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SILVER MINING

The outlook for silver mining companies is now much brighter than in the first few days of the war. A market has been found for silver ore, and the prospect of an advance in price of the metal is in some quarters considered very good. At Cobalt the few important mines which were closed down are now producing again.

Transportation has been made safer on the Atlantic by the driving of the enemy's warships from the trade routes. The risk of shipping even such a valuable cargo as silver bullion will, it is hoped, soon be a small one. In the meantime bullion is being produced and stored.

As the Cobalt district produces about thirty million ounces of silver annually, an amount equal to one-half of the production of the United States, an entire loss of the market for silver even for a few months would have been seriously felt in Northern Ontario. The industry gives profitable employment to several thousand men and pays handsome dividends to the stockholders. It is therefore a pleasure to record that the pessimism of the first few days has given way to optimism.

Many forces have been at work to protect the industry. The companies could scarcely be expected to have provided for such an emergency. Some were fortunately in a position to continue operations in spite of the temporary loss of a market for silver or silver ore. Others found themselves in embarrassing positions, and discontinued work while studying the situation. It is to be hoped that the companies which dismissed their men will be able to show that such action was necessary. There seems to have been undue haste, coupled with a disregard for the fortunes of employees. If it was done simply to save money for dividend purposes, it was inexcusable. Loyal employees should be given more consideration.

SILVER FOR COINAGE

In the United States Senate during the past few weeks a determined effort has been made to obtain Government assistance for the silver producing mines of the Western States. As a result there has been passed a bill providing for the purchase by the Government of 15,000,000 ounces of silver. It is not expected that this amount will be immediately needed, nor is it likely to be purchased unless the price falls below 53 cents per ounce. According to Senator Thomas the amount necessary for the purposes of subsidiary coinage seldom exceeds 3,000,000 ounces per year. Senator Smoot explained that the bill only provides that the Secretary of the Treasury can anticipate the requirements for the purchase of silver up to 15,000,000 ounces.

In the discussion on the bill interesting points concerning the use of silver for coinage were brought out. Senator Smoot said:

"Not until the end of the Franco-Prussian war, when Germany stood with her heel upon the neck of crushed and prostrate France, levying upon her a war tribute of five thousand milliards of francs, to be paid before her territory would be evacuated, was there any serious disturbance in the monetary world between the operations of gold and silver as money, which were conjointly discharging the financial obligations of all peoples and were given equal credit in the markets and exchanges of every civilized nation of the world. It was under these circumstances that the German Diet deliberately demonetized one of the metals, the favorite metal of the people of France, the metal which its citizens hoarded in their savings, which always maintained its standard of equality at a fixed ratio among that great people and all its customers. For the purpose of doubling the burden upon that crushed and conquered people the monstrous crime of silver's demonetization was conceived and carried into execution, thus disturbing the financial equilibrium all over the world. This action was followed by the United States in 1873 by similar legislation, enacted at a time when silver bullion was intrinsically worth more than silver coin, notwithstanding the pretence that such legislation was essential to overcome an impending flood, a threatening overflow, in overwhelming abundance of the white metal to the disturbance of all values and the probable disintegration of business"

Senator Newlands, speaking of the monetary situation, said:

"I do not propose to go into all of the intricacies of the money question, but I do wish to present in a few words the monetary situation of the world. In 1873 the movement for the demonetization of silver among the principal countries of the world culminated. The claim was made at that time that gold was the only stable measure of value; that the largely increased production of silver lessened the value of that metal as a money metal, and that the stable production of gold insured it as a stable standard of value. How futile events have proved that reasoning to be.

"The world starved for the want of money from 1873 until 1896, during which period the production of gold did not materially increase, while the increased production of silver was largely utilized for money. Then an increase in the production of gold took place, as a result of which the world had in 1913 an annual production 300 per cent. greater than the production of 1893. During that period the production of silver has increased only 30 per cent., proving that, so far as production is concerned, silver is a more stable metal than gold itself.

"During this time we have not as yet found enough metallic money to satisfy the demands of the world for money, and there are in South America a thousand million dollars of paper money with almost no metal backing it, and we have in this country in our greenbacks and in our national bank notes about a billion dollars more of uncovered paper money."

These are statements of two only of many well posted men who believe that silver should be more largely used for coinage. Should such views prevail there will doubtless sooner or later come a sharp rise in the price of the metal. Under such conditions, the life of the Cobalt mines may be much longer than even the most optimistic had dared to hope.

GOLD MINING AT KIRKLAND LAKE

Since the war broke out there have been numerous reports, some of which have unfortunately been published in our columns, to the effect that development work had been stopped at Kirkland Lake. It is true that outside prospecting has been discontinued; but the development work at the Tough-Oakes mine is being carried on as usual. The work at both shafts is chiefly drifting. The stoping so far done is for the most part merely "cutting out" work. We are advised that development continues to give excellent results, and that the ore placed in sight during the work for the month of August has a gross value of $250,800. The production during August was 2,950 tons of ore, having a gross value of $102,341.

This is a very creditable showing, and should give confidence to those who have interests in the Kirkland Lake district.

The Tough-Oakes has started construction on a 100 ton mill. The excavation is completed and concrete forms are being placed. The erection is under the direction of Mr. James Johnston, who erected and operated the mills of the Nipissing Mining Co. at Cobalt.

THE HOLLINGER MINE

Five years ago prospectors discovered gold ore in the Porcupine district. No mining had been done in the district. The deposits were located in the midst of a heavily forested country and twenty-five miles from the nearest railway. A great change has taken place. One of the mining companies operating in the district has already mined over $5,000,000 in gold and made a profit of over $3,000,000.

Many difficulties were overcome. The cost of developing the property was high owing to its location. Disastrous fires checked progress. An ill-advised labor strike, while unsuccessful, increased cost of operations. In spite of the many difficulties encountered the company has now made a profit greater than its capitalization.

The company gives employment to several hundred men and is an important factor in the development of Northern Ontario.

While substantial progress has been made the Hollinger is as yet only in its infancy. The mine has splendid prospects of becoming one of the best in the world.

THE MINING UNIONS AT BUTTE

For several years Butte has been the stronghold of the Western Federation of Miners. It is so no more. A new organization has been formed at the expense of the old one. Little improvement has been made. There has been a change in leadership; but the new union vies with the old one in making a reputation for violence..

By resorting to mob rule the leaders of the Independent Union have taken control of Butte. The citizens who attempted to organize for protection against the Union leaders have been threatened with violence. The character of the president, Muckie McDonald, is indicated in a street speech:

"There is one thing I want to say to you people. We understand that the sheriff's office is planning to get the leaders of this union and that they expect to pick us up one at a time. Now I want to serve notice that if there is anything of that kind doing, you want to report it to headquarters at once. We don't stand for anything of that sort, and we serve notice right now that there will be some direct action if they try anything of that kind. We understand that some of the business men are in on it, too, and I don't know whether the city hall is in it too or not, but we want it understood that the new union is running Butte. If there are any skunks in this crowd we will take care of them, too. We didn't follow the example of the old union. We took the men who were our enemies and told them to get out of town; but we didn't mistreat them, and we didn't beat them up. We treated them all right, but told them to get out of town. We understand that the sheriff's office went and brought them back, but it won't be healthy for them to show up; that's all. Now, we are going to be peaceable; no one can say that Muckie McDonald has broken any law. We will not start anything, but if they start anything they had better look out. They will get some direct action."

It is not likely that American citizens will long submit to the rule of such men as Muckie. The mine operators have announced that Butte is now an open camp. The Western Federation leaders have brought ruin to that organization. The Independent Union has not proven worthy of recognition.

PEACEFUL GERMANS AND AUSTRIANS ARE SAFE.

It has come to the attention of the Government that many persons of German and Austro-Hungarian nationality who are residents of Canada are apprehensive for their safety at the present time. In particular the suggestion seems to be that they fear some action on the part of the Government which might deprive them of their freedom to hold property or to carry on business. These apprehensions, if they exist, are quite unfounded.

The policy of the Government is embodied in a Proclamation published in the Canadian Gazette on 15th August. In accordance with this Proclamation restrictive measures will be taken only in cases where officers, soldiers or reservists of the German Empire or of the Austro-Hungarian Monarchy attempt to leave Canada, or where subjects of such nationalities engage or attempt to engage in espionage or acts of a hostile nature, or to give information to or otherwise assist the King's enemies. Even where persons are arrested or detained on the grounds indicated they may be released on signing an undertaking to abstain from acts injurious to the Dominion or the Empire.

The Proclamation after stating that "there are many persons of German and Austro-Hungarian nationality quietly pursuing their usual avocations in various parts of Canada and that it is desirable that such persons should be allowed to continue in such avocations without interruption," directs as follows:

"That all persons in Canada of German or Austro-Hungarian nationality, so long as they quietly pursue their ordinary avocations be allowed to continue to enjoy the protection of the law and be accorded the respect and consideration due to peaceful and law-abiding citizens; and that they be not arrested, detained or interfered with, unless there is reasonable ground to believe that they are engaged in espionage, or engaging or attempting to engage in acts of a hostile nature, or are giving or attempting to give information to the enemy, or unless they otherwise contravene any law, order-in-council or proclamation."

Thus all such persons so long as they respect the law are entitled to its protection and have nothing to fear.

ONE TASK FOR ALL

By Rudyard Kipling, in London Times.

For all we have and are,
For all our children's fate,
Stand up and meet the war—
The Hun is at the gate!
Our world has passed away
In wanton overthrow;
There's nothing left to-day
But steel and fire and woe.

Though all we know depart,
The old commandments stand—
In courage keep your heart,
In strength lift up your hand.
Once more we hear the word
That sickened earth of old,
No law except the sword
Unsheathed and uncontrolled;
Once more it knits mankind,
Once more the nations go
To meet and break and bind
A crazed and driven foe.
Comfort, content, delight,
The ages' slow-bought gain,
They shrivel in a night—
Only ourselves remain
To face the naked days
In silent fortitude,
Through perils and dismays,
Renewed and re-renewed.
Though all we made depart,
The old commandments stand;
"In patience keep your heart!
In strength lift up your hand!"

No easy hopes or lies
Shall bring us to our goal—
But iron sacrifice
Of body, will and soul.
There's but one task for all,
For each, one life to give;
Who stands if freedom fall?
Who dies if England live?

ASBESTOS IN SOUTHERN QUEBEC*

By J. A. Dresser.

The controlling supply of asbestos for the world is obtained from southern Quebec, 150 miles or less north of the international boundary line between Canada and the United States, and about 75 miles south of the city of Quebec. The principal production is furnished by eight mines, seven of which occur within a distance of six miles. There are also several smaller properties in the vicinity. The industry was begun in a small way some 35 years ago and has advanced more or less regularly ever since. The annual production now exceeds 100,000 tons and its value is about $3,000,000. It represents over 80 per cent. of the world's production.

Asbestos has been known in the eastern townships of Quebec since 1847, when attention was called to it in an official report by Sir William Logan, the first Director of the Geological Survey of Canada, but it was not until 30 years later that it came into commercial importance. The largest deposits, those of Thetford and Black Lake, were found in 1877 during the construction of the Quebec Central Railway. Work was begun upon them almost at once and has been continued ever since.

