many pestiferous questions of a busy man, he will certainly secure the appreciative gratitude of his chief. Let me whisper to you that even among professors often kept under keen nervous strain by the demands of classes and by the consuming desire to have their subjects understood by the young people before them, the foresight of an assistant who knows where all the specimens or apparatus are that are to be used in illustration and has them ready without undue oversight, comes as balm to excitable nerves.

Work after leaving the engineering school is on the whole rather less difficult than the exacting requirements maintained by our good institutions. There is less variety but more intensive effort of the same kind. The young engineer often misses the keen intellectual stimulus provided by his association with his classmates in the courses. He finds that his work calls less for the full exercise of all his powers. Once some years ago I made a quick trip to give a little lecture on gold mining in a course before the university and townspeople at Evanston, Illinois. Hastening home for my classes, I sat down in the dining car opposite a man whose appearance attracted me, but to whom with the foolish diffidence of Americans generally I was afraid to speak. Europeans can give us a few useful points in these respects; for on the other side, if two strangers find themselves seated at a small table together, they will at the very outset very often exchange cards and chat pleasantly together. Well, we two on the diner eyed each other out of the corners of our eyes, each afraid no doubt that the other would sell him a gold brick if he opened up an acquaintance. Finally my neighbor passed me the salt and we fell into conversation. Once started we had so much to say that we talked half the night. He proved to be a graduate of the Rensellaer Polytechnic Institute, the earliest of our engineering schools in America, and the great mother of civil engineers. He had gone into the iron business and had served his first apprenticeship on a blast furnace. Once the furnace was tight and was not running well, so that all hands were on duty thirty-six hours at a stretch. The general manager of the company, who knew him well, came around and said to him, "Well, Jack, I guess this is something different from your old college days." "My dear sir!" said Jack, "this is child's play compared to what I have been through in the engineering school." He was right. When examinations in subjects involving applied mathematics, or in branches of science calling for exact knowledge, or the preparation of graduating these, geological reports, and experiments with pumps and dynamos roll upon us, we are being prepared to find the demands of later work seem comparatively simple.

No one who knows our engineering schools can have any doubt whatever that our courses in applied science are preparing for later life hard-working, earnest men who simply cannot be discouraged and who stand up to the calls made upon them like good soldiers. I doubt very much if, on the whole, you will find later work as difficult as many situations in the professional school.

But in some ways conditions are different in actual practice. In the professional school it is a fair field and no favor. A very just set of judges on the whole give the faculty's decisions. But in actual practice self-interest counts for more; family influence, the influence of property, and the various other factors enter. Questions of right and wrong are less prominent than in college life. Conditions are more selfish, and often bring disappointment and injustice.

But you must be strong enough not to be soured by such experiences when they come. You must be big enough not to mind them, but to keep your own attitude toward life as much as possible a generous and helpful one. One summer I was called to Nova Scotia and I sailed across from Boston to Yarmouth at the southern end of the peninsula, and rode on the train through what the railroad folder called the land of Evangeline. My neighbor in the seat and I fell into conversation. He was a graduate of one of the largest and best of our eastern technical schools, and was then employed in some important works in Providence. Obviously he was not getting on badly, for he was off on a vacation trip with his little family. Yet his earlier experiences had evidently soured him, for he said, "I'll tell you the proper preparation for business. It is not a college or technical education, but the life of a newsboy or bootblack, who knows everybody's hand is against him and uses his hand against everybody. The newsboy has cut his eyeteeth." That attitude is not the true one. We have, to be sure, our hard experiences and our discouraging ones, but we do not knuckle under for all that. On the contrary, we forget them as soon as we can. When the umpire roasts our team in one place, we lose the game and are sore over it for awhile; but the next time we will be playing somewhere else and the umpire will be different. Experience shows that sooner or later all the good, strong, well-qualified men win out, and getting free from the ruck become reasonably well established. Then through our local engineering societies, such as the Lake Superior Mining Institute, or through our national society, the American Institute of Mining Engineers, or the Mining and Metallurgical Society, or in other ways, come our professional associations and friendships which are altogether delightful. They are well worth much patient and dogged endurance at the outset.

On bestowing a degree in medicine it is the custom, as you doubtless all know, for some older member of the profession to administer the oath of Hippocrates, a very ancient ritual which has been observed for quite two thousand years. Many times at commencement at home we have seen the group of young physicians stand while they were reminded of the pledge which had come down through the long line of centuries, so long in fact, that the very gods by whom the early Greeks made affirmation have passed away. Each man is adjured to swear by whatever he holds most sacred to practise his profession in honor and uprightness, to be always ready for the call of the sick, to enter no man's house other than to bring the acts of healing, to never perform, much less suggest, a wrong, to keep inviolably secret what is learned of the lives of men. Many times amid a solemn hush I have heard the senior professor in the medical school conclude: "And now if you observe your oath may success and prosperity attend you; the opposite if you shall prove yourself foresworn."

In engineering no ancient pledge has come down to us from Archimedes, our great forerunner,, nor from those master minds which built the pyramids or laid out the great systems of irrigation in the valleys of the Tigris and Euphrates. Our profession, distinctively named, is of comparatively modern date. Yet mining is a very ancient art. We do not know when the first rush of placer miners to some new productive diggings took place; but the myth of the Argonauts and the Golden Fleece reminds us that there were such expeditions. We do know that the Assyrians fought with the Egyptians for the copper mines of the Sinatic Peninsula which separated them; that Athens was the leading state in Greece because of the lead-silver mines at Laurium, its seaport, whose ancient slags are now being reworked by the French; that Hannibal, said by H. C. Hoover to have been originally a mining engineer, fought the Romans for the copper mines of Spain; and so on through the centuries.

While we have no Hippocratic oath, we must feel the force of the traditions of a calling that is very old. We must realize, too, that when a man has completed a severe course of training, and has his name added to the alumni list of a professional school of high character, he has given pledges for straight dealing and true speech for all the remainder of his life. The graduates of our engineering schools feel this just as do the graduates of the Military Academy at West Point. And rarely in the former as in the latter, do we find in the long list of names and professional service, the records of those who have been actuated by other than high professional standards. Graduates have in their keeping not only their own reputations, but also the reputations of the schools wherein they have prepared for special service. No appeal for straight conduct and true speech could be stronger.

And now when Commencement is over and you are out in life you will all miss the fellows and the old associations, but while not permitting the old ties to diminish in strength, you must be prepared to make new ones and find friends wherever your work takes you. You must enter into the life and interests of the communities where you will finally settle, and find in them the satisfying of the craving for sympathetic companionship which all of us gregarious beings feel. From time to time come class reunions and alumni gatherings and the renewal of old associations. I doubt not you will always turn with affectionate remembrance to your years in your alma mater and think kindly of the nights when you fell asleep while the Ball and Nordberg stamps beat time for the deep bass lullaby of the Copper Country's mills.

FUEL OIL IN UNITED STATES NAVY

By Admiral H. I. Cone.

The fuels used in the U. S. navy are coal, fuel oil and gasoline. Coal must have certain characteristics to make it suitable for naval use. One of the most important strategical requirements of a warship is her ability to steam great distances without recoaling. Another is her ability, in time of need, to make high speeds. As both bunker capacity and boiler power are limited by other features of design, it follows that the coal must have the greatest thermal efficiency obtainable in connection with the other necessary characteristics. High volatile coals are usually very smoky in naval boilers. Smoke not only reveals the location of the fleet, but might fatally interfere with accuracy of gun fire.

The advantages of oil as compared with coal are:

An evaporation per pound of fuel in the ratio of about 14 to 9, and per square foot of heating surface in about the ratio of 10 to 8. Fuel can be taken aboard more rapidly without manual labor, and without interruption to the routine of the ship. The problem of fueling at sea is solved. Steam for full power can be maintained as readily as for low power. A vessel burning oil is capable of runs at full speed limited in duration only by the supply of fuel. There is no reduction in speed due to dirty fires or to difficulty in trimming coal from remote bunkers, or to exhaustion of the fire room force. There are no cinders and the amount of smoke can be controlled. A considerable reduction in personnel is possible. The weight and space required for boilers is reduced. First, by the reduction in heating surface required, and second by the shortening of fire rooms. Consequent on the reduction in heating surface is a decrease in weight and cost of boilers. Coal and ash handling gear is eliminated. This renders unnecessary the piercing of the hull for coal trunks and discharges from the ash expellers or ash ejectors. The stowage and handling of oil is much easier than of coal and will result in a much cleaner ship with consequent increase in time available for drills. The mechanical supply of fuel to the boilers gives a prompt and delicate control of the steam supply, permitting more sudden changes in speed than with coal, which is a tactical advantage. The nature of fuel oil permits utilization of remote portions of the ship and of constricted spaces for its stowage.

These advantages have long been recognized by the U. S. navy, and there have been experiments with liquid fuel dating as far as 1867. All these experiments have confirmed our belief in the considerable military advantages which will accrue from its use, but until recently it has been impracticable to use it extensively on account of the uncertainty as to the adequacy of its supply and the sufficiency of its distribution among the seaports of the world. We are now assured, however, as regards the supply, that there is sufficient oil on the public lands of the state of California alone to supply all probable naval demands for one hundred years should oil be burned to the exclusion of coal, and of course there is considerable oil in other portions of United States territory. The question as to the distribution of oil among the ports from which fuel might be required by our vessels in time of war is one that is well within our power to solve, as from its nature the oil can be transported and stored more easily than coal. Indeed for transport of oil in time of war we are already better provided than for coal, there being a large number of tank steamers flying the American flag. Oil is therefore certain rapidly to replace coal as a fuel for navy purposes.

Since 1907 all torpedo boat destroyers contracted for, of which there are twenty-nine, burn oil exclusively, and the battleships "Delaware," "North Dakota," "Florida," "Utah," "Wyoming," "Arkansas," "Texas" and "New York," contracted for during this period, are fitted to burn oil as auxiliary to coal, each of these vessels carrying about 400 tons of the liquid fuel to be burned at full power after the coal fires become dirty, or when it becomes difficult to trim coal from the bunkers in the fire rooms. In the case of these battleships the advantages of the oil have so appealed to the personnel that oil alone is burned to a great extent in port, and to some extent while cruising, although the installation of the oil burning equipment did not contemplate these uses.

The "Nevada" and "Oklahoma," the two battleships which have recently been contracted for, will burn oil exclusively. This is perhaps the most radical development in naval engineering since the advent of the turbine. It has permitted in the case of these vessels a reduction in boiler weights, which has made possible the use of heavier armor than has hitherto been employed. The reduction in length of boiler compartments has permited the grouping of all boilers under one smoke pipe, which course clears the upper deck considerably and permits more extensive arcs of fire for the turrets.

Aside from the use of oil as fuel under steam boilers, it now seems probable that within comparatively few years oil used in internal combustion engines will furnish the principal fuel for all naval vessels. This is in consequence of the recent remarkable development of heavy oil engines of the Diesel type in Europe. Hitherto, oil engines have not merited much consideration for large naval vessels on account of the limited power that could be developed in a single cylinder. An installation of any considerable power required a multiplicity of cylinders. Now, however, we are credibly informed that 1,000 horse-power has been developed in a cylinder about 33 in. in diameter with a 40 in. stroke, at 150 revolutions per minute in a two-cycle marine type readily reversible engine. This engine has a speed control that is satisfactory, and an economy of fuel consumption probably twice that of a steam engine.

In the United States navy heavy oil engines built or so far projected are limited to a number of submarine vessels and to mother ships for submarines. The former develop 1,200 horse-power, distributed between two shafts, the latter 900 horse-power on one shaft.

Gasoline is used as fuel for all of our earlier submarines and for a large number of small power boats

*A paper read before the Eighth International Congress of Applied Chemistry.

carried by warships. Its use is likely to be discontinued entirely as soon as suitable heaviy oil motors for the small power boats are developed. As stated above heavy oil engines are already supplanting gasoline engines in submarines.

The United States navy has at Philadelphia a fuel-oil testing plant where all grades of fuel oil are tested, many different designs of burning apparatus, different heaters and different forms of air admission are maintained. Actual use aboard ship indicates that about 200 gallons of oil is equivalent in power to one ton of good coal. That is not quite five barrels. In actual heat units a pound of fuel oil contains about 19,500 British thermal units, the navy standard steaming coal runs a little over 14,500.

Oil used on the east coast comes from Oklahoma and Texas. However, experiments at Philadelphia show very little difference in steam production between oil from different parts of the country. There is one thing—navy fuel is not permitted to have a flash point below 150 deg. F.; that is, on a closed cup, whereas in locomotives, in power plants, and on some merchant vessels, California crude is used, and a large amount of Mexican crude, where the flash point might be lower than 150 deg. So that fuel oil for the navy is oil that has been subjected to some refining treatment, and had the lighter and more volatile products removed.

COAL MINE DISASTER ON VANCOUVER ISLAND, BRITISH COLUMBIA.