The Danville mine, the next largest producer, was opened in 1879, and the slip-fiber deposits of East Broughton were located shortly afterward.

For the first 15 years only the "crude" asbestos was recovered; that is, fiber long enough to be extracted by hand cobbing. Although this is still a valuable part of the production, it is now a relatively small part of the total output.

After several trials, a process of mechanical concentration was begun about 1893 by some of the pioneer operators of the district, which with many modifications has been successfully used ever since. Although there have been numberless changes in the operation and appliances, the present practice is a direct development of the first principles of the earliest attempts at concentration, and much credit is due to those who originated it. Its effect may be realized when it is stated that in leading mines to-day 95 per cent. of the quantity and 75 per cent. of the value of the total production is obtained by mechanical concentration.

The growth of the industry is best known by quoting the production of a few years taken at regular intervals:

	Production, Tons.	Value.
1878.....	50	.....
1882.....	810	$52,650
1892.....	6,082	390,462
1902.....	30,219	1,126,688
1912.....	111,175	3,059,084

All the mines have easy railway access. The principal shipping stations are Thetford Mines, Black Lake, and East Broughton on the Quebec Central Railway, a part of the Canadian Pacific system, and Danville, on the Grand Trunk Railway. Thetford Mines is about 76 miles from Quebec, 67 miles from Sherbrooke, and 168 miles from Montreal. The other stations mentioned are from 4 to 18 miles from Thetford Mines, except Danville, which is some 50 miles distant, on the Grand Trunk Railway, 88 miles from Montreal and 86 miles from Quebec.

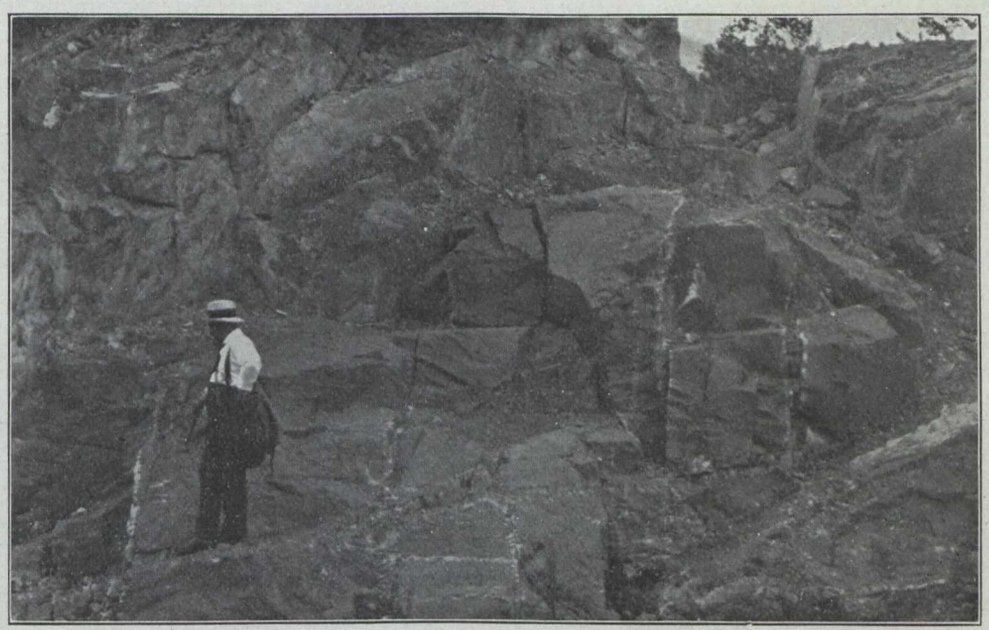
Geological Party at Black Lake, Quebec

The asbestos deposits are found in the hilly country of southern Quebec known as the Eastern Townships. Much of the district has been settled for upward of 100 years and is now generally occupied by small dairy farms. The hills are a continuation of the Green mountains of Vermont, a part of the Appalachian system.

The geological structure is complex. There has been intense folding, faulting, and regional metamorphism. Glacial drift conceals a great part of the rock surface, but glacial erosion has been an important factor in uncovering and exposing the deep-seated rocks in which asbestos occurs. The asbestos is in a series of basic igneous rocks which occur in stocks and sills that have intruded sedimentary strata of Cambrian, Ordovician, and in places of Silurian age. These basic intrusives are part of the well-known and extensive series which appears at frequent intervals in the Appalachians from Georgia to Newfoundland. The commercial production of asbestos is almost entirely limited to a small district.

*A paper to be presented at the Pittsburg meeting, A. I. M. E., October, 1914.

The principal types of igneous rocks are peridotite, pyroxenite, gabbro, and diabase. They are products of differentiation from a single magma, and are characteristically arranged in the order given above from the base upward in sills, and from the center outward in stocks. This order, it will be noted, is that of decreasing basicity and density. A relatively small amount of hornblende granite which is also present has generally been intruded a little later than the basic rocks.



Asbestos Veins in Peridotite, Black Lake, Quebec

Peridotite is altered in important amount to serpentine, and pyroxenite generally to soapstone, but in places probably also to serpentine.

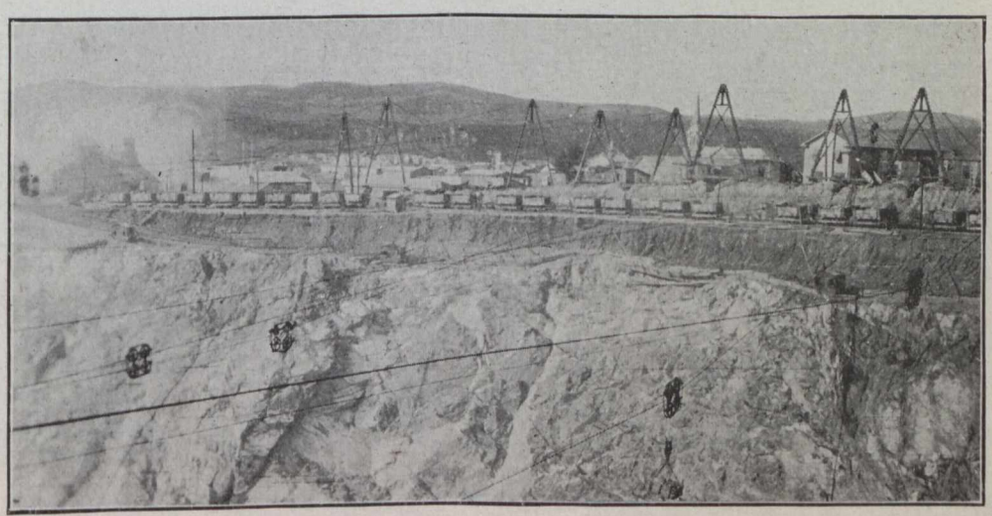
Character and Mode of Occurrence of Asbestos.

The asbestos is entirely of the chrysotile variety, and has essentially the same chemical composition as serpentine, in which rock only it occurs. There are two types of asbestos in this district: namely, "cross-fiber" asbestos, and "slip," "parallel," or "mass fiber," asbestos, the three terms being used almost interchangeably.

Cross-fiber Deposits.—This variety furnishes the major production, both in quantity and value. It occurs in veins up to 2½ in., or rarely 3 in. wide; the greater number are ½ in. or less in width. The fibers, as the name implies, lie crosswise the vein.

The veins rarely reach a length of 200 ft., but are usually very much shorter, the greater number being only a few feet in length. They run in all directions through the rock, in places cutting one another abruptly, but more frequently uniting at meeting. A careful examination shows that many of the larger and more persistent veins show an approach to a rectangular arrangement, and probably represent joints in the primary rock. Others have a roughly parallel order and denote fractures due to regional compression, while many smaller veins truncate the corners of rectangular joint blocks in shell-like form.

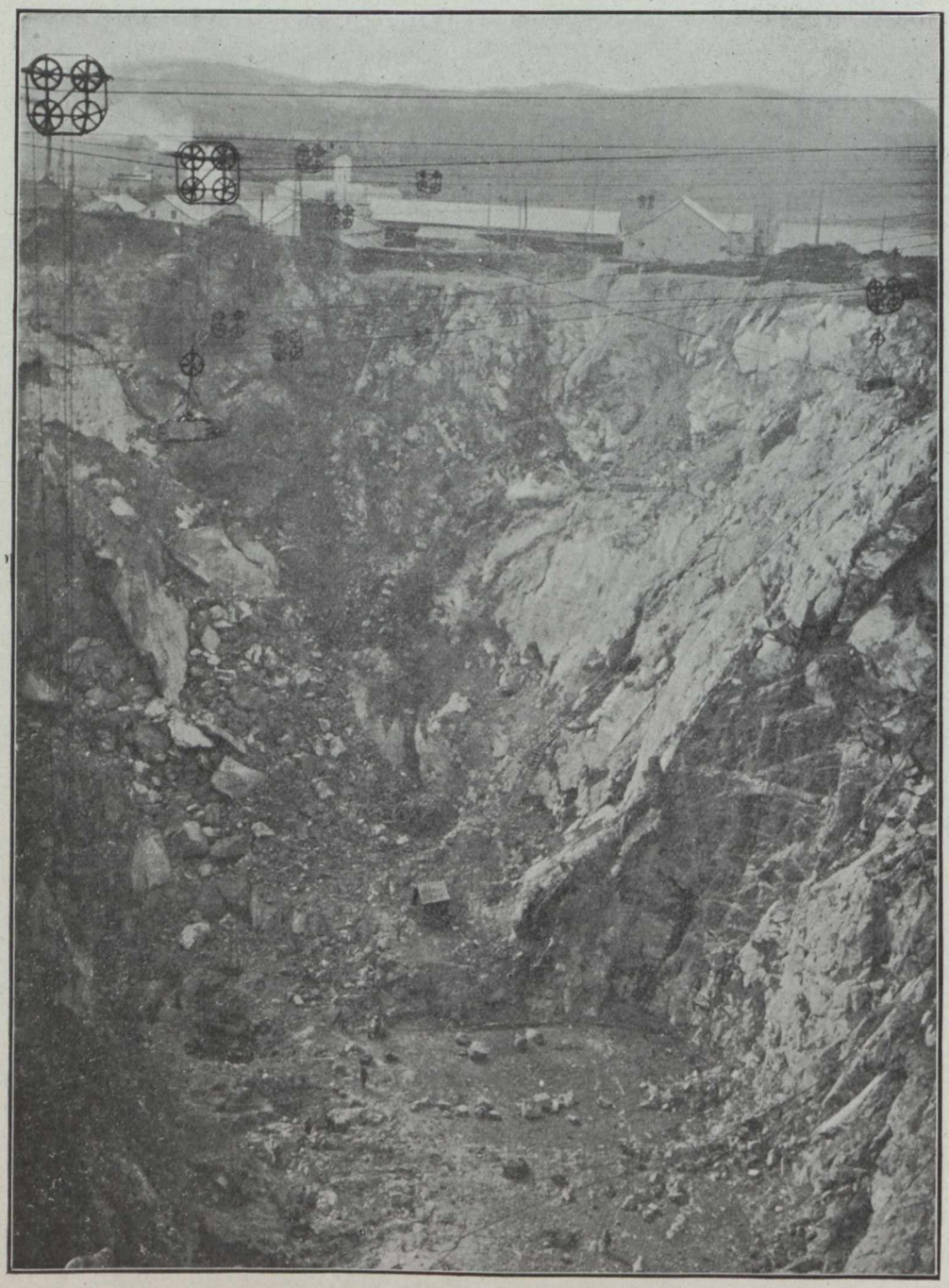
Vein Structure and Origin.—The veins are usually divided into two parts by a thin seam of iron ore, generally magnetite, which is parallel to the sides and near the center of the vein. Bordering the veins on each side there is invariably a band of serpentine about three times the width of the vein. The country rock near the veins is peridotite of the most basic phase (dunite) that occurs in the district. There is incipient serpentinization in all parts of the peridotite, but commercial asbestos is found only between walls of com-



An Asbestos Mine in Quebec

pletely serpentinized rock whose thickness is proportional to the width of the vein. Microscopic and chemical evidences, as well as the distribution of the veins, point conclusively to the origin of the asbestos by alteration and recrystallization of the country rock *in situ*. Microscopically it is evident that the asbestos fibers have grown outward on each side from the seam of iron ore mentioned above; chemically there is no distinction between the asbestos and serpentine, while an essential difference between serpentine and peridotite of iron ore within or at the sides of the veins, and the correspondence of the position of the principal veins to that of joint and other fractures, the iron seams are believed to mark the original channels by which circulating waters have been introduced which produced the hydration of the peridotite and its alteration to serpentine, a certain portion of which has crystallized as asbestos.

The source of the water has given rise to considerable discussion. The fact that much excellent asbestos



Mining Asbestos in Quebec

is that the former contains 12 to 14 per cent. of water. The position of the veins and the deep-seated character of the rock make it impossible that such open fissures ever existed where the veins are now found. While much remains to be explained both as to the processes and their causes, the facts are self-evident that zones of the country rock have been altered to serpentine and proportionate parts of these have taken the form of asbestos veins. From the persistence of the seams has been found near granite dikes has given rise to the opinion that magmatic waters accompanying the intrusion of these has been the cause. Locally there is much to support this view, but viewed broadly the small amount of granite as well as its variable distribution make it improbable that it has been the chief cause. Magmatic waters accompanying the peridotite itself are a more likely cause. Yet, this rock was solidified and was afterward fractured both by con-

traction (joints) and by regional deformation before the waters could have been introduced. On the other hand, the present water level is comparatively near the surface in this district, and, as the region is one that suffered great erosion in glacial times, the present surface may long have stood below ground-water level. It is not proved that meteoric waters are not a competent cause to produce these effects and at least a share in the cause may probably be attributed to them.

In the deepest workings yet made, which are a little more than 200 ft. deep, there is no apparent change in the quantity or quality of the product, and no desposit of serious importance has yet been exhausted. The principal deposits are found in the most basic parts of the peridotite (dunite); that is, near the base of sills or toward the central parts of stocks. Owing to glacial erosion having been more effective on the north side of the stocks several deposits are found near the north edge of the peridotite core of the principal stock.

Slip-Fiber Deposits—Slip-fiber or parallel-fiber asbestos is a fibrous phase of serpentine in which the fibers are arranged parallel to adjacent cleavage faces in the rock. In places the rock is almost entirely in a fibrous condition and the name "mass-fiber" is sometimes used for such occurrences. It is probable that this class of asbestos has been derived from pyroxene.

Where slip fiber is abundant the proportion of asbestos in the rock is much higher than in the case of the cross-fiber occurrences. But much of the slip fiber is short and the proportion that is recoverable and useful, though higher, is not so greatly different from that obtained from the cross-fiber mines. Only a little "crude" asbestos is obtained from deposits of this class.

Mining and Dressing.

Mining.—The distribution of the asbestos is such that all the rock within the area mined must be handled. Except in one mine where underground work is quite extensively carried on in winter or for development purposes, the mining, or rather quarrying, is all open-cast work. The ground is cut down in benches, generally 6 to 12 ft. high, which are carried across the floor of the pit so as to afford sufficient working face. Several of the pits have reached a depth of 200 ft. from the original surface and are from 600 to 1,200 ft. or even more in length.

Handling.—Hoisting is done by means of cable derricks with boxes carrying about a ton each. In one case a tramway enters the pit through an inclined tunnel and the rock is hauled out in cars drawn by a cable. Hauling on the surface is done by small locomotives with side-dumping cars of 4 or 5 tons capacity.

Dressing.—The separation of fiber from the rock commonly begins in the pit. Rock containing "crude"—that is, veins ¾-in. or more in width and of good quality—is sent to the cobbing sheds for hand separation, and asbestos that is liberated by the breaking of the rock in the pit is collected in hand boxes; dead rock is taken to the waste dump, and the remainder, usually 35 to 60 per cent. of all the rock handled, goes to the ore bins, or directly to the mill for mechanical concentration.

The milling practice varies somewhat in different mills, but is very similar in all. It consists essentially of coarse crushing, drying, and alternate finer crushings and screenings. At each screening, the asbestos then liberated is drawn off through overhead pipes by suction fans and collected in settling tanks. When thoroughly screened from dust and classified according to length of fiber by means of a rotary screen, the different grades pass to their respective storage bins, or in some mills are mechanically bagged.

In the coarse crushing, jaw crushers are used. Gyratories and frequently rolls are used for the finer crushing. When rolls are used special appliances are needed for teasing out the fiber, which becomes compressed into matted sheets by the rolls. The final crushing of the rock is effected by a specially designed "cyclone." This consists of two "beaters" or fans of chilled iron, in shape like the screw propeller of a boat and weighing upward of 100 lb., which revolve at a speed of 2,000 rev. per minute, or more, in a closed chamber. From the rock fragments thus driven together the smallest particles of asbestos are released and collected as before.

Suction fans for the removal of dust from the cyclone, the classifier, and sometimes from the mill, are important accessories to the equipment. Magnets are usually placed over the shaking screens to eliminate particles of iron ore. The average recovery of cross fiber seems to vary at different properties between 3 and 8 per cent. of the rock treated; slip fiber, perhaps 2 or 3 per cent. higher.

Product.—The fiber recovered in the mill is classified into three or more grades, the crude asbestos usually into two grades. The adoption of a standard classification has been discussed, but owing to local differences in the character of the fiber, as well as other causes, no standardization has yet been effected. Each mine follows its own grading and there is a lack of uniformity in the products of different mines. An arbitrary classification that has been adopted by the Department of Mines of the Province of Quebec is as follows:

Crude Asbestos, Hand Cobbed.

No. 1—Value $200 per ton or more.
No. 2—Value less than $200 per ton.

Mill Stock, Mechanically Separated.

No. 1—Value $45 per ton or more.
No. 2—Value $20 to $45 per ton.
No. 3—Value less than $20 per ton.

The production of 1912 was as follows, according to the classification given above:

Quantity of Rock Mined 1,870,608 Tons.

Qualities	No. of Men Employed	Wages Paid	Shipments Tons.	Shipments Value	Shipments Av. per Ton.	Stock on Hand Tons.	Stock on Hand Value
Crude No. 1	.....	.....	1,914	$510,785	$263.16	867	$221,215
Crude No. 2	.....	.....	3,766	379,445	100.76	2,867	310,596
Mill Sk. No. 1	.....	.....	3,682	237,203	64.42	2,370	137,106
Mill Sk. No. 2	.....	.....	32,682	1,018,960	31.17	8,234	301,774
Mill Sk. No. 3	.....	.....	69,097	912,691	13.21	6,838	131,206
Totals	2,910	$1,377,444	111,175	3,059,084	27.52	24,176	1,102,206

The stock on hand at the beginning of the year 1912 amounted to 33,751 tons, valued at $1,583,076.

Uses.—A small proportion of the crude asbestos is used for making asbestos cloth and various fire-proof textiles. A much greater amount is used for covering and insulating purposes. Boards, shingles, and roofing felts for fire-proof construction, materials for electric insulation and protection from acids, and boiler and pipe coverings are the forms of manufacture in most common use. There is only one plant for the manufacture of asbestos goods in Canada, the Asbestos Manufacturing Co., at Lachine, Quebec. This plant makes shingles and other roofing materials, pipe covering, mill boards, and asbestos lumber for the Canadian and European markets. Its consumption is about 5 per cent. of the total output of the mines of Quebec. Approximately 75 per cent. of the output of these mines is exported for manufacture to the United States, and the balance to Great Britain, Germany, France, and other European countries.

Condition and Outlook for the Industry.

There has been a decrease of stock on hand during the past two years. This seems to indicate that the industry is emerging successfully from a critical condition into which it was thrown four years ago by a rapid overproduction, which resulted from some extravagant financial promotions.

The deposits are large and the principal mines seem to have almost inexhaustible reserves. Consequently the plants installed are of a durable character and around the mines substantially built towns have grown up. The labor is largely obtained in the locality. Many of the men own their houses, living conditions are favorable, and there have been no serious labor troubles in the history of the industry.

For the immediate future, or as long as mining can be done by open-cast methods, the cost will probably vary only with the nature of the ground, the depth of hoisting, and the price of labor and materials. But in methods of concentrating changes are more likely to take place. The present practice is the result of 20 years' experience, during which time many changes, and great improvements have been made. At present the practice of different mills varies considerably in details and probably also in efficiency.

The enlargement of the market for manufactured goods, which is steadily growing, depends largely on the skill and enterprise of the manufacturers and the supply of substitutes for asbestos. The constantly increasing price of lumber must improve the field for shingles and asbestos lumber, while the ingenious applications of asbestos for heat-resisting and insulating materials seem likely to give it a continued advantage over any substitutes at present known.

The absence of rival fields for so long a time is rather remarkable. Similar rocks in like associations are known in many parts of the world, yet the only sustained and growing production outside of Quebec is obtained from the Ural districts in Russia, the United States and South Africa being much smaller producers. In his report on Mining Operations in the Province of Quebec for 1912, T. C. Denis, Superintendent of Mines of Quebec, cites the following statistics for the year 1910, from the Colonial and Foreign Statistics of the Home Office, London. The quantities are given in metric tons and values in pounds sterling:

Cape Colony	1,273	£23,143
Cyprus.	442	2,754
India.	3	6
Rhodesia.	301	3,320
Natal.	2	15
Transvaal.	70	2,575
Russia (approximate) .	10,936	82,000
United States	3,350	14,036
Total outside of Quebec	16,377	£127,849
Quebec.	73,124	£548,184

MINING IN BRITISH COLUMBIA

Nelson, B.C., Sept. 5.

As a result of representations made to him by Lorne A. Campbell, M.P.P., of Rossland, R. F. Green, M.P. for Kootenay, while at Ottawa during the recent emergency session took up with Hon. W. T. White, Minister of Finance, the question of some measure of assistance to the mining industry of this section during the present war.

In reply to Mr. Green's representations, Mr. White said that he had so many appeals for aid from various industries that it would be futile to attempt to deal with any individual or any one company. He was quite willing, however, that the arrangement which had been made with the Cobalt mine owners as to the handling of silver should be extended to British Columbia and to Kootenay in particular. Under this arrangement the Government undertook to assist in the handling of silver bullion. The Government would issue Dominion bills to banks equal to the amount of money the banks might advance to mining companies or smelters on the security of silver bullion backed by the notes of the mining or smelting companies. This, it was felt, would assist the mining companies in financing their business and continuing operations.