Twenty-two miners lost their lives on the afternoon of May 27, when an explosion occurred in the Western Fuel Co.'s Reserve mine, situated about five miles from the company's shipping docks at Nanaimo, Vancouver island, British Columbia. As the mine is a comparatively new one, it has not yet been extensively opened, so the number of men working in it was not large—only 36 at the time of the disaster, and of these 13 were rescued uninjured and one, who though badly hurt, is likely to recover.

The cause of the explosion has not yet been ascertained. The Provincial Department of Mines has commissioned Mr. James Ashworth, of Vancouver, B.C., a coal mining engineer of lengthy and wide experience, to make an investigation. Mr. Joseph G. S. Hudson, of Ottawa, of the Explosives section of the Canada Department of Mines, and Mr. Thos. Graham, chief inspector of mines for British Columbia, are also at the mine.

The Reserve mine is near the centre of a 2,500 acre virgin coal field in Nanaimo and Cranberry districts; it has been opened by two shafts, main and auxiliary, 350 ft. apart, dimensions 10 x 26 ft. inside of timbers. In April, 1913, a 10 ft. seam of coal was reached at a depth of about 1,050 ft. The development of the mine was delayed by the strike of coal miners on May 1, 1913, and it was not until 1914 that much progress was made toward opening the coal. The mine equipment—machinery and plant, fan, etc.—is modern, and all plans are for an eventual production of 1,500 to 2,000 tons of coal a day. Approximately $750,000 has been expended in developing and equipping the mine and in construction of a standard gauge railway from mine to shipping docks.

MINING ROYALTIES AT COBALT*

By A. A. Cole.

As there appears to be some misconception as well as lack of appreciation of the reasons for the royalties payable by certain mines at Cobalt, the following explanatory notes may be of interest:

When the Timiskaming & Northern Ontario (Ontario's Government railway) was started, the Government placed the management under a Commission. The railway was granted a right-of-way and also certain townsites along the line of location. Later on the Government also granted to the railway the minerals underlying the right-of-way and under the townsites except where these had already been disposed of. In the vicinity of Cobalt these mining rights proved very valuable both in the case of the right-of-way itself and also under the townsite.

Instead of undertaking mining operations itself the Railway Commission divided its mining lands into convenient lots or parcels and leased them to companies or individuals, who acquired them by public tender. In this way the following four leases have worked and made returns to the railway:

The Cobalt Townsite Mining Company, The City of Cobalt Mining Company, The Right of Way Mining Company, The Nancy Helen Mines, Limited.

The company acquiring a lease paid a cash bonus to begin with and thereafter a royalty on shipments. Originally the royalty was based on the value of the ore at the collar of the shaft, but this was later changed to a percentage of the net profits.

The policy of the Railway Commission has been to assist the lessees from time to time by a gradual reduction of royalties as the resources of the mines were exhausted. This has worked out in a satisfactory manner both to lessor and lessee.

Each lease started out by paying 25 per cent. royalty on the value of all shipments at the collar of the shaft, with the one exception of the Townsite Company, which was supposed to pay 50 per cent. royalty on all ore assaying over $1,000 per ton, and 25 per cent. on ore assaying lower than that amount. This was early considered unsatisfactory and a uniform royalty of 25 per cent. on gross value was adopted. The next reduction was to 25 per cent. net, or to be more explicit, 25 per cent. on profits calculated as in the Supplementary Revenue Act (now called The Mining Tax Act).

The further successive reductions have been to 20 per cent., 17 per cent., 15 per cent., 12½ per cent., 10 per cent., and 7½ per cent. On July 1st, 1914, all leases from the Railway Commission were reduced to 7½ per cent., and the agreement now stands that this will be the royalty till September 1st, 1915, on which date all royalties will be reduced to 5 per cent. on profits.

By the above leasing system the lessee only pays a royalty on ore recovered. The fairness of this system, particularly to the lessee, may be illustrated by the following example.

To the south of the Town of Cobalt there are two lots of approximately 40 acres each, the Silver Queen and the Cobalt Townsite properties. In 1906, when Cobalt properties were coming prominently before the public, the Silver Queen property was part of the holdings of the Hudson Bay Mining Company, while the Cobalt Townsite property belonged to the T. & N. O. Ry. These two properties lying side by side each had silver-bear-

*From report of the Mining Engineer of the T. & N. O. Ry. Commission ing veins exposed on the surface and similar geological conditions. The ore exposed on the Silver Queen was richer than that on the Townsite, but the area of silver-bearing formation was more restricted on the Silver Queen property, so that a comparison of these two properties is legitimate.

The Silver Queen property was sold to the Silver Queen Mining Company for $810,000 cash. This meant that this amount of capital had to be expended to acquire the property before any ore could be taken out.

In the case of the Cobalt Townsite property, instead of selling it for a large cash payment, which could easily have been obtained, the T. & N. O. Ry. Commission leased the property to the Cobalt Townsite Mining Company on a long time lease (999 years) exacting a payment of $50,000 cash bonus and a royalty on all o extracted.

In the former case the purchaser had to pay the whole $810,000 cash before there was any chance of a return, while in the latter case only 1/16th of this amount had to be paid to begin with, and the further payments were only made as the ore extracted was sold. These royalties to date have amounted to $279,482.72.

The Railway Commission expects to receive further royalties from this property in the future, but the operating company only pays these on receipts from sale of ores. It does not have to assume the responsibility of a large cash payment at the commencement of operations and consequently its capital is left available for development work and the fairness of the arrangement to both parties concerned is obvious.

The royalties received by the T. & N. O. Ry. Commission from its mining leases to the 31st October, 1914, are as follows:

Cobalt Townsite	$279,482.72
City of Cobalt	100,791.13
Right of Way	272,109.17
Nancy Helen	6,126.60
Mining Corporation of Canada	8,405.60
Total	$666,915.22

A number of other mines at Cobalt pay royalty directly to the Government on certain special arrangements, but these have nothing to do with the T. & N. O. Ry. Commission. Thus, when the Crown Reserve mine was sold by the Government, a clause was attached to the deed of sale whereby the Crown Reserve Company paid a certain amount of cash for the property and in addition pays a royalty of 10 per cent. on all ores shipped, the valuation being the gross value at the collar of the shaft. A similar clause was attached to all sales of lots in the Gillies Limit.

The mines paying royalty directly to the Ontario Government are shown in the following statement:

O'Brien, $700,966.07; Crown Reserve, $771,883.44; Hudson Bay, $326,806.35; Chambers Ferland, $26,-256.60; Hargraves, $1,200.00; Waldman, $777.48; Wyandoh, $1,421.72; Provincial, $6,735.14; total, $1,836,-049.84.

The above royalties are paid on the following bases:

O'Brien Mine.—Fifteen per cent. of the net profits as ascertained on the basis of the Mining Tax Act (R.S.O. 1914, ch. 26, sec. 5). The royalty at first was at the rate of 25 per cent. of the value of the ore at the pit's mouth (less surface costs) but was reduced in 1913.

Crown Reserve Mining Co.—Ten per cent. of the value of the ore at the pit's mouth.

Hudson Bay Mines.—Ten per cent. of the net profits as ascertained on the basis of the Mining Tax Act. The rate charged at first was 15 per cent. on the net smelter returns, but was reduced in 1913.

Chambers Ferland Mining Co.—At first 25 per cent. of the value of the ore at the pit's mouth, as in the case of O'Brien Mine. Afterwards reduced to 25 per cent. of the net profits on the basis of the Mining Tax Act; and in 1912 the royalty was abolished, reserving to the Crown the right, in case of rich ore being found in quantity, to impose the royalty up to the extent of 25 per cent. on the net profits as above.

Hargraves Silver Mine.—Same as Chambers Ferland.

Waldman Silver Cobalt Mining Co.—Ten per cent. of the value of the ore at the pit's mouth.

Wyandoh Mining Co.—Ten per cent. of the value of the ore at the pit's mouth.

Cobalt Provincial Mines.—Ten per cent. of the value of the ore at the pit's mouth.

The Peterson Lake Mining Company has divided its property up into 10 acre lots and has leased a number of these lots to independent mining companies on a royalty basis. Thus the Seneca Superior and the Gould are working leases from the Peterson Lake Company paying the owning company 25 per cent. on all ore shipped, calculated on the gross smelter returns. In these cases the royalty is paid to the Peterson Lake Company and none is paid to the Government. Only Bonanza veins can pay on such a basis.

The Ontario Government collects a revenue from mining companies throughout the Province through the operation of the Mining Tax Act. This is a tax, however, and not a royalty, and is calculated on the basis of 3 per cent. on all profits above $10,000 annually.

COAL GAS RESIDUALS.

Coal gas residuals form the bases of many industries. Owing to the great development of by-product coke ovens and gas plants in Germany and the application of modern chemistry to the utilization of their by-products, these industries have largely been controlled by that country. In the readjustment of industrial and trade conditions after the war, it is desirable that as many of these industries as possible be established in Canada and in other parts of the British Empire.

There are two large by-product coke ovens in Canada which produce 67 per cent. of our coke output. These plants are situated at Sault Ste. Marie, Ont., and at Sydney, N.S. Since the outbreak of war, the latter plant has been installing a benzol recovery plant, but, in western Canada, there are numerous beehive coke ovens which do not save any by-products whatsoever. Again, while large quantities of tar are recovered from local gas plants, no industries have been established for the refining, separation and use of the products obtainable from it.

Not only is the saving of the by-products from the coking or carbonization of coal a measure of conservation, but the sale of these residuals is the means of reducing the cost of production in a degree corresponding to the efficiency of the recovery methods adopted and the market value of the products.

This subject is of special interest at this time on account of the effect of the war on the industries dependent on aniline dyes and because the English lyddite and French melinite explosives are made from carbolic acid, a coal tar derivative. A new explosive, trinitrotoluene, is attracting even more attention. It is made from toluene, which is found in the benzol obtained by distillation from tar or in ordinary coal or coke-oven gas.—W. J. D.

THE THEORY OF TUBE-MILLING*

By H. A. White.

As experience has greatly increased our knowledge of the most economical methods of using the tube-mill, it has, at the same time, opened up fresh problems which still await both theoretical and practical solution.

The whole subject may conveniently be considered under the two heads of design and operation. These may be further sub-divided as follows:

Design.—(a) Shape; (b) Dimensions; (c) Linings; (d) Discharge; (e) Feed; (f) Prime mover; (g) Measuring apparatus.

Operation.—(a) Speed of revolution; (b) Load of pebbles; (c) Working level of load; (d) Size of pebbles; (e) Coarseness of feed; (f) Amount of feed; (g) Moisture in feed; (h) Fluctuations in power and speed.

Shape.—From the fact that the operation of a tube-mill depends almost entirely upon centrifugal force arises the theoretical deduction that a long cylinder is the most suitable shape. The length of this cylinder will be determined (if trunnion bearings are used) by strength of material which it is economical to use for its walls, and generally by the amount of feed which it is possible to pass through the tube. The maximum length must obviously not exceed that at which the discharged product is as fine as the final pulp required, and in order that capacity may be fully utilized it is probably best that the pulp discharged should not contain much more than half its weight reduced to the desired fineness. Thus if the final product desired is of —90 material, the tube discharge should not have much more than 45 per cent. of this grade. This ensures a full supply of material to be crushed up to the very end of the mill, though the feed end will be working under the more favorable conditions. The practical limit will favor length (giving larger units), while the merely theoretical aspect would be in the other direction, which tends to remove from the circuit all material fine enough as soon as it is produced. The short tubes temporarily in favor in some parts of the world principally owe their adoption to some other feature of their design, whose effect is not fully appreciated, or to the fact that the tonnage of sand fed is too small for the most efficient work in longer tubes.

The only other shape suggested is a combination of the cylinder with a double cone, and this design is apparently based upon a misapprehension of what takes place in the tube of ordinary shape. This mill aims to provide special arrangements for graduating the power to the work required, but having a varying diameter must be driven at a speed which, however carefully chosen, must be incorrect for a great portion of the load. The varying crushing power, in a direction parallel with the axis, so expensively attained in the Hardinge Mill, is inevitably present in the ordinary mill, in a direction at right angles to the axis, and the well known tendency of the smaller pebbles to travel toward the discharge end of the standard tube mill, gives the advantage of reducing the power consumed at the point where the feed has naturally become finer. It is obvious that the unit of capacity is more cheaply obtained in a cylinder than in a double cone, and no defence of any sort has been put up for the cone at the inlet end.

It might be suggested that a slightly tapered cylinder (say 2 in. wider at inlet than outlet) would be useful, as the lining, if 2 in. thicker at inlet than discharge, as is common with silex liners, would have a cylindrical surface when new, and while giving a uniform "life" along the tube, would improve the tendency to keep the larger pebbles near the feed end and provide a longer average drop at this point where the feed is coarsest.

This construction would not interfere with giving correct speed more than the wear of liners does at present, but it is doubtful if the increased capital required could not be better utilized in a different type of liner, especially as the extra diameter at inlet would have an unfavorable effect upon the adjustment of the "working level" subsequently referred to.

Dimensions.—Having concluded that the shape most suitable is a long cylinder, the relative and absolute dimensions of length and diameter require further consideration.

The diameter of a tube mill will depend upon the size of the largest pieces in the feed and the largest pebbles which can conveniently be used. The weight of the pebble and the diameter of the tube are to some considerable extent mutually compensating factors whose product will determine the largest pieces permissible in the feed.

The longest drop any pebble in a tube will get will be in the layer corresponding with an "angle of departure" of 45 deg., if the speed of revolution is sufficient to give any layer that angle; if not, the outer layer will have the longest drop. The drop cannot therefore exceed 0.8 x diameter of "circle of reference." (The "circle of reference" is the locus of centres of pebbles touching the lining of the tube, and the "angle of departure" is the angular distance from horizontal diameter of tube at which a pebble begins its curve of flight.)

The ft. lb. of energy required to smash any piece of average ore will vary as the square of its diameter, and may be from 2 to 6 ft. lb. for a 1 in. diameter piece, in accordance with shape, etc.

Assuming a maximum of 6 ft. lb. for 1 in. feed, pebbles approximately spherical with Sp. Gr. 2.75, and tube linings of 4 in. thickness, if the largest pieces of ore to be fed were of 1 in. diameter the following would be diameter of tubes required:

For a 4-in. pebble a tube diameter of 39 in.; for a 3-in. pebble a tube diameter of 76 in.; for a 2-in. pebble a tube diameter of 226 in. In a similar manner it may be calculated that a standard tube of 5 ft. 6 in. x 22 ft. will not take a feed coarser than ½ in. unless a sufficient proportion of pebbles larger than 2 in. are present.

Similarly, if it were required to design a tube to take ore direct from the rock-breakers with a maximum size of 3 in., the diameters corresponding with various pebble sizes, putting the blow required at 36 ft. lb., and allowing for a lining 4 in. thick would be:

For 6 in. pebbles a tube of 5 ft. 2 in. dia.; for 5-in. pebbles a tube of 8 ft. dia.; for 4-in. pebbles a tube of 14 ft. 6 in. dia.

As, however, the blow is mitigated by resistance of semi-fluid pulp so that in practice it is found that feed larger than ½ in. is somewhat unsatisfactory with the 5 ft. 6 in. tube, though the pebbles present therein will average about 0.65 lb. (2¼ in.) with lumps of rock fed in at an average of about 2 lb., it is probable that a suitable tube for taking ore direct from the rock-

*Extracts from a paper presented at a meeting of the Chemical, Metallurgical and Mining Society of South Africa.

breakers would have an inside diameter not less than 8 ft., and the coarse ore fed in to form pebbles would be lumps from 6 in. to 8 in. cubes. In such a case it would probably prove advantageous to use a second row of ordinary tubes for the final reduction.

The capital cost for the cheapest design will depend upon the relative cost per square foot of barrel and ends. If a square foot of end costs "n" times a square foot of barrel, then the length must be "n" times the breadth. In designing a tube all the costs which are affected by the diameter must be tabulated for the various sizes and a similar set of calculations made for the various lengths and upon the above principles a determination can then be made of the best relative dimensions. I am informed that the ratio so determined will be about 4 to 1, which implies that the ends, including driving pinion, trunnions, etc., cost four times as much as the cylinder per square foot. It has, of course, been assumed that the internal capacity is a reasonable measure of the work a tube mill can be made to perform, which is in practice found to be roughly accurate.

Other considerations are of at least equal importance with considerations of prime cost, and the principal one appears to be connected with the amount of feed it is practicable to pass through the tube so that the full length may be utilized. Four hundred tons per day is quite common on the Witwatersrand, and this seems to be sufficient for the ratio of 4 to 1 with a 5 ft. 6 in. diameter tube; but it would be difficult to set a limit for the possible amount if the feed and discharge inlets are suitably arranged.

Before proceeding with the other divisions of our subject, a reference is necessary to the experiments recently carried out by the Mines Trials Committee, which has been kind enough to give permission to make use of the results obtained.

This series of experiments was carried out in the ore-dressing laboratory of the South African School of Mines and Technology by Professor G. H. Stanley, assisted by Mr. Morris Green.

Experiments were undertaken to observe and measure—

(a) The effect of varying speeds of revolution

(b) The effect of varying loads of pebbles.

(c) The effect of different "working levels" and the ascertaining of the most suitable discharge screens.

(d) The effect of varying sizes of pebbles and feed coarseness.

(e) The effect of varying kinds of tube lining.

(f) Testing the practicability of using a continuous automatically replacing lining of the pebbles themselves.

During the conduct of the trials it was further decided to

(g) Measure the fluctuation in speed and power consumption during a revolution of the tube.

The tube was a cylinder of ½ in. iron with a diameter of 77 in. inside and a length of 18 in. mounted on a heavy cast-iron spider and driven by gearing. The back was of 1 in. ribbed cast iron mounted on a shaft 7 in. diameter. The front was closed in by 1 in. iron screening, prevented from bulging out by two strong iron supporting plates. A man-hole was used for introducing or removing pebbles. The spur-wheel on the shaft was cut steel gearing with 150 teeth, pinion 20 teeth, counter shaft belt pulleys 30 in. and 20 in. diameter, motor pulley 8 in.

A 25 H.P. shunt wound motor was supplied, and the speed varied by using suitable resistances, and this gave no trouble. The calculations on power consumed do not take into account any variation in efficiency caused by changing speed, as the engineers did not consider this of importance.

Imported Danish pebbles from 2 in. to 4 in. diameter were used, and a very fine spray of water had to be directed upon them to keep down the dust. All the observations are upon the tube loaded with pebbles only.

The voltmeter and ammeter employed were carefully calibrated from time to time.

The tachometer supplied was of little use as its readings were not sufficiently "dead-beat." A stopwatch was therefore used in counting number of revolutions. Various subsidiary apparatus was used to determine levels and "angles of departure" of pebbles, etc. As the light was insufficient, no cinematograph record could be taken, as intended, but numerous diagrams were drawn from eye observations to illustrate the appearance of the moving pebbles under the various conditions. Several oscillograph records of the current consumed, and tracings of an electrically vibrated tuning fork upon smoked paper wrapped round the shaft were also taken, the latter being used to determine the variation of speed during a complete revolution of the tube.

All the observations recorded were made with the tube mill containing pebbles only, thus securing simplicity and definiteness. Any practical application of the deductions when sand and water are present requires due allowance for these factors.

Linings.—The liner used for most of the experiments was of plain concrete, and this wore away very rapidly, especially at first while it was fairly new, and the wear was not very regular. A concrete surface does not appear to have much "grip" on the pebbles, and according to the calculations made on observed figures it allowed more "slip" than even the unlined tube.

A steel bar liner, arranged alternately flat and upright in the usual manner, was found to take up pebbles well till the actual working surface consisted of pebbles. The wear in this liner was not measureable during the experiments made with it, and the working surface appeared to take up the pebbles well, giving a minimum amount of "slip."

No other kind of liner was available for experiments, but the experimental tube mill remains available for trials in this direction, if at any time such appear to be desirable.

An objection to the bar liner of the Osborne or similar types is the greater amount of amalgam held up thereby as compared with the silex liner. This may be to some extent minimized by using cement as a backing to fill up interstitial spaces, but even with great care the retention of amalgam is capricious, and may vary on the same mine from 500 to 2,500 oz. It will, however, do almost as efficient work at the first hour of starting as at the end of its life, and this compares favorably with the indifferent work done when a new thick silex liner is started up.

Upon driving a tube beyond a certain critical speed, one or more layers of pebbles may be made to adhere to the circumference, and thus form an automatic lining, which would replace itself as it wore out.

TABLE I.

Diameters and R.P.M. to Make Layers of Pebbles Continuous.

The diameters given refer to the "circle of reference" and show measurement inside tube lining less diameter of pebbles used. A layer of pebbles is said to be "continuous" when it adheres to the circumference of the tube or lining during a complete revolution.

Diameter	1st layer continuous		All Pebbles Continuous		
	R.P.M. Calculated	R.P.M. Observed	R.P.M. Calculated	R.P.M. Observed	Load
in.					in.
53	36.4	36.0	40.8	46.0	
54	36.1	——	40.5	——	+ 5
55	35.7	——	40.1	——	——
56	35.4	34.7	39.8	46.2	——
57	35.1	35.5	39.5	47.8	+ 2
58	34.8	35.0	39.1	48.5	+ 4
59	34.5	34.5	38.8	47.2	+ 10
60	34.2	(39.0)	38.5	47.2	+ 12
61	33.9	——	38.1	——	— 7
62	33.6	(38.0)	37.8	49.0	——
63	33.4	——	37.5	——	0
64	33.1	33.2	37.2	46.0	——
65	32.8	——	36.9	——	+ 6
66	32.6	33.5	36.7	51.2	——
67	32.3	——	36.4	——	+ 12
68	32.1	33.7	g6.1	51.2	——
69	31.9	——	35.9	——	+ 17
70	31.6	——	35.6	——	——
71	31.4	——	35.3	——	——
72	41.2	——	35.1	——	——
					——

It will be observed that slightly more than the theoretical speeds are required to make the first layer continuous, and that though an increase of 3.9 to 4.4 R.P.M. is theoretically sufficient to take up all the pebbles to the circumference, in practice an increase of 10 or 12 R.P.M. is required (owing to excessive slip in inner layers); the greater speed is naturally required with very heavy loading as the inner circle formed by the last pebbles taken up is proportionately smaller. To take up two or more layers on the circumference, the R.P.M. would require an extra revolution per minute for each layer, more or less, in accordance with size of pebbles and diameter of layer formed. It is evident, therefore, that if the speed were set for two layers of pebbles to form an automatic lining, a variation in speed of 3 per cent. either way would result in increasing the layers to three or reducing to one. There is consequently no great difficulty in this direction, but the fact that an increase in speed is in these cases accompanied by a decrease in power consumption requires the provision of a constant speed prime mover.

In all cases where a continuous layer of pebbles is maintained on the liner, it was found that the smaller pebbles reached the circumference; experiments with a very small model tube mill with sand present showed that if the speed were gradually increased only sand was found on the circumference, but a rapid increase of speed up to the required point enabled the much larger beads used to form the automatic layer. It may be anticipated that in practice as the layers on the circumference become reduced in size by wear, the tendency will be for their place to be taken by sand, and especially by pyrite or amalgam, because the smaller particle can be held there by the centrifugal force where a larger particle would fall, as its centre would fall outside the limiting circle fixed by the speed of revolution.

Discharge.—While the inlet opening to the tube need only be large enough to pass the largest pebbles to be fed in, with an allowance for the wearing lining, the diameter of discharge aperture may either be large enough to bring down the level of the semi-fluid pulp to the required point, or the discharge screen may be provided with a lifting scoop delivering to a discharge outlet of smaller diameter.

This discharge scoop works in a chamber cut off from the end of the tube by a false end plate, provided with a screen having the diameter required; and iron balls or a few stem ends might be placed therein to smash up the small pebbles passing this screen, after the manner of the ingenious arrangement by Mr. Thurlow at the New Modderfontein.

Feed.—The Schmitt Feeder is very satisfactory and flexible, and where this is used there is no reason why the inlet to tube should not be of sufficient diameter as to obviate the possibility of jamming of the pebbles fed and to allow larger rock to be used for this purpose where desired.

Prime Mover.—The peculiarity of the tube mill that an increase of speed may have the effect of reducing the power consumed renders it necessary that the prime mover should be of a constant speed type to avoid the possibility of a dangerous runaway. This should be more especially necessary if the automatic lining of pebbles were used, as in this case the normal speed is much nearer the danger limit.

Measuring Apparatus.—The present usual method of controlling the pebble feed to tube mills by means of an ordinary ammeter in a three-phase circuit has several disadvantages. In the first place it does not discriminate between loads above and below the maximum power consumption, and of course the reading is directly influenced by the variations in the voltage of the power supply which at times are very considerable. Where measurement of power consumed must be relied upon, the most advantageous instrument would be a graphic recording watt-meter and a daily chart from this would be a useful check upon the regularity of maintenance of the required pebble load. If the same level of load is maintained in a silex liner it is obvious that the power consumed will vary with the wear of the liner, but experience will enable this variation to be properly allowed for and the chart may be marked as a guide.

It will be obvious that in comparative trials with various adjustments an integrating watt-meter, duly calibrated, is the only reliable instrument where motors are used and figures based upon comparative ampere readings are quite useless.

It is to be regretted that no reliable method of directly measuring the pebble load, while the tube is running has yet been devised, though some operators consider that the load may be roughly judged by pushing a thin iron rod through the centre hole of the discharge screen and thus judging the depth of the fallen pebbles.