Mr. White also promised Mr. Green before the latter left Ottawa that he would take up with the general managers of the banks the question of the handling of lead. The Minister was very sympathetic and was very anxious to secure a solution of this problem on a business basis—the only basis upon which, of course, he would deal with it.

Commenting editorially the Nelson News says:

"The announcement that the Government is ready to assist in the handling of the silver product of this section and that the matter of dealing with the problem of marketing the lead output of the mines of the district is under consideration will be welcome news to the people of Kootenay. This, with the advance in the price of zinc, should mean an early resumption of operations of the silver-lead-zinc mines of this part of British Columbia.

"The effect of the resumption of operations generally it is not necessary to dilate upon. It will mean that to a very large extent business throughout the silver-lead-zinc mining sections of the Kootenay will be placed on as good a basis as before the outbreak of the war.

"It is to be hoped that the efforts of Mr. Lorne A. Campbell, M.P.P. for Rossland, and Mr. R. F. Green, M.P. for Kootenay, to put the mining industry back in its old position, despite the war, will be successful. And with two such men so keenly interested there can be little doubt but that this hope will not prove in vain."

LAKE SUPERIOR MINING INSTITUTE ANNUAL MEETING

The meeting of the Lake Superior Mining Institute, which was credited to the Marquette range this year, will go down in the history of the organization as one of the most enjoyable of that body. Having entertained the association three times previously, it was decided to depart from the general custom of spending all the time at the mines, and take a side trip on the lakes to the city of Detroit. Marquette being the oldest of the iron ore ranges was very well known to nearly all of the Institute members, and to have held the party here for three or four days would have become somewhat monotonous.

It was not a good time for the most generous attendance on the part of the members. There are many new orders coming from the headquarters to the mine representatives, this being a most trying time in the metal as well as other industries. Men are being laid off, wages lessened, and changes made generally, and many could not leave their places who would, under more favorable conditions, have been present. Considering these things the number who did come exceeded the expectations of Secretary A. J. Yungbluth and others in charge of the meeting. At the dinner served at Wawonowin Golf Club, Ishpeming and Negaunee, about three hundred were present, while this number was exceeded at the whitefish dinner served at the Lake Shore Engine Works in the evening. This was a fine representation. On the lake trip there were about 140 members present, enough to make a right active, jolly party.

In Ishpeming there were the first aid contests at Union Park, beginning at 9.30 in the morning. This was the first time the Institute had staged anything like this, and it proved very interesting, and was well suited to the programme and to the mining industry. Twelve teams representing eight different mining organizations participated. They were lined up in a semi-circle in front of the grand stand, presenting, in their neat costumes, a very pleasing appearance. Each team had been well drilled, and when only a portion of them were working the rest stood at attention. Six men composed a team, five workers and one patient. There were ten events. Two one-man events; two three-men events, and the balance of teams events, which kept the teams busy until noon. Certain time was allowed each event, after which the gong was rung at the end of every minute until all had completed the event. For one minute overtime one point was deducted. Two minutes overtime barred the team from marking in that event, disqualifying them. There was some nervousness exhibited by several of the members of the teams at the outset, but despite this work was done well in every instance.

The exhibition was witnessed by a large number of people and there were many ladies in attendance. This promises to be a regular feature at forthcoming Institute meetings, and properly belongs here. It is an encouragement to the teams and is aiding a splendid work.

With the first aid contests ended the members were conducted to the Wawonowin Golf Club house, near by, where a very fine lunch was served.

The members then visited Union Park again, where there was what was reported to be a baseball game in waiting. It was between the old rivals, Ishpeming and Negaunee, leaders and tail enders in the Marquette Delta County League.

Here, the Cleveland-Cliffs Co. is sinking what will be when completed one of the deepest shafts in the iron country, it to go more than 2,000 ft. It is a circular shaft, 17 ft. bore, and is to be concreted from top to bottom. It has been concreted to a depth of 150 ft., and will take about two years to finish. An excellent equipment has been provided for the work. In two hours recently 20 ft. of concrete was poured. The sinking here is done by a cage, which is working satisfactorily.

The next stop, and the last at the mines, was at the Negaunee mine of the Cleveland-Cliffs Co. This is one of the neatest, we may say the neatest, of any of the iron ore mines in the Lake Superior country. It's a model, and suggests thrift. The equipment is electrical from top to bottom, the final word in mine operation. It's the very best known. Man has not conceived or invented anything more efficient than is to be found here. The mine is raising about 1,100 tons of ore daily, working in a quiet way, suited to the market. Every member was loud in his praise of the appearance of everything at this location. Steel and concrete play important parts in the construction work. The shaft is concreted as are tunnels leading into it. Stockpile trestles are steel and concrete. It's a solid order of things and meant for business.

From the Negaunee mine the party went on by automobiles to Marquette. It was a dusty ride, but enjoyable, their being about sixty cars in line. The Lake Superior and Ishpeming Railway Co.'s ore dock was inspected. It's the only all steel and concrete ore dock in the world, absolutely fireproof. It's all electrically operated, too. There are 200 pockets each with a capacity of 300 tons.

After inspecting this dock the Institute members automobiled to the Lake Shore Engine Works, where the plant was inspected, and where a new ore loading machine to be used underground in drifts was one of the objects attracting attention. This loader was working in a timbered drift, on surface, handling gravel, which it did efficiently. Various expressions were heard as to its probable practicability, but this is to be fully tested at the Balkan mine, Alpha, Menominee range, in the near future. The machine went through all the motions of a steam shovel smoothly.

The Lake Shore Engine Works, besides having a reputation for mining and other machinery, is also known among the Institute members for its whitefish. Once tried they are always in demand, so that Mr. Flodin has found a task, at each reappearance of the Institute on this range, in providing one of his famous dinners. This dinner was served in the big foundry room, which had been finely decorated for the occasion. At the entrance, in the form of an immense wheel, was an electric sign welcoming the members. More than three hundred sat down at the tables. The fish was broiled to a turn and was delicious. The fishermen must have had a splendid catch that morning to care for all who were served and who asked if they could please have some more. With the fish were many things, being proper accompaniment.

At eight-thirty in the evening the members attended the Marquette Theatre, where a special moving picture show had been prepared for them. There were two intensely interesting reels by the Bureau of Mines in cooperating with Witherbee Sherman & Co., showing surface and underground views at Mineville, N.Y. Through the pictures first aid and rescue work was frequently shown. A reel of pictures provided by Mr. J. M. Longyear showed scenes in and about the DeBeers mines, Kimberley, diamond and gold operations being illus-

trated. It was exactly right for a mining institute programme.

The party left Marquette at six in the morning. St. Ignace was reached on schedule time and the boat found waiting for them at the dock. Here they were joined by Dr. Allen and his party of geologists, 24 in number.

The trip on the boat from St. Ignace was a pleasant one, the weather being favorable. The members received the best of attention and were well cared for.

The first business session was held Tuesday afternoon on the boat with President W. H. Johnston of Ishpeming presiding. A number of papers were read and discussed, and short talks made by several of the state geologists.

Another business meeting took place in the evening, when the reports of committees were received and officers elected to serve during the ensuing year. L. C. Hardenberg, of Ironwood, range superintendent for Pickands, Mather & Co., was chosen president, and A. J. Youngbluth, of Ishpeming, was re-elected secretary. E. W. Hopkins, of Commonwealth, was re-elected treasurer.

Wednesday afternoon visits were made to Detroit Copper and Brass Rolling Mills, the Detroit Iron and Steel Co.'s furnaces and the Semet-Solvay Co.'s coke ovens.

Thursday the party looked over the Ford plant and the Chalmers factory.

The people of Detroit extended the party a hearty welcome, and spared nothing to make their stay comfortable and pleasing.

Gogebic range will entertain the Institute next year.

HOLLINGER.

For the four weeks ending August 12th the Hollinger Gold Mines, Ltd., shows gross profits of $171,975.76. Working costs during the period were $68,578.37, and the total ore hoisted was 16,891 tons.

The mill ran 96 per cent. of the running time and treated 16,456 tons of ore. The average value of ore treated was $15.46 per ton; approximate extraction was 94.4 per cent., and milling costs $1.149 per ton.

During the four weeks there was expended on plant $30,546.34. Profits from January 1st to August 12th amounted to $1,015,451.07, and of this $720,000 has been paid out in dividends. In his report Manager Robins says:

"Ten of the new stamps were started in that period, and since then ten more have been started, so that at the present time sixty stamps are working upon Hollinger ore.

"A winze has been started below the 675 ft. level and the next level (800 ft.) should be reached about the end of October. The vein upon the 675 ft. level has opened out to 20 ft. in width and averages $10.90 over that width. This value is about the average of this portion of No. 1 vein upon the upper levels."

Milling began twenty-six and a half months ago. The first dividend was paid on November 2, 1912. Notwithstanding the strike and the inadequacy of the plant to deal with the mine as it expanded, these results were accomplished to August 12:

Year.	Total Value of Ore Milled.
1912 (6½ months)	$ 970,304.89
1913	2,589,392.76
1914 (8½ months)	*1,577,037.21
Total	$5,136,734.86

Year.	Total of Profits.
1912 (6½ months)	$ 600,664.42
1913	1,628,113.64
1914 (to August 12)	1,015,451.07
Total	$3,244,229.13

*Estimated.

The gold contents of the tons milled represented 171 per cent. on the capital of the Hollinger Co. The profits represented 108 per cent. on the capital. The dividends paid and chargeable against the operations to August 12 amounted to $2,250,000, or 75 per cent. on the capital. Over and above that there was the $981,684.56 at surplus, and ore reserves the worth of which is giving the directors every assurance.

The following table shows a comparison of Hollinger performances during the past three twenty-eight day periods:

	June 17.	July 15.	Aug. 12.
Gross profits	$129,168	$132,712	$171,975
Current assets	369,025	497,241	514,221
Gold assets	270,419	165,872	209,297
Surplus	859,225	901,938	981,135
Working cost	63,626	70,637	68,578
Working cost per ton milled	4,578	4,322	4,167
Running time of possible, p.c.	90	94	96
Average value	$14.59	$13.62	$15.46
Approx. extract, p.c.	95.20	91.00	94.04
Ore treated (tons)	13,598	16,343	16,456

PROGRESS IN CALGARY OIL FIELD

According to the "Natural Gas and Oil Record" interest early in September centred around the wells of the Calgary Petroleum Products Co., the Dingman 1 and 2, during the past week. The work of drilling the No. 1 well in deeper started last Saturday. The gas pressure and oil flow increased steadily from the time that work started. Thursday the drill was 30 ft. into the sand when work was stopped. The tubing is being put back into the hole, the owners being satisfied that the well will now be a steady producer. Since the additional depth has been reached the well has repeatedly gushed over the crown block. Regular daily shipments of ore are now being made from the Dingman property. The oil is being sold principally for use in traction engines in the harvest fields and the farmers claim that the oil gives better satisfaction than any gasoline that they can buy. Shipments now are about eight barrels a day, but this will be increased just as soon as the proper facilities for handling can be arranged. Drilling has been resumed at the No. 2 well, where the oil showings are the equal of the No. 1 well at the same depth.

The Sweetgrass district continues to attract a great deal of attention. The Segur Sweetgrass well has now passed the six hundred ft. mark and many other companies are preparing to enter that territory. The Beaver Oil Co. is sending a Star drilling outfit in to test its properties, and the Standard Oil Fields Co. has acquired holdings in the district. E. P. Howard has closed negotiations for a large tract of land for a party of Chicago capitalists.

Drilling has been resumed at the United after a week's delay while fishing for lost tools. This well is down 2,445 ft. and is nearing the oil bearing sands. The Southern Alberta well is down 2,200 ft., and the showings are said to be excellent. There have been oil

showings for the last 200 ft. Oil seepage was found in the Passiac well last week at a depth of 1,000 ft. The flow of gas at the Monarch well has been increasing steadily for the past few days. This well is now down more than 3,200 ft.

The Calgary Alberta Co. spudded in early in the week in Township 17, Range 3, West of the 5th. The Consolidated well No. 2 has now passed the 1,000 ft. mark. The Western Pacific well struck a heavy flow of gas at 900 ft. Work at both the Alberta Petroleum and Prudential wells progressed rapidly during the week, and the showings in both wells are more favorable than at any other time. The Federal is again drilling and is now 1,050 ft.

MOTHER LODE AND SUNSET MINES

Memoir 19, being No. 26 of the Geological Series of the Geological Survey Branch of the Canada Department of Mines, has been distributed. This memoir has been prepared by O. E. Leroy. It is a report devoted to a description of the geological relations of the ore deposits of the Mother Lode, Sunset, and adjacent mining properties at Deadwood, Boundary district of British Columbia, and is an extension of similar work previously done at Phoenix and vicinity in 1908. (See Memoir No. 21, Geology and Ore Deposits of Phoenix, by O. E. Leroy, Geol. Survey of Canada).

It is one of the unfortunate exigencies of the preparation and publication of reports of this nature that at times several years elapse between the time the field work is done and that at which the report is made available to the public. In this instance it is shown on the Economic Geology and Topography map sheets accompanying the report that in 1910 the economic geology was investigated by O. E. Leroy, the areal geology by C. W. Drysdale, and the topography by W. H. Boyd and assistants. In mentioning this it is with the idea of expressing regret that conditions appear to have necessitated a delay of nearly four years between the completion of the field work and the time at which the report was printed and distributed, rather than to make any complaint on this score.

The introductory general statement follows:

"The Boundary for the last eleven years has been the most important copper producing district in British Columbia and for several years has held the leading position among the copper producing centres of Canada. In the first decade (1900 to 1909) the copper content in the ores mined amounted to 247,995,303 lb., [Total to end of 1913 is 363,671,849 lb.—Ed.] the metal also containing important amounts of gold and silver as by-products. The production in 1910 amounted to 31,354,985 lb. of copper based on smelter returns.

"The principal mines which are producing the typical low-grade and almost self-fluxing copper ores in the Boundary district are the Knob Hill-Ironsides, Gold Drop, Rawhide, Snowshoe, Monarch and War Eagle, situated at Phoenix; the Oro Denoro and Emma, at Summit; and the Mother Lode, at Deadwood, near Greenwood. The controlling companies operating the above-mentioned mines are the Granby Consolidated Mining, Smelting & Power Co., Ltd.; the Consolidated Mining and Smelting Company, of Canada, Ltd.; and the British Columbia Copper Co., Ltd.

Other abstracts from the report give the following information:

Field Work.—The area mapped is about two-thirds of a square mile in extent and includes the Mother Lode, Sunset, Crown Silver, and Marguerite mines. The map is published on a scale of 400 ft. to an inch with a contour interval of 20 ft.

Situation—Deadwood camp, with the Mother Lode mine as an arbitrary centre, is about 3½ miles by rail from Greenwood, and is about 3,450 ft. above sea level. It is approximately 12 miles north of the International boundary, and six miles from Phoenix, where the other more important mines are situated. Greenwood, 117.3 miles by rail from Nelson, is situated on the southern line of the Canadian Pacific railway, which leaves the main trans-continental line at Dunmore Junction, and which is now being extended to Vancouver through southern British Columbia.

History—Gold was first discovered in Boundary creek, and placers were worked as early as 1862. During the interval between 1862 and 1891 little attention was paid to the district, and but few mineral claims were located. In 1890, the Rossland gold-copper deposits were discovered, and this apparently stimulated prospecting over a wide area in southern British Columbia. During the following year prospecting was actively carried on at Deadwood, Phoenix, and other neighboring mineralized areas in the district. The prospectors came into the country by way of Marcus in the State of Washington. A pack trail followed the Kettle River valley and connected with the Dewdney trail at Grand Forks. From it branch trails were built into the several camps by the prospectors. In Deadwood camp the Mother Lode was located on May 23, 1891, by William McCormick and Richard Thompson; the Sunset on June 2 by John East; and the Crown Silver on the same day by William Ingram. These claims were located under the old law which allowed claims to be 600 by 1,500 ft. with extralateral rights. This act was repealed in 1892 when the present law was established allowing claims 1,500 ft. square with vertical side lines. Practically the whole area in the vicinity of the above-mentioned claims was staked during the subsequent years. In the first few years similar disappointments were experienced by the prospectors to those at Phoenix. The ores were found to be of a very low grade, though the orebodies were apparently of large size. The self-fluxing qualities of the ore were only discovered at a later period when subjected to metallurgical tests.

The history of Deadwood hinges altogether on that of its premier mine, the Mother Lode. It was bonded in June, 1896, by Col. John Weir, of New York, and in 1898 became the property of the British Columbia Copper Co. Extensive developments were planned and carried out, preparations were made for the construction of a smeltery at Anaconda—which adjoins Greenwood to the south—and a spur was built from the Columbia & Western railway at Greenwood to the mine. The latter was completed in 1900 and the first furnace of the smeltery was blown in early in the following year. Since then the company has gradually expanded, both by increasing its holdings of mining properties and by enlarging its smelting and converting plant which is now capable of treating about 2,400 tons of ore a day. The Sunset and Crown Silver mines were sold in 1897, and after passing through the hands of several companies, a reorganization was effected in 1909 whereby the holding company, known as the New Dominion Copper Co., passed under the control of the British Columbia Copper Co.

The total production of the mines at Deadwood up to the end of 1910 is probably not less than 2,114,481 tons of ore, though exact figures are not available. Of this amount 2,014,481 tons is to be credited to the Mother Lode mine.

Bibliography—The concluding part of the first chapter gives a very brief account of geological work previously done, and a list of reports and papers bearing directly on the geology of Boundary district, and on the mining and smelting industries at Deadwood and Anaconda.

Character of District—The second chapter is a summary of the general character of the district—regional and local topography, and climate and flora.

General Geology—First a general description of the formations is given in the third chapter, and then a detailed description. Under the head of Palaeozoic are discussed the Knob Hill group of rocks, the Brooklyn formation and quartz porphyrite; under Mesozoic, igneous rocks—the granodiorite group and hornblende porphyrite—are dealt with; under Tertiary, igneous rocks are further considered, the lithology of the olivine basalt, augite porphyrite, monzonite porphyry, and pulaskite porphyry each having due notice. In chapter IV, Economic Geology, the distribution of the ores in the mineralized zone, geological relations, character of the ore bodies and particulars of the ore precede observations on the mineralogy, first of the metallic minerals and then of the non-metallic. The metallic minerals include chalcopyrite, iron pyrite, magnetite, limonite, and malachite; the non-metallic minerals embrace actinolite, tremolite, garnet, epidote, zoisite, chlorite, calcite, and quartz. The last section of this chapter shows the origin of the orebodies.

Chapter V is devoted to a detailed description of the mines—the Mother Lode, Sunset, Crown Silver, and Marguerite—in the cases of the larger mines—of location, production, development and equipment, methods of mining, geological relations and character of the orebodies and ores.

Several half-tone reproductions of photographs and sketches, maps, etc., illustrate the text, while an index facilitates reference to the various parts of the report.

FIRST AID AMONG METAL MINERS IN BRITISH COLUMBIA

At a meeting of the Western Branch of the Canadian Mining Institute held at Nelson, British Columbia, about the end of last May, Mr. Dudley Michel, of the Provincial Department of Mines, instructor in "First Aid to the Injured," delivered his first public address following his appointment in the capacity just mentioned. After having dealt with various phases of this important subject he said:

"Therefore, from the economic as well as the humanitarian side of the subject, every mine manager should be vitally interested in the conservation of the limbs and lives of his employees. The slogan of the progressive mine manager of to-day is 'Safety First,' and he who fails to get into the movement must soon drop out of the race.

"The Hon. the Minister of Mines, Sir Richard McBride), and the department over which he presides, realizing that the metalliferous mining field of this Province offers many opportunities for the formation of first aid centres, have decided to do some missionary work in it, and I have been honored in having been appointed an instructor and organizer in first aid work, and in that connection I expect to visit all of the mines you have charge of.

"Realizing though that nothing can be successfully done in this movement without the earnest co-operation of each mine manager, his under officials, the mine doctors and the employees themselves, I respectfully solicit your kind assistance in this work. Uniformity is essential. To obtain this it has been deemed advisable to co-operate with the St. John Ambulance Association, this organization having local centres established in the chief cities, railway centres and most of the large coal mining camps throughout the Province. The syllabus and examination course of this association are alike wherever its classes are held, and the St. John Ambulance first aid certificates granted to those who pass its examinations are good all over the British Empire. It will thus be readily seen that a certificate from this association has far greater value than one obtained from any local organization, so is much more to be desired by the student in first aid work.

"I expect to commence my work in Rossland camp, and go thence to the Boundary district, going to as many mines as shall be practicable, and I shall greatly appreciate your valued assistance in the preliminary work of organization, and enlistment of the co-operation of the doctors in your respective communities."

Several managers of mines employing many men gave Mr. Michel assurance that they would do all in their power to assist him in carrying out the work outlined, and later they did much to facilitate the organization of first aid instruction classes and so arranging work that their men could attend one or other of the classes without inconvenience. At Rossland, Mr. M. E. Purcell, superintendent of the Consolidated Mining and Smelting Co.'s Centre Star-War Eagle group of mines, and Mr. Ernest Levy, manager for the Le Roi No. 2, Ltd., actively encouraged the first aid movement, while two resident doctors gave gratuitous instruction to the classes that were formed. In Boundary district, too, there was cordial co-operation on the part of mine officials of the Granby Consolidated Co. at Phoenix and of the British Columbia Copper Co. at the Mother Lode mine near Greenwood, also of the mine doctors. In order to encourage their employees to take the first aid instruction course, the mining companies supplied those attending the classes with the St. John Ambulance Association First Aid text book and other requisites without charge. The response on the part of the miners and other employees was very gratifying, there having been fully 200 men in the classes formed in Rossland and at the Boundary mines. Others were formed afterward—at the Consolidated Co.'s Silver King mine near Nelson; the Molly Gibson mine on Kokanee creek, about 25 miles from Nelson; in Ainsworth camp for men employed at No. 1, Silver Hoard, Highland and Maestro mines, and at Riondel, on the opposite side of Kootenay lake, for employees at the Bluebell mines and mill, where Mr. S. S. Fowler, general manager for the New Canadian Metal Co., arranged for the attendance of a doctor to lecture to the instruction class. The total number of men who joined the classes from the time Mr. Michel commenced work at Rossland was about 420.