In ordinary tube mill installations driven by three-phase motors, one integrating watt-meter would be sufficient for all the tube motors to enable power charges to be properly allocated, one ammeter and one voltmeter would likewise be sufficient for the whole circuit, while each motor switchboard should be provided with a recording watt-meter, and an ordinary indicating watt-meter should be placed in a secure position, clearly visible from the pebble feeding point.

The effects of varying speeds of revolution.—In all the experiments carried out under this head, the power consumed when the tube was running empty at the various speeds was first determined. The net power after deducting these results from the final reading refers therefore to the power actually consumed in lifting pebbles, plus internal friction inside the tube. It may be assumed that the power actually consumed in lifting pebbles will be a fair measure of the crushing capacity of the tube, and that at anything like reasonable speeds and loads the amount of fine material produced per H.P. will not vary to any great extent, in the same way that heavy stamps have a high crushing power per machine unit, but no greater product per H.P. than lighter stamps.

It was very obvious on watching the fall of the pebbles, that greater loads required higher speeds to develop full power consumption, the effect of the greater speed being to provide adequate paths of free fall for the greater load of pebbles. If the speed was too low or the tube too crowded at the speed used, the inner layers of pebbles had no space for free fall and were merely carried round and round with slight relative movement, which in most cases would mean wasted power. The low power shown with excessive loads is due to the further effect of the pebbles, after filling up this inner cavity, heaping up at the bottom of the tube and thus lessening the fall of the other pebbles present until the speed was great enough to carry up the excess pebbles on to the rim. A free fall was thus again secured, but of course the effective tube diameter was reduced by the pebbles adhering to the lining.

It was observed in practicable cases that the angle of departure corresponding with the inner layer cannot be much less than 30 deg. if free fall is secured, and this is the limit of loading at any speed beyond which there is a loss of efficiency. If more pebbles are added there is no free space between the rising layer and the falling pebbles.

It has not been found possible to devise any means of gauging this free space in a working tube, as it always contains a few jumping pebbles, though observations with a small model show it to be free from sand. At present there is no means of determining from power readings upon which side of the maximum loading effect a given tube is working.

An interesting visual observation was that at very low speeds the smaller pebbles gathered towards the centre of the tube, at practicable speeds no segregation was noticeable, and at speeds beyond the critical the smaller pebbles worked out to the periphery. This is also observable with sand and glass beads in miniature model.

The noticeable points in the following table are the increased speed (necessary for maximum power) required for increased load: the slow rise in power up to the maximum and the quicker fall thereafter; especially from the point at which pebbles are picked up on the lining.

Further observations on the effect of speed variation will be found under the next heading, where they can be more suitably discussed.

Table II.—Variation in Power with Load Constant at Various Speeds.

I.—Diameter inside concrete lining beginning 58 in., end 59 in.

Pebble load 2 in. above centre level—weight 1,400 lb.

II.—Diameter inside concrete lining beginning 61 in., end 62 in.

Pebble load 12½ in. above centre level—weight 2,520 lb.

III.—Diameter inside concrete lining beginning 62 in., end 62.6 in.

Pebble load 7 in. below centre level—weight 1,300 lb.

I.		II.		III.	
R.P.M.	Net H.P.	R.P.M.	Net H.P.	R.P.M.	Net H.P.
24·0	3·79	24·6	2·57	23·2	4·51
				24·6	4·67
25·0	4·23	25·7	2·67		
26·0	4·24			26·0	4·78
26·5	4·40	26·5	2·83		
27·0	4·46	27·4	3·10	27·4	4·93
27·7	4·56				
28·2	4·51	28·0	3·32	28·0	5·04
29·0	4·46	29·2	3·64	29·0	5·04
29·5	4·66				
30·0	4·66	30·0	3·80		
30·5	4·66				
31·2	4·98	31·2	3·97	31·0	4·55
32·0	4·98	32·2	3.59		
32·4	4·64				
33·7	4·41	33·0	3·32		
34·7	4·22	34·5	3·03	35·0	2·71
		35·5	2.63		
37·7	2·51	37·0	2·44	37·0	2·67
		38·2	2·23		
39·4	1·91	39·2	1·93	39·0	2·03
				39·7	0·58
40·5	1·56	41·0	1·81		
42·6	1·23	43·7	1·37	42·5	0·29
46·2	0·58	46·2	0·67	47·2	0·19
		47·2	0·39	49·2	0·09

The above are selected from the very numerous experiments in order to show the various effects at different speeds with normal, under, and overloading of tube.

BETHLEHEM STEEL.

The New York Times declares there is not the least danger of German interests getting control of Bethlehem Steel. Majority control of stock is not on market. Charles M. Schwab still owns a majority of stock and has no intention of selling it. It is declared that Mr. Schwab could get $100,000,000 for his stock if he so elected. It is stated that English interests learned last fall that Mr. Schwab had been offered fabulous figures for his majority ownership, but was promptly guaranteed orders by British war office big enough to keep Bethlehem going for 18 months. Mr. Schwab says: "My interest in the Bethlehem Co. is not for sale. I have contracts that I cannot break."

GRANBY.

In connection with recently published reports to the effect that now that the Granby Consolidated Company has arranged for paying off its floating debt by the sale of six per cent. convertible bonds the payment of dividends will soon be resumed, the statement is made that the directors cannot yet be influenced to declare a dividend; on the contrary, action in this direction will not be taken until they shall think fit. The fact that some of the mines of the company were closed for several months following the declaration of war last August seems to have been forgotten by many. There were overhead charges which had to be met from surplus, so the company is now renewing the strength of its financial position.

CORUNDUM MINING IN ONTARIO*

By Alfred Ernest Barlow.

[Dr. Barlow was lost on the Empress of Ireland. His Memoir on Corundum has just been published.]

The presence of corundum in the northern part of the county of Hastings, Ontario, was really made known as the result of a visit made in October, 1896, by Mr. W. F. Ferrier, then lithologist to the Geological Survey of Canada. In the Summary Report for the year 1896 Mr. Ferrier relates the history of the discovery and the circumstances which occasioned his visit to that region. He writes: "One of the most interesting occurrences upon which I have to report is the recent discovery of corundum in Hastings county, Ontario. This came about in a somewhat unusual way. In 1893 I came into possession, by purchase, of a number of specimens collected by Mr. John Stewart, formerly of Ottawa, amongst them being a package labeled 'Pyroxene crystals south part of Carlow.' On examining these specimens some time ago I recognized them as corundum, and immediately took steps to ascertain, if possible, the precise locality from which they came. As you are aware I communicated the facts to you and was authorized in October to visit the township of Carlow, endeavor to locate this mineral, and determine the extent of the deposit. I was accompanied by Mr. A. A. Cole, and after considerable difficulty found the mineral on lot 14, con. 14, of the township of Carlow, Hastings county, Ontario."

The growth of the corundum mining industry of Canada which was only made possible by and is a direct outcome of Ferrier's initial discovery, has been both steady and rapid. Starting in April, 1900, about 60 tons of graded grain corundum was produced, although only 3 tons of this were shipped. In the following year 444 tons was produced; in 1903 this production was nearly doubled when 806 tons of corundum was cleaned and graded. The maximum output was in 1906, when 2,914 tons was produced, but only 2,274 tons was sold, valued at $204,973. In the following year there was a very much greater discrepancy between production and sales, due to the industrial depression prevailing in 1907, and of the total output of 2,682 tons credited to this year, 790 tons was left in stock in the warehouse. From 1909 to the present there has been a better balance preserved between production and shipments, so that in 1912 there was the large shipment of 1,960 tons of graded grain corundum valued at $239,091, being the largest amount received since the establishment of the industry. Of this large total in shipments, 1,928 tons valued at $205,819 was exported, leaving only 32 tons to supply the home market. The total shipments of corundum made since the beginning of the industry until the end of 1913 have amounted in value to nearly $2,000,000.

The corundum bearing areas are situated close to the edge of the great Canadian Shield of the pre-Cambrian rocks, about midway between Ottawa and Toronto. They are in the midst of an old and partially settled district with numerous wagon roads, some of which are good while others can only be considered as passable. Craigmont, the centre of the corundum mining industry, is most easily reached from Barrys Bay, a station on the Ottawa and Parry Sound branch of the Grand Trunk Railway, 109 miles west of Ottawa. Barrys Bay is nearly 12 miles north of Combermere, a small village on the Madawaska river, about 7 miles north of Craigmont. A small steamer provides daily communication for passengers and mail between Barrys Bay and Combermere, and at certain intervals reaches Francois point on the York river, the deep water landing place about 2½ miles from Craigmont.

The Irondale, Bancroft and Ottawa Railway runs almost parallel with and usually in the vicinity of the southwestern extension of the main belt of the corundiferous syenites from Kinmount Junction (where it connects with the Lindsay-Haliburton branch of the Grand Trunk Railway) to Bancroft, a distance of a little more than 54 miles. At Bancroft connection is made with Central Ontario Railway for Trenton, on the main line of the Canadian Northern and Grand Trunk Railways, the intervening distance between these stations being about 86 miles. Trenton is 110.5 miles east of Toronto on the Canadian Northern Railway and 101.19 miles by way of the Grand Trunk Railway. The Central Ontario Railway crosses the Toronto-Montreal line of the Canadian Pacific Railway at Central Ontario Junction, 224.4 miles west of Montreal or 114 miles east of Toronto.

The Kingston and Pembroke Railway affords access to the most southerly of the three belts of corundum bearing rocks, Olden station, between Sharbot Lake and Kingston, being located on this belt.

Investigation of the corundum deposits.—The Director of the Bureau of Mines of Ontario being convinced of the great importance of the discovery of corundum, and the probability of the early establishment in this region of an extensive mining industry, deputed Mr. Willet G. Miller, then professor of geology at the School of Mining, Kingston, Ontario (now Provincial Geologist of Ontario), to carry out the necessary investigations. Much interest had been evinced by the discovery of this mineral by manufacturers of emery wheels and others so that it seemed advisable that a careful examination should be made at once of the Carlow deposit in order to obtain more information, especially from an economic point of view. Moreover it was considered that a determination of the character of the deposit would materially assist in the intended search for other occurrences of the mineral in the district. Professor Miller's instructions, therefore, called for an examination of the corundum bearing rocks, and to search for other deposits of the mineral in the district as well as to make careful notes on deposits of other minerals of economic importance which might be met with in the field. In this work Professor Miller had the able and zealous assistance of Messrs. R. T. Hodgson and W. C. Rogers, then students at the Kingston School of Mining. Early in July in company with Mr. N. T. Armstrong, of New Carlow, Professor Miller spent a few days in the study of the original locality where corundum had been discovered, as also two other deposits of the mineral in this vicinity. Later in the season, from August 2 until October 15, Professor Miller, having closely studied the mode of occurrence of the corundum, spent most of the time in prospecting for the mineral in the northern part of the county of Hastings, and the southern part of the adjoining county of Renfrew. As a result outcrops of corundiferous rocks were found in seven different townships, covering a distance of about 30 miles.

*Extracts from Memoir 57 Geological Survey, Ottawa: Corundum, its occurrence, distribution, exploitation and uses, by Alfred Ernest Barlow.

Development of the corundum deposits.—The great extent and comparative richness of the Ontario corundum deposits prompted the Government of that province to take such action as seemed best calculated to develop the deposits and also to establish a home industry. Regulations were accordingly drafted under which the mineral rights in lands lying within the known areas of corundum-bearing rocks were withdrawn from sale, so that their acquisition for mining purposes could only be obtained under the leasehold system. An order-in-Council was adopted on July 4, 1898, embodying a series of provisions having such a purpose in view, it being stated that the Commissioner of Crown Lands may receive tenders for mining lands and mining rights in the explored belt to the 15th day of September, 1898.

Only one substantial tender was received under the terms of the proposed regulations, but an agreement upon all details was not reached until September 15, 1899. The contract was entered into with the Commissioner of Crown Lands by Messrs. Joseph H. Shenstone and B. A. C. Craig, of Toronto, on behalf of the Canada Corundum Company. A partial agreement, however, was made on September 15, 1898, with these same gentlemen, together with Mr. Lloyd Harris, of Brantford, that they should explore the corundum belt and select corundum-bearing lands from it, not to exceed 2,000 acres. Mr. Thomas Hodgson, who had been Professor Miller's assistant in the two previous years, and Mr. M. B. Baker, of Kingston, were engaged to do the necessary prospecting for the location of workable deposits of corundum. By September, 1899, a total area of 1,400 acres had been chosen and these lands were leased on September 15 to the Canada Corundum Company, who were organized to carry on mining and milling operations.

The Canada Corundum Company was, therefore, the first in the field, and in addition to the mining areas leased from the Government, purchased other lands from private owners. These included certain lots having deposits of corundum situated in Raglan, Radcliffe, Brudenell, Carlow, Monteagle and Dungannon townships. Briefly stated, the agreement between the Ontario Government and the Canada Corundum Company, granted to the latter the exclusive right to make the first selection of corudum deposits throughout the Ontario corundum-bearing area, on lands whose mineral rights were still vested in the Crown. The company, as their part of the covenant, agreed to the expenditure of $100,000 on certain specified conditions in the development of these mining lands and the establishment of a corundum industry. The agreement also entailed an obligation on the company's part to conduct certain experiments affecting the use of corundum especially as an ore of aluminum.