Mr. Michel planned to visit Slocan mines, and some at Sheep creek, in the southern part of Nelson mining division, but at the time of writing it is not known to what extent he was successful in forming classes there, and securing the attendance of the miners at them. However, there seemed good reason to expect similar interest being taken in the first aid work in these districts, so that it is very likely its desirability and usefulness was re-

cognized there as in Rossland and the other parts where it had been taken up with enthusiasm. The closing of a number of mines has to some extent interrupted progress, yet sufficient advancement has been made to ensure that when conditions are again normal and men employed in the mines in as large numbers as before the European war caused suspension of operations in some of the mining camps, classes will be resumed and more men be instructed in first aid work.

The Chief Inspector of Mines, Mr. Thomas Graham, of Victoria, is much gratified with the generally good results that have followed the formation of first aid classes at metalliferous mines. The work was undertaken by the Provincial Department of Mines on his strong recommendation, and it having been successful in large degree, there is little doubt that the Hon. the Minister of Mines will readily sanction its continuance next year, and extension to all operating metal mines in British Columbia wherever it shall be found practicable.

THE CAVING SYSTEM IN THE LAKE SUPERIOR DISTRICT

J. Parke Channing, the well known consulting mining engineer, in his paper prepared for the present meeting of the Lake Superior Mining Institute, discusses the introduction of the caving system on the Marquette range, and where the credit for the innovation should go. It follows:

"The recent statement by me that the late Mr. Joseph Sellwood was responsible for the introduction of the caving system of mining in the Lake Superior mines, has called forth criticism as to the accuracy of my statement, and it is claimed that this method was first used at the Cleveland Hematite mine, which was a soft ore property lying about half way between Ishpeming and Negaunee.

"In 1886, when I went to the Gogebic Range for the first time, the Brotherton mine, near the village of Wakefield, was being operated by Mr. Joseph Sellwood. He had for the superintendent the late Mr. John Pengilly, who had as his two foremen Mr. John Harris and Mr. Thomas R. Hocking. The mine was wrought on the sub-level system of caving, which I fully described with illustrations in an article entitled Lake Superior Iron Ore, published in volume III. of the Mining Industry, being for the year 1894. Later on when Mr. Sellwood took charge of the Chandler mine on the Vermilion range he transferred Mr. Pengilly to that property, and this mine was wrought on a similar system.

"In 1890 I left the Gogebic Range and went to Ishpeming, Michigan, to take charge of the East New York mine, and took with me for mine foreman Mr. Hocking, who had, up to that time, continued as one of the foremen at the Brotherton mine. We changed the method of mining at the East New York from square sets to caving, and at the same time Mr. Thomas F. Cole, who was in charge of the Queen group of mines at Negaunee, introduced this system at his mines with great success and economy. After coming to reside in Ishpeming I visited all the mines in the district, among them the Cleveland Hematite, and I am quite sure that the caving system was not in use at that time.

"I have been told that Mr. George R. Wallace, afterward manager of the Fayal mine on the Mesaba range, introduced the caving system at the Cleveland Hematite at the suggestion of two north of England miners, who had been accustomed to its use at home. If this is so, evidently the experiment was not considered a success, or else at the time of my residence in Ishpeming it would have been in use at the Cleveland Hematite.

"It is a well known psychological fact that similar problems are often solved in an identical manner by men who have had no communication with each other. It is said that Wallace was at work on the Origin of Species at the same time as Darwin, and it is interesting to note that Mr. Guy R. Johnson introduced a sub-drift of mining at Longdale, Va., at the Longdale mine, which was almost identical to that of the Brotherton. This method he described in a paper on page 96, volume xx. of the Transactions of the American Institute of Mining Engineers for the year 1891, under the title of 'Methods of Working and Surveying the Mines of the Longdale Iron Company, Virginia.' Mr. Johnson, himself, told me many years ago that he had never heard of the Brotherton use of this system, and, if my memory serves me right, he also said that he had not known of it as the North of England system of mining, but that he and his staff worked it out as the best solution of the problem presented them.

"Time is passing and a new generation of mining men are coming in. The Lake Superior Mining Institute is becoming a record of the history of Lake Superior, and I, as one of its charter members, would welcome any information on this interesting question. Most new inventions and discoveries are 95 per cent. past experience of others and 5 per cent. novelty. He who adds but a little to the world's efficiency deserves credit, and I would be the last one to hold it from him."

McGILL GRADUATES AND THE WAR SITUATION

The following letter has been sent to every McGill graduate:

At a time like the present, when the destiny of the Empire is at stake, McGill University and its graduates should come forward and do everything in their power to help the common cause. The individual graduate probably does not fully realize the influence the graduates as a whole have in Canadian affairs. Over 5,000 educated men, holding important positions all over the Dominion and elsewhere, are a tremendous power and influence, particularly if their efforts are concentrated on certain fixed objects.

It was felt by the Executive of the Graduates' Society and by the committee in charge of the reunion, which it had been proposed to hold in the fall of 1915, that in the present crisis in the Empire, something should be done; and it was decided to write a letter to every graduate asking him to use all his influence towards patriotic ends.

In order to make our influence felt in a definite way, it was thought that a fund should be started to which every graduate of the University would contribute. The contribution of each individual would be for the nominal amount of one dollar, which would represent his patriotic vote and the signification of his intention to do everything possible to assist Canada in the responsibility and duty created by the war.

The vote of the McGill graduates will be deposited in cash form to the credit of the Canadian National Patriotic Fund.

You are therefore invited to fill in and return the accompanying check form, which will be cashed at par, or to enclose one dollar in some other form.

An immediate response is necessary if this action is to have all the effect that is hoped for from it.

For the Executive,

JOHN L. TODD, President.
WILLIAM STEWART, Secretary.

Remittances should be addressed to Mr. George C. McDonald, 179 St. James Street, Montreal.

A splendid response to the appeal has already been received, and the subscriptions are coming in very rapidly. Letters from Sir Wilfred Laurier, Hon. Mr. Doherty, Minister of Justice, Chief Justice Sir Charles Davidson, Dr. F. D. Adams and many other prominent McGill graduates have been received, heartily approving of the movement.

THE CANADIAN COPPER COMPANY'S DEPARTMENT OF SAFETY *

By E. T. Corkill, Safety Engineer.

In July, 1913, the Canadian Copper Co. organized a Department of Safety, for the purpose of accident prevention. The work of this department is largely in charge of the safety engineer, working in conjunction with the Central Safety Committee. This committee consists of the following: President, Vice-President, General Superintendent, Superintendent of Mines, Smelter Superintendent, Chief Physician and Safety Engineer.

The general superintendent is chairman of the committee, and the safety engineer secretary. Meetings are held during the first week of each month for consideration of the monthly accident report of the safety engineer, and recommendations brought forward for accident prevention. At these meetings the accidents occurring during the month preceding are discussed, and ways and means devised for the prevention of similar accidents wherever this is possible.

In addition to this Central Committee, Workmen's Safety Committees have been formed throughout the different departments. These committees consist of from five to seven men, depending on the size of the department, and meet every two weeks. The safety engineer meets with these committees and keeps a record of all their recommendations, advising them at a subsequent meeting as to the disposition of these recommendations. Since the organization of these committees many recommendations have been received and fully 90 per cent. have been carried out. The work of these committees from the smelter, mechanical and transportation departments has been exceptionally good. The mines committees have not been so successful, owing to the preponderance of foreign labor. The duty of each committee is to take note of defects in machinery, buildings, methods of working or handling material, or of any conditions throughout the work which may be the cause of accidents to employees. Each member of committee is allowed the necessary time from his work to attend these meetings, and if he is on another shift he is allowed three hours time for attending.

Reports are made out by the doctor for every accident case he attends, giving date, nature of accident and probable period of disablement. This report is forwarded to the safety engineer. A notice is also sent by the doctor when the man is able to resume work, and a card also filled out and given to the injured person to be presented to foreman or timekeeper, giving the date the man is allowed to resume work.

A foreman's report is also made out and forwarded to the safety engineer, giving full particulars of each accident. In this manner a full and complete record is obtained of all accidents that necessitate a workman laying off work.

As an encouragement to the men, and to stimulate interest in the safety work, a pennant is awarded to the building at the smelter that has the lowest accident rate for the month. A pennant is also awarded the mine that has the lowest accident rate.

A comparison of the accident rate for the year beginning July 1st, 1913, when the safety department was created, and ending June 30th, 1914, with the corresponding period of the preceding year, shows the following:

Number fatalities per 1,000 men employed—1.98 or decrease of 74.7 per cent.

Serious accidents per 1,000 men employed—18.2 or decrease of 35 per cent.

Minor accidents per 1,000 men employed—69.7 or decrease of 18.3 per cent.

The present system of having a doctor's report made out for every accident insures the reporting of every accident by the foreman to the safety engineer. Before the safety department was formed a large number of minor accidents were not reported. The decrease of 18.3 per cent. in these accidents should, therefore, be much greater.

All the fatal accidents during the year occurred in the mines. The accident decrease in the various departments is as follows:

Mines Department—Fatal accidents, 54 per cent. decrease; serious accidents, 31 per cent. decrease; minor accidents, 9 per cent. increase.

Smelter Department—Fatal accidents, none, compared with three for preceding year; serious accidents, 44 per cent. decrease; minor accidents, 48 per cent. decrease.

Mechanical Department—None, compared with one for preceding year; serious accidents; 49 per cent. decrease; minor accidents, 25 per cent. decrease.

Transportation Department.—Fatal accidents, none, compared with three for preceding year; serious accidents, 75 per cent. decrease; minor accidents, 80 per cent. decrease.

Electrical Department—Fatal accidents, None, compared with one for preceding year; serious accidents, same; minor accidents, 75 per cent. decrease.

The greatest decreases have been in those departments that employ the larger number of English-speaking men. The mines employ about 80 per cent. foreign labor, most of whom cannot speak English. It is, therefore, with great difficulty that any headway is made with these men in the work of accident prevention, and the reduction of accidents in the mines will be correspondingly slow.

*From report of T. H. Sutherland, Chief Inspector of Mines of Ontario, July, 1914.

THE COLORADO STRIKE.

President Wilson has submitted a plan for a three years' truce to all parties in the Colorado mining strike, during which the state mining and labor laws shall be enforced, with restoration to employment of all striking miners not found guilty of violation of the laws. Intimidation of non-union or union men is to be prohibited and wage scales are to be posted at each mine. A grievance committee is to be chosen by employees of each mine, entrusted with treating with the employer when trouble arises.

THE HISTORY OF TUNNELLING*

By D. W. Brunton and J. A. Davis.

The art of excavating underground passageways has been known to mankind for many centuries. The ancient Egyptians and Hindus employed it in the creation of many wonderful subterranean temples and sepulchers in hard rock, and similar monuments are found in the works of the Hebrews, Greeks, Etruscans, Romans, Aztecs and Peruvians—in fact, of all ancient civilized peoples.

Egyptian Temples and Tombs.