Active mining development work was inaugurated in April, 1900, under the supervision of Mr. Thomas Hodgson. The village and post-office were called "Craigmont" in appreciation of the services of Mr. B. A. C. Craig, the first vice-president and general manager of the company, to whose optimism and insistence the world is indebted for the establishment of its greatest natural corundum industry. An old sawmill, with a small water power, on a creek flowing near the base of Robillard mountain, on which the corundum deposits are situated, was almost entirely remodeled, and concentrating machinery, with a crushing capacity of about 20 tons of corundum bearing rock daily, was installed. This mill is about 7 miles from the village of Combermere on the Madawaska river. At first water power alone was used, but in a very short time this was supplemented by a 25 horsepower steam engine. Mining or quarrying operations (for the corundum rock was obtained by means of a series of large open-cuts or excavations), were undertaken on lots 3 and 4, concession 18, of Raglan, and later were extended into the same lots with addition of lot 2 in concession 19, of the same township. The equipment of the mill, which is located close to the line between lots 1 and 2, concession 18, was mainly designed for experimental purposes, following Prof. De Kalb's experimentation at the Kingston School of Mining, but on a much larger scale. It anticipated the construction of a much larger mill when the various problems attending the concentration of the corundum would be more thoroughly understood. Before the end of the year (1900) about 60 tons of cleaned, graded corundum were produced, but of this amount only 3 tons were sold.

Other companies organized.—In 1901, the Imperial Corundum Company, as also the Crown Corundum and Mica Company, both of Toronto, Ontario, were organized, and the same year did a considerable amount of development work, the former on lot 14 and part of lot 15, concession 8, and the latter on lot 14, concession 9, of the township of Methuen, in Peterborough county.

It was the irony of fate that despite the somewhat unusual imposed conditions affecting the lease by the Ontario Government of lands in the belt of corundum bearing rocks, all mining activity, even that contemplated, was on lots which were deeded to the original settlers, inclusive of the mineral rights, many years before.

In the spring of 1901, Mr. John Donnelly, of Kingston, convinced that other deposits or corundum might be found which had not been selected by the Canada Corundum Company, who had been accorded special permission by the Ontario Government to make the first selection of corundum-bearing lands, engaged Messrs. M. B. Baker and A. Longwell to prospect for occurrences of corundum, which gave promise of development as mines. These gentlemen, after a search of about six weeks, selected the corundum deposits situated on lots 27 and 28, concession 19, of Raglan township, in the county of Renfrew. Besides the advantageous situation of these occurrences on the side of a big hill, the location is within a short distance (2.5 miles) of Palmer rapids on the Madawaska river, a water power which with a head of 17 feet has a minimum capacity of 980 horse-power. A company known as the "Corundum Refiners, Limited," was organized under the management of Mr. P. Kirkegaard, formerly of the Deloro Gold Mines, to develop this property. Plans were also made for the erection of a large mill at Palmer rapids, but up to the present time, with the exception of some stripping and other preliminary mining development work, little or nothing has been done.

Ontario Corundum Company.—In July, 1902, the Ontario Corundum Company, with offices at Ottawa and Boston, commenced corundum mining operations at the locality where corundum was originally discovered by Ferrier (lot 14, concession 14, of Carlow township) now known as Burgess Mines. A Blake crusher, 7 x 10 in., was installed to crush the corundum-bearing rock, but it was afterwards found better to cob the ore into large lumps, this hand sorting resulted in a product which would average about 15 per cent. of corundum. This practice was continued until the latter part of 1903, the high grade cobbed product being shipped to the United States for further concentration.

At the end of 1902, the new mill for this company was completed, and high grade, grain corundum was then produced and shipped. The practice adopted was that in use in the corundum mills of North Carolina and Georgia, the crushed rock going to mullers to separate the corundum from the micaceous and decomposition products associated with it. The fines were thus washed away and only the coarser material, after being dried and sized, was concentrated.

The large mill for the Canada Corundum Company was started in January, 1903, and about a year was required to build and equip it. It had a capacity of about 200 tons per day of corundum rock, with a production of between 10 and 12 tons of graded grain corundum daily.

In this same year a detailed contour survey of the southern side of Robillard mountain was made by Mr. John A. Baker, the whole of this slope being denuded of trees. This enabled an accurate mapping of the various outcrops of corundum-bearing rocks, noting any peculiarities of composition, and especially of the presence and relative abundance of corundum. This mining geological work was done by Mr. Alex. Longwell.

In the spring of 1904 the mill of the Ontario Corundum Company was destroyed by fire, but before the end of the year another and larger mill was designed and constructed in which the principle of concentration by dry methods was adopted. The Armstrong property (lot 14, concession 14, Carlow) was operated as a quarry for corundum by the Ontario Corundum Company until June 1, 1905.

The Imperial Corundum Wheel Company, with head office at Buffalo, N.Y., did some preliminary mining development work on lot 13, concession 1, of Monteagle township. The material secured was sorted by hand and the high grade product thus obtained was shipped to Springfield, where it was further concentrated.

The Ashland Emery and Corundum Company were the successors of the Ontario Corundum Company, beginning operations on January 1, 1906. During this year they prospected several locations for corundum in the vicinity of their mill at Burgess Mines, especially at John Armstrong's hill, on lot 10, concession 15, of Carlow. In view of this and the difficulties attending transport, shipments were small and irregular.

During 1906 the Canada Corundum Company, under the managership of Mr. H. E. T. Haultain, did considerable prospecting and some stripping on certain lots in the first and second concessions of the township of Monteagle on the southeast side of the York river. Most of the production for 1906, which amounted to 2,914 tons of grain corundum, valued at $262,448, must be credited to the Canada Corundum Company. Both the Canada Corundum Company and the Ashland Emery and Corundum Company were operating in 1907, the former company producing a considerable tonnage, while at the same time endeavoring to sell the large amount which they had in stock in their warehouses. The latter company in this interval was prospecting besides making some mill runs. A few shipments were made, but mining operations were conducted on a small scale. About the beginning of the year 1908, the Canada Corundum Company ceased operations owing to over-production and the small demand of the market for graded grain corundum. Throughout the year the company was busy trying to sell this great surplus product.

Manufacturers Corundum Company.—In 1909 the Manufacturers Corundum Company acquired the mines and mills of the Canada Corundum Company, and also in the following year the concentrating plant and the properties of the Ashland Emery and Corundum Company. Mr. D. A. Brebner, with headquarters at Toronto, is manager, with Mr. E. B. Clark as assistant manager at Craigmont.

In addition to the corundum quarries at Craigmont, a considerable tonnage has been secured from the corundum deposits immediately north of Grady lake, on lots 14 and 15, concession 16, and at present from lot 10, concession 15, of Carlow township (John Armstrong's hill). Until the total destruction by fire in February, 1913, the operations of the Manufacturers Corundum Company and the consequent production have both been maintained on a large scale, but the burning of their mill will bring about a serious curtailment in their activity, as under the most favorable conditions the capacity of this mill at Burgess Mine cannot be made to exceed 3 tons daily of graded cleaned corundum, operated at its maximum capacity. Furthermore there must be an undue loss, resulting from the crowding of the material and the imperfection of the method in use which is a combination of the wet and dry process.

Progress made.—The corundum industry of Canada, as represented by the operations of the companies, an epitome of whose history has just been related, has made very substantial progress in spite of very many disadvantages. Most of these difficulties were in a manner inherent and peculiar to the product sought to be exploited. Perhaps the most serious disability from which the industry at first suffered, related to its concentration and preparation for market, but closely related adverse conditions affected the selling of the refined article when brought to the high standard aimed at and reached. Almost from its inception it had a worthy competitor in carborundum and a little later alundum, and both of these artificial abrasives have in many fields successfully challenged the superiority of the natural substance. In spite, however, of this very serious competition, there is a steady and a very insistent demand for corundum, which may be regarded and with good reason, as preferable to all other abrasives in certain classes of work. In spite of the very substantial assistance from a practical point of view of the Ontario Bureau of Mines, which in the first place not only directed and controlled the prospecting for corundum, and the concentration of corundum-bearing rock, but helped by their expressed faith in the industry, in the final financial arrangements, the industry had a very small beginning, although its subsequent growth was both rapid and steady. As discovered and first described, the mode of occurrence and geological association of corundum in Hastings were believed to be unique, and it soon became evident that the problems attending its concentration were not only in many respects novel, but likely to prove very complex before corundum of the purity desired could be produced.

Transportation, at first sight apparently simple and inexpensive, proved on experience to be unduly costly and for the most part inadequate. The local labor supply was small and irregular, many of the men employed being unaccustomed and averse to continuous work, and recourse was had to the most trivial domestic demands to secure immunity from steady employment. For many years after the beginning of operations there were frequent changes in the direct management, the mine superintendent alone being allowed to remain until the present time, despite the fact that, either as managers or superintendents some of them had already gained a world-wide experience in concentration methods. The publicity and selling departments also shared in these initial and to some extent unusual difficulties. At first the main objective of those in charge of this department was to supplant emery as an abrasive, ignoring the fact that certain peculiarities in the physical character and composition of emery recommended its use in wheel manufacture, notwithstanding the very manifest superiority of Ontario corundum both as regards purity and abrasive efficiency. Each, although in many respects rivals, as abrasives have certain spheres of usefulness, which may not be invaded by the other. Those in control of the corundum industry neglected altogether to so extend their operations as to engage in the manufacture of the various products requiring the use of corundum, contenting themselves with the less lucrative production of graded grain corundum. However, owing to the unbounded optimism and energy of those in control, especially Mr. B. A. C. Craig, and later Mr. D. A. Brebner, the various difficulties were gradually overcome and the industry firmly established. The various grades of corundum produced are now accepted as standard by the numerous wheelmakers and others engaged in the use of corundum as an abrasive. The degree of purity guaranteed is very closely maintained, while until the total destruction of the big mill at Craigmont, the trade were sure of obtaining a steady and abundant supply of a very uniform product.

Almost coincident with this fire disaster, although more slowly realized, came the conviction that the corundum deposits of Craigmont (Robillard mountain) which were at first thought to be inexhaustible, had reached a stage when it was both difficult and expensive to obtain a sufficient supply of the desirable quality of ore. The decision that such ore is by no means abundant on this hill has been reached by reason of rather extensive drilling and tunnelling operations, combined with the knowledge gained in the operation of the large excavations or quarries. There is, however, a considerable supply of good corundum ore in the deposits north and west of the Burgess Mines in Carlow township. Other deposits of corundum which are regarded as of commercial grade and size, occur in the vicinity of Palmer rapids, in the north-eastern part of Raglan township. These likewise have the advantage of convenient location to existing means of transportation. Deposits of corundum of very distinct promise occur in Brudenell township and in the north-west corner of Faraday township. The mill tests of the material secured from the Monteagle and Dungannon localities in the vicinity of the York river are said to have been disappointing. Transportation will again largely determine the scene of future operations. Competition of artificial abrasive has no doubt lessened the demand and price for natural corundum, but in spite of these there is always a ready demand for the natural product, especially in times of industrial activity. The future of the industry, although uncertain, is by no means without hope.

INTERNATIONAL NICKEL.

The International Nickel Co. has issued its report for the year ended March 31, 1915. The consolidated income account compares as follows:

	1915.	1914.
Earn. con. cos.	$7,049,112	$6,452,758
Other income	181,649	114,029
Total income	$7,230,760	$6,566,787
Exp. tax	517,374	437,812
Net income	$6,713,387	$6,128,975
Int., dep., etc.	1,115,315	1,336,310
Surplus	$5,598,071	$4,792,665
Preferred div.	534,756	534,756
Bal. for com.	*$,063,315	$4,257,909
Common divs.	4,753,938	3,803,150
Surplus	$309,377	$454,759

*Equals to 13.31 per cent. on $38,031,500 common stock, as against 11.19 per cent. on same stock previous year.

The general balance sheet compares as follows:

Assets.

	1915.	1914.
Prop.	$44,016,051	$44,552,025
Adv. Nickel Corp	3,157	1,668
Def. charges	......	39,235
Secr'd loans on call	1,000,000	......
Stocks and bonds	58,210	137,838
Certf. of dep.	950,000	......
Inventories	3,100,381	4,289,021
Accts. rec.	1,416,092	1,615,405
Bills rec.	11,071	10,050
Interest	39,270	......
Adv. for int.	58,529	52,295
Cash	4,542,539	3,243,672
Total	$55,195,300	$53,941,207

Liabilities.