It is not surprising that the Egyptians, with their wonderful knowledge of quarrying as well as of many other useful arts, should have been versed in methods of underground rock excavation. Remains of their work, some of which dates back to 1500 B.C., may be found in the grottos of Samoun, the tombs near Thebes and Memphis, the catacombs of Alexandria, and the temples of Ipsamboul. A gigantic tomb has been found at Abydos, which was cut in the solid rock during the XIIth dynasty by Senwosri III.; also Rameses II., who is perhaps the best remembered personage of these ancient times, constructed, either because of vanity or the great length of his reign, many rock-cut temples, the grandest of which is probably that of Abu Simbel.

The work was performed with hand tools and the labor necessary to have fashioned monuments of such magnitude and grandeur must have been stupendous. For cutting granite and other hard rock, the workmen used saws of copper, which were either fed with emery powder or were set with teeth of that abrasive. A similar method was employed as early as the fourth dynasty for circular holes, which were drilled by a tube having fixed teeth or fed with emery powder. For removing rock in a quarry or in a tunnel, grooves varying in width from 4 to 20 in. were made on four sides of a block, which was then broken out by the swelling action produced by soaking with water a number of wooden wedges driven into these grooves.

Hindu Caves and Temples.

The excavations in India probably number at least 1,000, the majority of which are of Buddhist origin. They are usually of two types—chapels and monasteries. The chapels consist of a nave with a vaulted roof, separated from the side aisles by columns, and containing a small chapel at the inner circular end. The monasteries consist of a hall surrounded by a number of cells for the residence of monks and ascetics.

Most of the Indian excavations are of much later date than those in Egypt. The earliest, the Sudama or Nigope cave, was constructed probably about 260 B. C., the Lomas Rishi was built about 200 B.C., and those of Nassick about 129 B. C. These earlier caves imitated very closely contemporaneous timber-roofed temples, and for this reason the columns all slope inward, copying with great fidelity of detail the rafter supports of the wooden temples. In the Karli caves (about 78 B. C.) this feature is absent; the columns of the nave are quite plumb and the perfection of architecture and ornamentation is unsurpassed by any of the later Hindu rock temples. The galleries and rooms of the caves of Ellora contain a total of nearly five miles of subterranean work. Although the builders may possibly have known of gunpowder, it was not used in the construction of these tunnels, which, like all the preceding works, were accomplished laboriously with hand tools and probably by slave labor. The caves of Salsette belong to the sixth century A. D., whereas those at Elephanta were constructed about 800, and the Gwalior temples were excavated still later, during the fifteenth century.

Grecian Tunnels and Mines.

Modern archaeological investigation indicates that tunneling was possibly known to the Minyae, an ancient Grecian people dating back beyond 2000 B. C., whose cycle of myths includes, among others, that of the Argonautic expedition. A series of shafts, 16 in all, are to be seen near Lake Kopais, in Boetia, which are supposed to have been constructed by these peoples for the ventilation of an ancient drainage tunnel. The shafts are 200 to 1,000 ft. apart, 6 to 9 ft. wide, and have a miximum depth of 100 ft. The tunnel was probably the enlargement of a natural watercourse, such as are commonly found in similar calcareous rocks. Krates, of Chalkis, a mining engineer who lived in the time of Alexander the Great, is credited historically with an attempt to drain this lake by utilizing and enlarging natural watercourses.

Although the exact date of the introduction of mining into Attica, probably from the Orient, is unknown, it seems to have been subsequent to the time of Solon (about 600 B. C.). By 489 it is certain that the silver mines of Laurium were yielding a highly satisfactory return, and at the instigation of Themistocles the net profits from them were applied by the Athenians to the construction of a fleet, so that these mines no doubt contributed largely to the prosperity and power of Athens. The workings, approximately 2,000 in all, consisted of shafts and galleries in which the rocks were hewn out with hand tools and brought to the surface on the backs of slaves. Air was supplied to the large underground stopes or chambers by ventilating shafts about 6 ft. square and 65 to 400 ft. deep.

Gold was mined in Macedonia and Thrace at least as early as the fifth century B. C., and Herodotus mentions a tunnel in the island of Samos, built in the sixth century, which was 8 by 8 ft. in cross section and nearly a mile long.

Aztec Mines.

The Aztecs were well acquainted with mining, and they obtained copper from the mountains of Zactollan; the mines of Tasco furnished silver, lead and tin; and the extensive galleries and other traces of their labor were of great assistance to the early Spanish miners. With no knowledge of iron, although iron ore was very abundant, their best tools were made of an excellent substitute in the form of an alloy of copper and tin. With tools of this bronze they could not only carve the hardest metals, but with the aid of powdered silica they could cut the hardest minerals, such as basalt-porphyry, and even amethyst and emerald.

Peruvian Mines.

Although the mines of the ancient Peruvians were little more than caverns excavated in the steep sides of the mountains, nevertheless they knew of the art of tunneling, as is shown by the tunnels of their aqueducts and by the extensive tunnel that they built to drain Lake Coxamarco. They, too, had no knowledge of iron, and their tools were made of an alloy of copper

*Extract from Bulletin 57, U. S. Bureau of Mines.

and tin, which they probably discovered quite independently of the Aztecs, whom they rivaled also in the cutting of gems.

Roman Tunnels.

The Romans, however, were undoubtedly the greatest tunnel builders of early history. They drove tunnels for passage, drainage, water supply and mining, not only in Italy, but wherever their conquests led them, as is evidenced both by records and by old workings left behind in the countries they dominated. One hardly needs to mention the numerous aqueduct tunnels and sewers of the ancient city of Rome, some of which are in use to-day, attesting the ability of the Romans in this branch of engineering. Remains of their work, many of them remarkably well preserved, have been found in France, Switzerland, Portugal, Spain, Algiers and even Constantinople.

Their tunnels were of no mean size. A road tunnel near Naples, constructed, according to Strabo, about 36 B. C., was approximately 4,000 ft. long, 30 ft. high and 25 ft. wide. About 359 B. C. Lake Albanus, which lies about 15 miles southeast of Rome, was tapped for its supply of clear water by a tunnel over one mile long 8 ft. high and 5 ft. wide. Possibly the greatest Roman tunnel was driven by the Emperor Claudius to drain the overflow waters from Lake Fucinus, which is situated about 75 miles nearly due east of Rome and has no natural means of outlet. This tunnel, completed in 52 A. D., after 11 years' labor, is over 3 miles long and was designed to be 19 ft. high and 9 ft. wide; but it appeared to have been even larger than this when, in 1862, it was reopened to obtain valuable land beneath the lake.

These works seem all the more marvelous when one considers the primitive methods available at that time. Explosives were unknown and machinery was not then used in mining. Rock openings were usually made by chipping, by channeling and wedging as in Egypt, or by cutting large grooves around the block to be excavated, using hand tools made of iron, copper and bronze, although it is quite possible that for certain classes of stone cutting diamonds or some similarly hard minerals were employed in conjunction with primitive tube drills and saws. These methods were often supplemented by fire setting, a method chiefly employed, however, in the large chambers or stopes and not well adapted for driving small tunnels. It consists simply of heating the rock to a very high temperature and quenching suddenly with water (or sometimes with vinegar in calcareous rocks), producing shattering and disintegration because of sudden contraction. Many writers have described the intense and fearful sufferings of men engaged in this work, usually slaves and prisoners of war, who perished by the thousands—a fact, however, of little concern to the ancient builders.

The value of Spain as a storehouse of precious metals, offsetting somewhat the influence of eastern wealth, was well appreciated by Roman leaders, and an armed force for the protection of the mines was maintained there constantly, in many cases at the cost of serious political and financial embarrassment at home. In southern Spain, where the numerous silver and copper mines contained much water, Roman tunnels are very common. They are remarkable for their small size, being usually about 5 ft. in height and, where timbered, 16½ to 36 in. in width. One adit, as far as explored, has a length of 1,850 ft. and a maximum depth of 183 ft., and another is 2,300 ft. long and has a maximum depth of 215 ft.

As nearly as can be ascertained to-day from discoveries in them of various objects of interest, including coins, it is certain that these adits must have been driven very early in the Christian era. Toward the latter end of the period in which these particular tunnels were used by the Romans attempts were made to work the orebodies below them by raising water from the lower stopes by means of slave-operated water wheels.

As artificial ventilation by means of blowers was at that time unknown, like most of the Roman tunnels these were ventilated by shafts which were spaced in the tunnel mentioned above at about 25 meter intervals; in order also to minimize the depth to which the shafts were sunk, the courses of the tunnels corresponded very nearly to those of the valleys or gulches above them instead of being straight, as is the usual modern practice. Like the adits, the ventilating shafts were remarkably small. Where timbered the adits were usually about 2 ft. 10 in. square in the clear, and where the rock would stand without timbering they were circular and generally did not vary much from 2 ft. 4 in. in diameter.

Tunneling in Europe During the Middle Ages.

With the fall of the Western Empire, tunnel work in Europe practically ceased for many centuries. Some excavations were made, it is true, for tombs and the crypts of monasteries and underground passages to a secluded exit for escape in time of defeat were a necessary part of the equipment of each castle. Crude attempts at mining also were practised in Germany. The Teutonic tribes, whose main occupation was warfare and who were barbarous and essentially nomadic at the time of the conquests of Julius Caesar, probably learned from the Romans the value of gold; later they began to search for precious metals and to pursue other peaceful occupations.

During the Middle Ages tunneling was devoted almost exclusively to the needs of war and was seldom employed in constructing aqueducts or other public works. There is, however, a record of a road tunnel begun in 1450 by Anne of Lusignan. It was intended to pierce the Alps at an elevation of nearly 6,000 ft. and afford better means of communication between Nice and Genoa, but was never completed. Work was subsequently resumed in 1782 by Victor Amadens III., but was finally abandoned 12 years later after a total of nearly 8,000 ft. of tunnel had been constructed.

Development of the Use of Gunpowder in Tunneling.

Although gunpowder in Europe, according to the consensus of opinion, was probably invented early in the fourteenth century, and by the end of the sixteenth century was commonly used in military operations for gunnery and for blowing up fortifications, it was not applied directly to mining or tunnel operations during this period. Agricola's "Bergwerck Buch," the third edition of "De Re Metallica," published by Basel in 1621, a complete English translation of which has been issued, pictures Roman methods and hand work and fire setting as the usual means of mining.

In the year 1613 Martin Weigel is said to have introduced gunpowder in mining. Gatschmann at this time describes the use of wooden plugs for stemming. The plugs were later (about 1685) supplanted by clay. August Bayer ("Das gesegnete Markgrafenthum Meissen," 1732) and Henning Calvor ("Nachrichten uber das Bergund Maschinewesen am Harze, etc.") also confirm the date of 1613 as that of the invention of drilling and blasting, but Honemann and Rossler make it 15 or 20 years later. Whatever may have been the date when

blasts were first fired in mines, it is certain that blasting had become fairly common in 1650, for powder is mentioned as having been purchased for the Harz mines as early as 1634, drill holes are reported at Dullen which bear the date of 1637, and blasting is known to have been introduced into the Freiberg district in 1643.

The use of gunpowder gave a new impetus to mining and a large number of men became skillful in overcoming the difficulties of underground drifting, so that it is not surprising to note that an increased number of tunnels for other purposes were begun soon after. The chief of these purposes was transportation, and in the eighteenth and early part of the nineteenth centuries many tunnels were driven for canals which, aside from wagon roads, were the only highways at that time. Later the development of steam railroads and the desirability of maintaining level gradients led to the building of a still greater number of tunnels. A brief summary of the features of the more important transportation tunnels constructed abroad and at home follows.