	1915.	1914.
Com. stock.	$38,031,500	$38,031,500
Pref. stock	8,912,600	8,912,600
Misc. Funds	165,501	164,979
Accounts pay.	637,239	642,984
Acc. taxes	89,582	92,757
Common divs.	1,901,575	950,788
Accrd. int.	7,989	5,662
Preferred div.	133,689	133,689
P. and L. surplus	5,315,624	5,006,247
Total	$55,195,300	$53,941,207

In his remarks to stockholders, President Monell says:

"During the fiscal year just closed, the general disarrangement, in both our domestic and foreign business, due to the outbreak of the European war, caused a general curtailment in the demand for the company's products for several months following the outbreak of hostilities.

"In the late fall, when domestic conditions and those affecting foreign shipments and foreign exchange had become adjusted to meet the changed state of affairs brought about by the European war, an increasing demand for the company's products became apparent, with the result that the volume of business for the fiscal year has been somewhat greater than heretofore.

"The plan of extending to the company's employees the opportunity of purchasing stock on a monthly instalment basis, which was inaugurated last year, was continued this year with equally satisfactory results. During the fiscal year the number of stockholders has increased from 3,752 to 4,465."

A NEW MACHINE FOR MAKING AND SHARPENING ROCK DRILL BITS.

The Sullivan machinery company is placing on the market a new drill-making and sharpening machine, designed on the lines of the Imperial Sharpener, for a number of years built by Mr. T. H. Proske, of Denver.

The Sullivan machine bears only a family resemblance to its Denver prototype. The new machine is larger, more heavily built, more powerful. All its working parts are much larger and more substantial and with more generous bearing surfaces. The new machine is about double the weight of the old.

The Sullivan sharpener consists of two members, one horizontal, the other vertical, both mounted on a substantial box-shaped frame. These members consist of Sullivan 2⅝-in. rock drill cylinders, with standard "lite eight" or differential air thrown valve motion. The horizontal drill or hammer is used for upsetting the steel into the shape of the bit or shank, by means of suitable steel dollies, loosely set on the end of the shank or distance piece. In this hammer, the piston is a floating one, as in a hammer drill, and delivers its blows on the upset anvil block-head of the projecting shank.

The vertical member furnishes power for shaping the wings of the bit, etc., and for drawing out and finishing the corners. This work is done by steel dies, one acting as an anvil, and the other attached to the piston rod above, as a swage or hammer. The vertical hammer is operated by a foot lever, which is ordinarily held up by a coil spring. This spring also serves to hold up a release pin, running through the lower valve bushing, and in turn holding the valve away from the lower seat, so that the piston is always held at the upper or rear end of the cylinder, by live air, when the hammer is idle. When the foot treadle is depressed, the pin drops, allowing the valve to seat, and the hammer to start.

The steel is held in position while being upset by steel gripping dies set in a heavy vise, which is operated by air power. This vise simply grips the steel, the forming being done altogether by the upsetting dolly and hammer. This vise consists of a heavy steel yoke, through each end of which runs a massive steel post or column. These posts are joined at the foot by a second yoke, into which fits the lower end of a substantial block or toggle link. The upper end of this link is pinned to a cross head block, running horizontally in guides in the frame. The cross head and link are actuated by a piston rod connected to a piston 12 in. in diameter, running in an air cylinder at the rear end of the frame. When air is admitted behind this piston, the cross-head is forced forward and the link forward and down, carrying the yoke with it, and closing the vise with tremendous force. The power provided by the air is multiplied many times just at the end of the travel, when the cross-head and link form a knuckle-like lever. With air at 100 lb. pressure, the pull thus exerted is estimated at not less than 100,000 lb. per square in.

One of the steel gripping dies is pinned into a socket in the top yoke of the vise, while the other fits a similar socket in the frame or base below.

The vise and the upsetting hammer are operated by one hand lever, the valve motion being so controlled that as the handle is depressed, the vise is closed before air is admitted to the upsetting cylinder. Further depression starts the hammer reciprocating. The vise valve rod contains a link and coil spring which holds the valve in position to keep the inlet port to the upsetting cylinder closed when the machine is idle.

In stopping the machine, the lever is raised, first shutting off air from the upsetting hammer and, when this has stopped, opening the vise.

Air enters the machine at the rear by standard pipe connections. No hose is employed, except a short length for cleaning purposes. One arm of the inlet pipe enters the valve chest of the vise or clamping cylinder, while a second supplies the vertical hammer. An outside connection leads air from the side of the clamping cylinder chest to the valve chest of the upsetting hammer.

The exhaust from this cylinder is led directly into the frame. Exhaust air is led from the clamp valve chest, by a pipe and red passages, to the vise rod guides. Whenever the vise is opened, this exhaust air escapes, effectively blowing dirt and scale out of the dies and clamp. A similar arrangement is used in the vertical member to keep the dies clean.

Bits of any form and gauge may be on this machine, on steel of any shape, solid or hollow; and shanks also may be formed to order, providing proper dollies and dies are furnished. The collared shanks on hollow steel for rotators or hand-feed hammer drills, and the lugged shanks for mounted water jet hammer drills are two forms that are made economically and rapidly.

It is an accepted fact that no improvement on or even satisfactory substitute has been found for the making and sharpening of drill bits by the hand work of a skillful blacksmith, in so far as the character of the steel is concerned. The drill sharpening machine makes bits faster and more uniformly, as to shape and gauge, than can the most expert hand-smith. But the qualities given the steel by the constant hammering of the bit on the anvil are not secured by mechanical means such as squeezing or molding, sometimes used as a substitute. Practical drillmen know that the footage drilled by a new bit is not as great as it will be after the bit has been under the blacksmith's hammer a few times. In other words, the hammering refines, toughens and aligns the structure of the steel in the direction that gives greatest resistance to wear and shock.

This is the effect secured by the Sullivan sharpener, in which all work, from first to last, is done by hammering, so that to the uniformity of gauge and perfection of shape attained in other sharpeners as well, are added the qualities of increased durability, toughness and strength.

COPPER.

Boston, June 11, 1915.

Instead of abating in any degree, the foreign demand for copper shows signs of increasing. Cabled inquiries for the metal early in the week have been followed by new demands from abroad calling for much larger tonnages than were originally sought.

The present record-breaking buying movement in copper got under way in big volume last Friday, since which time sales have crossed the 100,000,000 lb. mark according to estimates of producers booking large quantities.

PERSONAL AND GENERAL

Mr. H. C. Bellinger, of Spokane, Washington, for a number of years an operating metallurgist in British Columbia, and afterward general manager for the Great Cobar, Ltd., in New South Wales, Australia, was in San Francisco last month on his way to Nevada.

Mr. James Ashworth, of Vancouver, B.C., has been appointed by the Provincial Government, British Columbia, to make an investigation with the object of ascertaining the cause of the recent explosion in the Western Fuel Co.'s Reserve mine, near Nanaimo, Vancouver Island, B.C.

Mr. T. Walter Beam, of Denver, Colorado, is expected to again spend the field season in Similkameen district, British Columbia, as representative of the New York Syndicate No. 2 in connection with its exploration, by means of diamond drills, of a group of mineral claims situated in Camp Hedley.

From Fairbanks, Alaska, has come information to the effect that Mr. W. J. Elmendorf, of Seattle, Washington, who was for several years general manager for companies developing mining properties in Portland Canal mining division, British Columbia, has left Fairbanks for the Kantishna where, in the interests of New York capitalists, he will visit various mining properties and probably as well ascertain the availability or otherwise of the Nenana river for water-power purposes.

Mr. W. D. Greenough, manager of the Pueblo mine in Whitehorse copper camp, Southern Yukon, who went East a few weeks ago, was expected to return to the mine by the beginning of June.

Mr. Francis Glover, mine manager for the Princeton Coal and Land Company, operating a coal mine at Princeton, Similkameen, B.C., has been appointed agent for the holders of the Roany placer leases, on Tulameen river, about nine miles above the junction of that stream with the Similkameen.

Mr. Ronald Harris, formerly engaged in mining engineering in Canada, left Seattle, Washington, on April 25 for Knik, Alaska.

Mr. John Hopp has returned to Barkerville, Cariboo, B.C., after having spent the winter away from the several hydraulic placer-gold mines, owned by himself and associates and in that district.

Mr. Joseph G. S. Hudson, of the Division of Explosives, Mines Branch, Ottawa, who had been attending an inquest held at Nanaimo, B.C., on May 17, in connection with the death of some miners when the Pacific Coast Coal Co.'s South Wellington mine was flooded last February, has since been investigating the disaster that occurred on May 27 when 22 men lost their lives in an explosion at the Reserve mine, near Nanaimo.

Mr. Henry Johns, of the mining engineering firm of Keffer & Johns, of Spokane, Washington, was at Greenwood, Boundary district, about the middle of May.

Mr. Oscar Lachmund, of Greenwood, B.C., general manager for the British Columbia Copper Co., and the Canada Copper Corporation, recently investigated a mining property situated near Oroville, Washington.

Mr. Jules Labarthe, for a number of years superintendent of the lead and copper smeltery at Trail, B.C., and since then general manager for the Mason Valley Mines Co., Nevada, paid a visit to Trail last month. He is now a member of the firm of Bradley, Bruff & Labarthe, mining and structural engineers, San Francisco, California.

Mr. Lewis A. Levensaler, of the Tacoma Smelting Co., Puget Sound, Washington, was in Ashcroft mining division, British Columbia, last month, investigating a copper property.

Mr. W. H. Linney, who some years ago was connected with mining in Ontario, is now president and manager of the Dominion Silver-Lead Mines Co., which is preparing to resume development of its mine near Colville, Northeastern Washington.

Mr. I. L. Merrill, of Los Angeles, California, president of the Hedley Gold Mining Co., arrived at Hedley, Similkameen, B.C., on May 11, on one of his periodical visits to the company's gold mine and stamp mill, situated in Camp Hedley.

Mr. M. E. Purcell, of Rossland, B.C., superintendent of the Consolidated Mining and Smelting Co.'s Centre Star-War Eagle group of mines, recently left Rossland to spend a month's vacation visiting the Panama-Pacific International Exposition at San Francisco, California, and other places of interest on the Pacific Coast.

Mr. Roy Wethered, for some time with the Consolidated M. & S. Co., at its mines and concentrating mill in Ainsworth camp, is now superintendent for the United Copper Co.'s concentrating plant at Chewelah, Washington, U.S.A.

Mr. J. B. Tyrrell, Toronto, was elected president of the Geological Section of the Royal Society of Canada at its annual meeting held in Ottawa May 25-27.

Mr. J. S. DeLury is at Neuchatel, Alberta.

Mr. J. B. Tyrrell is in the Michipicoten District, examining mining properties there.

Prof. H. E. T. Haultain has been appointed arbitrator in a dispute between McCamus & McKelvie, lumbermen, and several mining companies operating at Cobalt.

Mr. C. H. Poirier has returned to Porcupine from New York.

Messrs. Jas. McEvoy, Toronto; Mr. C. H. Little, Haileybury; Walter Herd, Glace Bay, and E. D. Black, Edson, have been recommended to the Department of Militia and Defence, by a committee of the Canadian Mining Institute, to act as instructors in certain branches of mining practice to troops now in training for overseas service.

Mr. George Dunkell, head driller for the Western Pacific Co., Calgary, was struck by lightning and seriously injured on May 24.

Mr. George Watkin Evans, of Seattle, was in New York recently on professional business.

Mr. A. G. Burrows of the Ontario Bureau of Mines, is at Porcupine, gathering additional material for his geological report on the gold district.

Mr. Herbert M. Wilson, engineer in charge of the Pittsburg Experiment Station of the United States Bureau of Mines, has resigned from the Government service to become the director of a newly-formed organization to be known as the Coal Mine Insurance Association.

George O. Bradley, Charles E. Bruff and Jules Labarthe announce the opening of new offices in the Hobart Building, San Francisco, under the firm name of Bradley, Bruff & Labarthe.

NIPISSING.

Cobalt, Ont., June 10, 1915.

During the month of May, Nipissing mined ore of an estimated value of $175,522, and shipped bullion from Nipissing and Customs ore of an estimated value of $277,671. In the same period the high-grade mill treated 177 tons of ore and shipped 553,007 fine oz. of silver, while the low grade mill treated 7,016 tons. The estimate of production for the month is: High-grade, $102,324; low-grade, $73,198; total, $175,522.

SPECIAL CORRESPONDENCE

PORCUPINE AND SWASTIKA

Goodfish.—There is an excellent chance that the development which is taking place in the Goodfish Lake district may bring forth fruit in the shape of productive mines. In consequence of the great shortage of money for prospects, only the most essential work is being done; but the results to date have been quite satisfactory. Goodfish is an extension of the Kirkland Lake belt. The claims there were staked shortly after the Tough-Oakes and neighboring claims had been staked, and many of them have been held since. Little more than the assessment work has been undertaken until this year. Goodfish is partly in the township of Morissettee and not more than an hour's brisk walk over an excellent trail from Kirkland Lake. A bush road is now being built.

The Costello, in which Mr. C. A. Foster has a third interest, is the pioneer claim of the section. Some years ago it was stripped, a few test pits sunk, and it was thoroughly sampled, with the result that on the surface it gave an assay of seven to eight dollars over a width of from fifteen to twenty feet. Nothing of any importance has been attempted on it since, though it is now said that it is going to be developed.

The Martin claim adjoins it. Upon this property a shaft has been put down twenty feet, with the result that some very spectacular ore has been found. It is similar in character to that obtained in the Tough-Oakes vein, and is of good width. Much of the ore which does not show visible gold upon roasting exhibits beads of it.

The Gibson claim, at the other end of the same lake, is under option to a New York and Buffalo syndicate, for whom Mr. Frank Loring is acting. A shaft has been put down on the incline following the vein to eighty feet. At that depth there are two distinct veins of ore showing much molybdenite and some visible gold. Careful sampling indicates that four feet across the shaft an average assay will go at least sixty dollars and will often run up as high as eighty dollars. On the surface the vein was very narrow indeed.

There is no machinery in the camp at all yet, but a road is being built, and some may be taken in before the summer is much further advanced.

Tough-Oakes—Two properties are working in or near Kirkland Lake. The Tough-Oakes mill is now running at full capacity and regular clean-ups are being made. In the month of May the clean-up ran between $50,000 and $60,000. About 2,400 tons of ore was treated. It is the endeavor so to mix development ore with that stoped that a grade of twenty dollars a ton should go to the mill. At present, owing to some peculiarities of the ore, the Hardinge mill is not crushing more than eighty tons a day, while the tube mills can handle 60 tons each and the cyanide plant is capable of treating far more than is at present going to it. If it is not found practicable to tune up the Hardinge mill so that it will treat a hundred tons a day another and smaller mill will be installed. The mill is making an extraction of about 90 per cent. at present, and the tails, which are running about $1.40, are being impounded for further treatment. Several minor mechanical changes have yet to be made, and the management is confident that the extraction will be raised very considerably. In the mine all the ore is coming from the main shaft in the west drifts. Both at the 200 and the 300 ft. levels the vein has faulted and crosscuts are being run to pick it up beyond the fault. A crosscut is also being run to connect with the No. 3 shaft and to pick up the No. 6 vein.

At the Lake Shore mine, operating on a bay of Kirkland Lake, some interesting conditions have been found. The vein was followed down the shaft to 84 ft. when it dipped out. The shaft was carried down vertically. Upon crosscutting, the vein was soon picked up, but it did not give pay ore across a milling width until the contact between the porphyry and the conglomerate was reached, when the assay across 5 ft. jumped up to about sixty dollars. While the average values were not maintained at that high figure, yet as long as the vein followed the contact the ore was of good grade. To the east, under the lake, the vein has been followed for some distance and some crosscutting done. It is of good width and it is well defined and carries some gold. A diamond drill is now being operated boring a flat hole, and some small leads have already been crosscut in the porphyry. It is hoped by this work to pick up the extensions of the Wright-Hargreaves and the Teck-Hughes ore bodies which undoubtedly both run into the lake.

Porcupine Crown.—The diamond drilling and crosscutting to the south of the present workings at the Porcupine Crown has produced most satisfactory results. On the 200 and 300 ft. levels crosscuts have picked up the vein beyond the second fault and drifting is now continued in good high grade ore. On one level the drift is in good ore 60 ft. beyond the fault, in another, 40 ft. A considerable amount of exploration work was necessary before the extension of the vein was found.

On the 500 ft. level a horizontal hole was pushed to the south from the south end of the workings, with the result that the vein has been cut very much where it was anticipated it should be found. This discovery indicates that below 550 ft. or thereabouts the ore body should be continuous instead of being broken by the faults. The mill is still making a remarkable extraction. On several days last month the extraction amounted to no less than 98.41 per cent. on a $16 head. It has now been determined to treat the residues in the tailings pond before they are covered up with the waste dump, and fifty tons of it will be handled a day. These residues run a little more than three dollars per ton, so that the production from the mine will be cut down while they are being treated. On the other hand more drills will be available for development of the territory to the south, which has just been opened, and the mine will not be required to furnish a hundred tons of ore a day.

Imperial.—The steam plant of the Porcupine Imperial is now working and two drills are being operated. It is also understood that a contract for diamond drilling has been let.

McIntyre.—The new directorate of the McIntyre visited the property recently for the first time. It is understood that it has been determined to carry on a most aggressive policy of development underground, as it is considered that the prospects of the property fully warrant it.

The production from the McIntyre was considerably lower last month owing to the fact that a larger proportion of ore was taken from No. 4 shaft, where there is a considerable amount of sericite in the ore and it is difficult and slow to settle.

The construction of the Schumacher mill is finished. The work was started only on April 17th, and the whole has been finished and roofed in by June 20 by the contractors. All the machinery has been ordered, but none of it has arrived as yet.

In a crosscut from the main shaft to the McIntyre line, one of the series of veins cut with a diamond drill has been cut. It is 4 ft. wide and of a good grade of ore. It is one of a series of veins that is known to come across into the property from the McIntyre.

COBALT, GOWGANDA, SOUTH LORRAIN

Coniagas.—Drifting on the new vein found on the Coniagas mine from their new shaft in the centre of the town still continues with satisfactory results to the company. The company last week shipped three cars of concentrates to the Coniagas Reduction smelter at Thorold.

Nipissing.—Several new veins have been found by the hydraulic near Peterson Lake. These veins are narrow and the grade of ore is not high, but they are of good length and they are being developed. The pump will shortly be moved to Cart Lake, where it will be used to wash off the overburden on the conglomerate area owned by the Nipissing. A little superficial trenching was done on this area in the earlier days of the Nipissing. Underground quite a lot of drifting and crosscutting has been done from shaft 150, but veins found carried no silver of any importance. The Nipissing has about a hundred acres here which should be very well worth prospecting, as it is all conglomerate and of a good depth.

Temiskaming.—From the Temiskaming mine there has been shipped the heaviest weight of silver that has ever left the camp in the form of crude ore. The car weighed approximately 85,400 lb., contained 308,000 oz. and was valued at $152,460. The car was only valued by grab sample, but those are approximate figures.

It is not the richest car in regards to dollars and cents received from the smelter. Two years ago this fall when silver was selling at 64½ cents the McKinley-Darragh marketed a car of ore weighing 77,000 lb. containing 245,000 oz., for which they received net from the smelters $154,000. This was not as rich a car, considered from a value per ton basis, as the Temiskaming, and it is probable that the cars shipped from the Nipissing in the very early days of the camp and from the O'Brien in 1906 contained a larger percentage of silver. As regards the highest percentage of silver per ton, it is probable that the palm goes to the car shipped out of the Reeves Dobie at Gowganda, but it did not contain more than seven or eight tons.

Bullion shipments from the camp to England are scarcely less to-day than they were before the war, with the exception of the Nipissing. That company ships its bullion to agents in New York, who re-consign it to London.

NOVA SCOTIA

Dominion Coal Outputs.—The production of the Glace Bay mines for May will be roughly 440,000 tons, comparing with 405,351 in May, 1914. This is the first occasion for a year that the monthly production has exceeded that of the corresponding month in the previous year. The total output of the Glace Bay mines for the five months ending May will be 1,627 tons, comparing with 1,801,773 obtained during the corresponding period of 1914.

The output of June, 1914, was 452,270 tons, the largest single month's production ever obtained by this company from the Glace Bay collieries. It is expected that the outputs of June, 1915, will at least equal those of last June, and it will not be surprising to see them exceeded.

The production of the Springhill collieries for May will be about 31,000, slightly less than last May. The aggregate to the end of the five months, January to May, will be about 165,000 tons, or almost identical with the figures for the corresponding period of 1914.

The output from the twin collieries, Nos. 2 and 9, for May was the largest these mines have yet produced. The production of No. 2 (Phalen seam) was 76,000 tons, exceeding by three thousand tons the highest recorded figure for one month. The output of No. 9 was 40,000 tons, being within a few hundred tons of the best performance of this colliery. The mines were idle one day in the first fortnight of the month because of lack of outlet, and were again idle on Victoria Day, so that this record production was obtained in 24 working days, compared with the maximum of 27 working days. The combined production of the two seams was therefore 116,000 tons for the month, or an average of almost 5,000 tons daily. No. 2 colliery is now about fourteen years old, and it is no mean achievement to get so large an output at this date, without any notable expenditure having been made on equipment for many years past.

The "Morwenna" torpedoed.—A reminder of the actuality of the war has been given to Cape Breton in the torpedoing of the "Morwenna." This vessel was one of the "Black Diamond" Line vessels, which, owing to the temporary abandonment of the Newfoundland-Cape Breton-Montreal service by the Dominion Coal Company, was engaged in freighting steel products to Great Britain and France. Not content with torpedoing the "Morwenna," without warning, the German submarine shelled the vessel and killed one of the hands as the boats were being lowered. So far as your correspondent is aware, this is the first Canadian steamer to be destroyed by the Germans, presumably because it was the first time they had the opportunity. One nation on this side the Atlantic has solemnly stated it will hold the Imperial German Government to "strict accountability" for its submarine warfare. There is another nation in America that is already engaged in the straightening of accounts with Germany, and the Canadian people may be credited with average memories. Perhaps when this war is over it may be possible to buy a Sheffield blade in a Canadian store without the necessity of bulldozing the proprietor. It would be interesting to ask how many persons in Canada are under the impression that "Boker" cutlery is made in Sheffield. Irish linen collars may perhaps be preferred to Austrian-made collars when the little pleasantries of the Teuton are ended, and perhaps the legend "Made in Germany" may cease to flaunt itself on every article in the "Fifteen Cent Stores." Maybe underwear that is manufactured in Nova Scotia and in Ontario may be preferred by Canadians, to underwear made in the purlieus of Berlin-on-the-Spree, and possibly the words "Made in Austria" may no longer appear on every high quality lead pencil used in Canadian drawing-offices. And conceivably when the smoker wishes to light his pipe in days to come he may not be requested to "zunden an den braunen Streichflachen" with matches that are made in Zanow, Pommern—otherwise Prussia. It may be remembered that it was the

Pomeranians that burned Louvain and murdered its citizens.

We shall owe something to the men who fell at Langemarck, and the Canadian women and children who went down with the "Lusitania" on that day when the German commercial traveler ceases to murder sleeping babies and to poison wells and comes to Canada with samples of his wares.

BRITISH COLUMBIA

A General Review.—On the whole, mining in British Columbia is not now adversely affected to any very considerable extent by the war in Europe, the branches of the industry that last year experienced a decided setback having in large measure recovered their equilibrium, or, where production is not normal, other influences now being mainly responsible for lack of progress. For instance, placer-gold mining was continued as usual throughout the whole of the 1914 season, and now that the 1915 season has been opened, all the larger placer-gold mines that were operating last year have commenced this year's hydraulicking or other mining. In lode-gold mining, the chief important mines on the list of producers at this time last year, but not now contributing to the production of this metal, are those of the British Columbia Copper Co., the continued suspension of which is attributable to other causes. Several lead and silver-lead mines, notably the Bluebell, in Ainsworth division, and the Standard, in Slocan, that had not earlier resumed production, owing mainly to less favorable terms obtainable from the smelting company, are again being worked and will shortly be again on the shipping list. Zinc-lead ore is being treated at the concentrator of the Silverton Mines, Ltd., owning the Hewitt-Lorna Doone group, situated a few miles from Slocan lake, and the Rambler-Cariboo and Ivanhoe mills in Central Slocan, are also turning out a silver-zinc as well as a silver-lead product. Both the Ruth and the Slocan Star concentrators, in the same neighborhood, have been prepared for a resumption of milling, and both are equipped for making the two kinds of concentrates just mentioned. Further, the Standard mill, at Silverton, has had added to its modern equipment for concentration of silver-lead-zinc ores a small experimental unit with the object of giving a trial to French's process for separation of zinc and lead, which process, as stated in an official description published in the Annual Report of the Minister of Mines for British Columbia for 1911 (pp. 163-5) "aims at the extraction and recovery of the zinc contained in ores, such as the silver-lead-zinc ores of the Slocan, leaving as a residue the silver-lead, iron, and gangue-matter, which would afterward be smelted in the same manner as a lead-ore free from zinc." The Granby Consolidated Co. is now operating its mines and smelting works in Boundary district to full ordinary capacity, thereby again contributing largely to the production of copper and, in much smaller measure, to that of lode-gold and silver. As already mentioned, the British Columbia Copper Co. is not now producing, so that its usual proportion of those metals is lacking, but it is stated it will soon again be operating. In Kootenay district, the Consolidated Co. has not yet resumed production of silver-copper ore at its Silver King group, near Nelson. On the Coast, production temporarily has been halted at the Britannia mine as a result of the destruction, on March 22, of its aerial tramway, upper terminal and other works at the mine, but preparations for resuming ore-production are being energetically carried on, so that here, too, an early return to productive operation is expected. The Granby Consolidated Co.'s comparatively large addition to the output of copper in the Coast district, is, however, more than compensating for the present loss in total quantity caused by the enforced suspension of production from the Britannia mine. As to coal mining, the position is not generally satisfactory, but to a considerable extent this is attributable to the substitution of oil for coal as fuel by railway and steamship companies. With the object of reducing the advantages fuel oil has in competition with coal in the Coast and lower mainland districts, the Dominion Government is being urged to place a sufficiently high customs duty on fuel oil as to in large measure protect the coal-mining industry; on the other hand transportation companies are also making strong representations to the Government showing that their considerable expenditures in making provision for the use of oil as fuel must also be taken into serious account in dealing with this question.

Ore Production.—The increase in total quantity of ore received at the Consolidated Mining and Smelting Co.'s works at Trail, as indicated earlier in the month, is being maintained; though it is not yet general, decreases in receipts from some parts of Kootenay district are more than compensated for by increases in those from others. The total for four weeks ended May 27 was 32,051 tons as compared with 26,583 tons for the corresponding period in 1914. The respective proportions for the two years, the figures in brackets being for May of 1914, are as follows: East Kootenay 4,145 (1,353) tons, Ainsworth 518 (1,540) tons, Slocan 407 (1,650) tons, Nelson 295 (1,609) tons, Rossland 23,729 (19,495) tons, Boundary 15 (24) tons, State of Washington 2,942 (912) tons. The considerable increase from East Kootenay was in ore from the Sullivan Group lead mine; the greater part of the decrease from Ainsworth mines was from the Bluebell, at which, however, work was resumed late in May after a suspension of operations that lasted nine months; in Slocan, similarly, the decrease was attributable chiefly to the non-production this year of one mine—in this case, the Standard—but here again, operations have quite lately been resumed; in Nelson division, too, the smaller total is accounted for by the fact that a single producer of last year—the Silver King, which then shipped 1,545 tons—has not made any output this year. The increase of amounts received from both Rossland and Washington mines is satisfactory; of the latter, there were ten shippers in May of this year as compared with but four during the same month of 1914.

AMERICAN ZINC.

According to the Boston News Bureau the American Zinc, Lead & Smelting Co. is 70 per cent. sold for the balance of this year. In other words, all but 30 per cent. of the spelter and concentrates which it will produce for the second six months has been contracted for. Were the company to avail itself of to-day's bid prices for spelter it could sell its remaining output at prices to show an average of 20 cents per lb. for the last half of the year. Such is the mad competition for supplies of spelter from manufacturers who have taken big ammunition orders and who, of course, cannot sign contracts until they are sure of their ability to get their spelter, or for that matter spelter for delivery this side of September 1, there is none, and those who have charge of selling the output available for delivery in October, November and December are at their wits' ends to know what to do—grab a certain fabulous profit or wait for more?

MARKETS

TORONTO MARKETS.

June 10, 1915—(Quotations from Canada Metal Co., Toronto)—

Spelter, 35 cents per lb.

Lead, 8 cents per lb.

Tin, 45 cents per lb.

Antimony, 40 cents per lb.

Copper casting, 22 cents per lb.

Electrolytic, 22 cents per lb.

Ingot brass, yellow, 13c.; red, 15 cents per lb.

June 10, 1915—(Quotations from Elias Rogers Co., Toronto)—

Coal, anthracite, $7.50 per ton.

Coal, bituminous, $5.25 per ton.

NEW YORK MARKETS.

June 10, 1915—Connellsville coke (f.o.b. ovens)—

Furnace coke, prompt, $1.50 to $1.55 per ton.

Foundry coke, prompt, $2.00 to $2.40 per ton.

June 10, 1915—Tin, straits, 40.25 cents.

Copper, Prime Lake, 19.50 to 19.75 cents.

Electrolytic copper, 19.50 to 19.75 cents.

Copper wire, 20.75 to 21.00 cents.

Lead, 5.85 to 6.00 cents.

Spelter, 26.00 to 27.00 cents.

Shet zinc (f.o.b. smelter), 30.00 cents.

Aluminum, 28.00 to 29.00 cents.

Nickel, 45.00 to 48.00 cents.

Platinum, soft, $40.00 per ounce.

Platinum, hard, 10 per cent., $42.00 per ounce.

Bismuth, $2.75 to $3.00 per pound.

Quicksilver, $74.00 per 75-lb. flask.

SILVER PRICES.

	New York. cents.	London. pence.
May—		
26.	49¾	23 9/16
27.	49⅝	23½
28.	49½	23 7/16
29.	49¼	23 5/16
31.	..	23 5/16
June—		
1.	49⅜	23⅜
2.	49¼	23 5/16
3.	49¼	23 5/16
4.	49⅛	23¼
5.	49¼	23 5/16
7.	49⅜	23⅜
8.	49½	23 7/16

STOCK QUOTATIONS.

(Courtesy of J. P. Bickell & Co., Standard Bank Building, Toronto, Ontario.)

New York Curb.

	Bid.	Ask.
Alaska Gold	36.00	36.50
British Copper	.50	.87½
Braden Copper	7.37½	8.12½
California Oil	283 00	285 00
Chino Copper	47.62½	47.87½
Giroux Copper	.50	1.50
Goldfield Cons.	1.50	1.56¼
Green Can.	36.00	38.00
Granby	84.00	84.50
Inspiration Copper	32.87½	33.00
International Nickel	140.50	141.50
Miami Copper	26.50	26.62½
Nevada Copper	16.00	16.12½
Ohio Oil	136.00	138.00
Ray Cons. Copper	24.50	24.87½
Standard Oil of N. Y.	184.00	187.00
Standard Oil of N. J.	102.00	104.00
Standard Oil (old)	1315.00	.....
Standard Oil (subs.)	970 00	.....
Tonopah Mining	7.00	7.12½
Tonopah Belmont	4.43¾	4.56¼
Tonopah Merger	39.00	40.00
Yukon Gold	2.50	2.75

Porcupine Stocks.

	Bid.	Ask.
Apex	.02½	.03
Dome Extension	.08	.08½
Dome Lake	.10	.10½
Dome Mines	14.25	14.75
Foley O'Brien	.30	.35
Hollinger	25.75	26.25
Jupiter	.09½	.10¼
McIntyre	.42	.42½
Pearl Lake	.01	.01½
Porcupine Gold	.00½	.00¾
Porcupine Imperial	.05⅝	.05¾
Porcupine Crown	.78	.80
Porcupine Vipond	.46	.46½
Porcupine Tisdale	.02	.03
Preston East Dome	.02	.02½
Rea	.10	.12
West Dome	.03¼	.03¾

Cobalt Stocks.

	Bid.	Ask.
Bailey	.02½	.02⅝
Beaver	.32½	.34
Buffalo	.60	.90
Chambers Ferland	.16	.18
Coniagas	5.00	5.25
Crown Reserve	.80	.83
Foster	.04	.05
Gifford	.02	.02½
Gould	.00⅛	.00⅝
Great Northern	.02¼	.02½
Hargraves	.01	.01½
Hudson Bay	.....	19.50
Kerr Lake	4.55	4.75
La Rose	.49	.55
McKinley	.30	.33
Nipissing	5.65	5.75
Peterson Lake	.22½	.22¾
Right of Way	.04	.05
Silver Leaf	.02½	.03
Temiskaming	.34½	.34¾
Trethewey	.13	.15½
Wettlaufer	.03¼	.03½
Seneca Superior	1.00	1.15

PROFESSIONAL DIRECTORY.

The very best advice that the publishers of the Canadian Mining Journal can give to intending purchasers of mining stock is to consult a responsible Mining Engineer BEFORE accepting the prospectus of the mining company that is offered them. We would also strongly advise those who possess properties that show signs of minerals not to hesitate to send samples and to consult a chemist or assayer Those who have claims and who require the services of a lawyer, with a thorough knowledge of Mining Law, should be very careful with whom they place their business.

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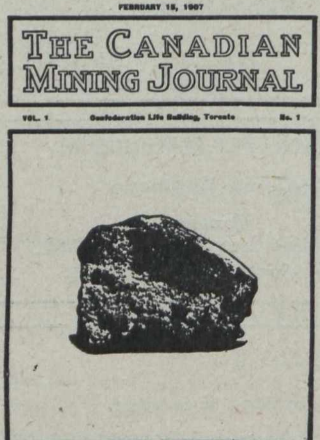

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Can. Ingersoll-Rand Co., Ltd
Northern Canada Supply Co.

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Northern Canada Supply Co.
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Smart-Turner Machine Co.
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Forging—
M. Beatty & Sons.
Smart-Turner Machine Co.
Peacock Bros.
Boving & Co. of Canada, Ltd.

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Furnaces—Assay—
Lymans, Ltd.
Mussens, Ltd.

Furnaces—Electric—
Boving & Co. of Canada, Ltd.

Fuse—
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Curtis & Harvey (Canada), Ltd.
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Canadian H. W. Johns-Manville Co., Ltd.

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Boving & Co. of Canada, Ltd.

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Mussens, Ltd.
Northern Canada Supply Co.

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Sullivan Machinery Co.
Fraser & Chalmers of Canada, Limited
Can. Ingersoll-Rand Co.
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Mussens, Ltd.
Northern Canada Supply Co.

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Northern Canada Supply Co.

Jigs—
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Roberts & Schaefer Co.

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Mussens, Ltd.
Northern Canada Supply Co.

Lamps—Safety—
Mussens, Ltd.
Canadian Explosives.
Peacock Bros.

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

Locomotives—Electric—
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Jeffrey Mfg. Co.

Locomotives—Steam—
Mussens, Ltd.

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Ledoux & Co.
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Hendrick Mfg. Co.

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Peacock Bros.

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Mussens, Ltd.
Northern Canada Supply Co.
Smart-Turner Machine Co.

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Mussens, Ltd.
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Jones & Glassco.

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Mussens, Ltd.
Fraser & Chalmers of Canada, Limited

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Pulleys, Shafting and Hangings—
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Northern Canada Supply Co.
Dodge Mfg. Co., Ltd.

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Boving & Co. of Canada, Ltd.
Mussens, Ltd.
Northern Canada Supply Co.
Peacock Bros.
Canadian Ingersoll-Rand Co. Ltd.
Fraser & Chalmers of Canada, Limited

Pumps—Centrifugal—
Boving & Co. of Canada, Ltd.
Mussens, Ltd.
Smart-Turner Machine Co.
Peacock Bros.
Thos. & Wm. Smith.
M. Beatty & Sons.
Can. Ingersoll-Rand Co., Ltd
Fraser & Chalmers of Canada, Limited

Pumps—Electric—
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Mussens, Ltd.
Canadian Ingersoll Rand Co., Ltd.
Fraser & Chalmers of Canada, Limited

Pumps—Pneumatic—
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Can. Ingersoll-Rand Co., Ltd

Pumps—Steam—
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Mussens, Ltd.
Thos. & Wm. Smith.
Northern Canada Supply Co.
Smart-Turner Machine Co.

Pumps—Turbine—
Boving & Co. of Canada, Ltd.
Mussens, Ltd.
Canadian Ingersoll-Rand Co., Ltd.
Fraser & Chalmers of Canada, Limited

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Smart-Turner Machine Co.

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Fraser & Chalmers of Canada, Limited

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Mussens, Ltd.
Northern Canada Supply Co.
Can. H. W. Johns-Manville

Rope Blocks—
Mussens, Ltd.

Rope Wheels—
Dodge Mfg. Co., Ltd.

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Jones & Glassco.
Mussens, Ltd.
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Thos. & Wm. Smith, Ltd.

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

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

Screens—
B. Greening Wire Co., Ltd.
Mussens, Ltd.
Jeffrey Mfg. Co.
Northern Canada Supply Co.
Peacock Bros.
Fraser & Chalmers of Canada, Limited

Screens—Cross Patent Flanged Lip—
Hendrick Mfg Co.

Separators—
Smart-Turner Machine Co.
Peacock Bros.

Shafting—
Dodge Mfg. Co., Ltd.

Sheets—Genuine Manganese Bronze—
Hendrick Mfg. Co.

Shovels—Steam—
Mussens, Ltd.
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Dodge Mfg. Co., Ltd.

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Hendrick Mfg. Co.

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Mussens, Ltd.
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Fraser & Chalmers of Canada, Limited
Hendrick Mfg. Co.

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B. Greening Wire Co., Ltd.

Transformers—
Northern Electric Co., Ltd.
Peacock Bros.

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Dodge Mfg. Co., Ltd.

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Peacock Bros.
Fraser & Chalmers of Canada, Limited

Turbines—
Peacock Bros.
Fraser & Chalmers of Canada, Limited

Turbines—Water—
Boving & Co. of Canada, Ltd.

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Peacock Bros.
Canadian Ingersoll-Rand Co., Ltd.

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Mussens, Ltd.
Northern Canada Supply Co.
B. Greening Wire Co., Ltd.

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Standard Underground Cable Co., of Canada, Ltd.

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Roessler & Hasslacher.

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