Canal Tunnels.

The first modern tunnel constructed for commercial transportation was the Malpas tunnel on the Langguedoc Canal in France. It was 515 ft. long, 22 ft. wide and 27 ft. high, and was built between 1679 and 1681, by Riquet, a French engineer. Although it showed that canals could be constructed through country before thought impassable, no more canal tunnels were driven in France until nearly a hundred years later, the Rive de Gier Tunnel (1,656 ft. long) being constructed on the Givors canal in 1770, and the Torcy tunnel (3,970 ft. long) on the Centre canal in 1787. The Tronquoy and the Riqueval Tunnels on the St. Quentin canal were started in 1803, and the Noireu tunnel (approximately 39,400 ft. in length) on the same canal was begun in 1822. On the Bourgoyne canal, the St. Aignan tunnel was started in 1824, so that by the middle of the nineteenth century nearly 20 canal tunnels, with a total length of nearly 93,500 ft., had been constructed in France.

The earliest transportation tunnel in England was the Harecastle, on the Grand Trunk canal, which was begun in 1766 and opened for traffic in 1777. This tunnel was 8,640 ft. in length, 9 ft. wide and 12 ft. high. There were originally four other shorter tunnels on this canal. The Harecastle tunnel was found to be too small to accommodate traffic, and was replaced in 1824 by a parallel tunnel which was 16 ft. high and 14 ft. wide, 4 ft. 9 in. of the width being used for a towpath. The Sapperton tunnel on the Thames-Medway canal was started in 1783. It was approximately 12,500 ft. long and its construction took six years. The next large canal tunnel in England was the Blisworth (9,250 ft. long), on the Grand Junction canal. It was started in 1798 and required seven years for its completion. In 1856 there were over 45 tunnels on the various English canals, aggregating some 220,000 ft. in length.

The first canal tunnel in the United States was the Auburn tunnel at the Orwisburg landing on the Schuylkill Navigation canal. The tunnel (which was 450 ft. long, 20 ft. wide and 18 ft. high) was begun in 1818 and opened for traffic in 1821. The hill it pierced is composed of red shale, and the highest point was only 40 ft. above the top of the tunnel. The tunnel was shortened in 1834-37 and again in 1845-46, and was finally made an open cut in 1855-56. The "Summit Level," or Lebanon tunnel, on the Union canal, begun in 1824 and finished in 1826, was the second canal tunnel in this country. It was originally 720 ft. long, 18 ft. wide and 15 ft. high, being driven through argillaceous slate at a total cost of $30,464. It was followed by the "Conemaugh" and "Grants Hill" tunnels, on the western division of the Pennsylvania canal (1827-30); the Paw-paw tunnel, on the Chesapeake and Ohio canal (1836); and two tunnels on the Sandy and Beaver canal, Ohio (1836-38).

Railway Tunnels.

The first railroad tunnel of which the authors have record was the Terre-noire tunnel, near St. Etienne, France, on the Roanne-Andrezieux horse railroad. This tunnel, which was begun in 1826, was 4,920 ft. long, 9.8 ft. wide and 16.4 ft. high. Some 14 other tunnels were built on the road from St. Etienne to Lyons between 1826 and 1833. The first tunnels on a rairoad using steam locomotives were those on the Liverpool and Manchester Railway, constructed between 1826 and 1830. It was on this road that the famous trial between the "Rocket," "Novelty" and "Sans Pareil" locomotives took place in 1829. The following summary of early rairoad tunnel building in Europe is quoted from Drinker's work on tunneling:

Tunnels, of course, multiplied rapidly in England with the extension of railways, and during the 12 or 15 years following the construction of the Liverpool and Manchester line there were a large number of tunnels built throughout the Kingdom, among them being the famous Kilsby, Box and Woodhead tunnels. The first tunnels on a steam railway in France were those built on the St. Germain line in 1837. Subsequently the ones on the Versailles, the Gard, and the Rouen lines raised the total length of tunnels in France in 1845 to 12,833 meters (42,105 ft.). The report of the Corps des Ponts et Chaussees on tunnels for 1856 shows at that date a total on French railroads of 126 tunnels, of a total length of 65,106 meters. Among the noted early French tunnels may be cited the Nerthe, Arschwiller, Rilly, La Motte, Lormont and Alouette. In Belgium the Cumptieh tunnel, built in 1835, on the Chemin de l'Etat, seems to have been the earliest. In Germany (Prussia and other States) the earlier lines were so located as to not require much tunnel work; and the Oberau tunnel (1839), on the Leipzic-Dresden line, in Saxony, was the first. In Austria Rziha gives the Gumpoldskirch tunnel as the first. A tunnel at Eriebitz (perhaps the same), on the North line, is mentioned in the Ponts et Chaussees report (above cited) as an early Austrian one. In 1856 there were some 50 tunnels in Austria, of a total length of 13,522 meters. In Italy the Naples-Castelamare line, opened in 1840, had several tunnels. In 1856 the total Italian tunnels amounted to 10,181 meters. The Boloina-Pistoja line is especially remarkable for its semisubterranean character. Among the early Swiss tunnels especially to be noted is the Hauenstein, commenced in 1853 and finished in 1858.

The first railway tunnel in the United States was constructed between 1831 and 1833 on the Allegheny Portage Railroad in Pennsylvania. The tunnel (which was driven through slate) was 901 ft. long, 25 ft. wide by 21 ft. high, and was lined throughout with masonry 18 in. thick. It was followed by the Black Rock tunnel (1835-37) on the Philadelphia and Reading Railroad and the Elizabethtown tunnel (1835-38) on what is now the Pennsylvania Railroad. After this time railroad tunnel construction became so general that by 1850 as many as 48 tunnels had been completed on American railways.

Mine Tunnels.

Among the early European mining tunnels driven with gunpowder and hand drilling mention should be

made of the Deep George and the Rothschonberger Stollen in Saxony, the Joseph II. adit at Schemnitz, Hungary, and the Ernest August Stollen, which was later driven under the Deep George. Several tunnels, of which the Taillades tunnel was the most important, were also driven in connection with the Marseilles Aqueduct during this period.

The Deep George Stollen was driven between 1777 and 1799. The total length of the main tunnel is 34,529 ft. Its various branches aggregate 25,319 ft. more, and yet this immense undertaking, driven entirely by hand, was to obtain a drainage depth of only 460 ft. It passed through graywacke for nearly the entire distance.

Work began in the Joseph II. mining adit, at Schemnitz, Hungary, in 1782, but owing to various interruptions the tunnel was not completed until 1878. The portal is at Wornitz, on the left bank of the River Gran, about 10 miles west of Schemnitz. The tunnel is 10.27 miles long, 9 ft. 10 in. high and 5 ft. 3 in. wide, and cost $4,860,000. It is used entirely for mine drainage, and the annual saving in pumping amounts to more than $75,000.

The Rothschonberger Stollen was driven to drain the mines of Freiberg, Saxony; it was begun in 1844 and completed April 12, 1877. The tunnel starts in the Triebisch valley, at Rothschonberg, about 12 kilometers above Meissen, on the Elbe. Its length on the line planned to Halsbrucke was 42,662 ft., but as completed to a connection with the Hirmmelfahrt mine was, including branches, 95,149 ft. The depth below the Anna Stollen was 308 ft. Hand drilling and black powder were used to the end of 1875, when Burleigh drills were introduced. The work was carried on by the State. The tunnel was 9 ft. square and was driven from 18 headings, yet 33 years were required for its completion, the average rate of progress in each of the headings being only about 15 ft. per month.

The Ernest August tunnel was driven below the Deep George Stollen in 1851-1864. The main tunnel is about 34,218 ft. long, but the entire length of the adit and its branches is 74,452 ft., all driven in rock similar to that in the George Stollen. The tunnel is 11 ft. high and 5½ ft. wide, and is driven on a grade of 35.6 ft. to the mile. Hand drilling and black powder were used, and with 7-hour shifts, the rate of progress was 50 ft. per month; 4-hour shifts increased the rate of progress to 78.7 ft. per month, and by crowding the miners to the limit the progress during the last three weeks was 75 ft., or at the rate of 107 ft. per month.

Some idea of the importance the early German miners attached to drainage may be gathered from the fact that this colossal enterprise gave them an increased drainage depth of only 315 ft.

The Taillados tunnel on the Marseilles Aqueduct was begun in January, 1839, and completed at the close of 1864. It was driven from 14 shafts, and in their construction so much water was encountered that the work of sinking was difficult and at times seemed almost impossible. It was finally necessary to place at one of the shafts a steam engine of 100 horse power in order to remove the water, which amounted to 3,300 gallons per hour. The cost of sinking the shafts was approximately $40.00 per ft., and the tunnel itself cost approximately $37 per ft., or, including the cost of the shafts, $48.50 per ft. The Assassin tunnel on the same project was somewhat less difficult to drive and cost only $25.50 per ft. for 11,400 ft., whereas the Notre Dame tunnel, which was lined with masonry for its entire length of 11,500 ft., cost $32.50 per ft.

The first large mining tunnel in the United States was begun as early as 1824. This was the "Hacklebernie" tunnel, near Mauch Chunk, Pa.; it was driven by hand, and black powder was used. When work stopped in 1827 an opening 16 ft. wide by 8 ft. high had penetrated 790 ft. through hard conglomerate. Work was resumed in 1846, and the tunnel was extended to a length of 2,000 ft.

Development of the Use of Rock Drills and High Explosives in Tunneling.

The invention of drilling machines, which occurred almost simultaneously with the discovery of high explosives, gave another great impulse to tunnel driving. The following table gives in Chronological order some of the more important events connected with these two wonderful improvements.

1847—Sobrero discovered nitroglycerin.

1849—J. J. Couch, of Philadelphia, patented on March 29 the first percussion rock drill.

1851—J. W. Fowle, of Philadelphia, patented on March 11 the first direct-action percussion drill.

1854—Schumann invented his percussion drill at Freiberg.

1857—Schumann drills used in Freiberg mines.

1857—Sommeiller invented a rock drill for use at Mount Cenis.

1861—January 1 Sommeiller improved drills commenced work in the Mount Cenis tunnel.

1863—Nobel first applied nitroglycerin as a blasting agent.

1865—Guncotton tried at the Hoosac tunnel by Thos. Doane, chief engineer.

1866.—Nitroglycerin tried with great success at the Hoosac tunnel by T. P. Shaffner.

1866—Burleigh drills tried and proved to be a great success at the Hoosac tunnel.

1867—Nobel invented dynamite.

1868—Dynamite patented in America by Nobel.

The first extensive utilization of these aids was in the construction of the Mount Cenis tunnel in Europe and the Hoosac and Sutro tunnels in this country. The success attained with them soon led to further activity in tunneling, not only for railroads but in connection with mining, drainage and water supply as well—an activity culminating in the immense amount of such work undertaken within the last 10 or 15 years.

The Sutro Tunnel.

The idea of draining the mines of Virginia City by a deep tunnel was first broached in the spring of 1860, when Mr. Adolph Sutro began negotiations with the mines, the State, and finally with the Federal Government for contracts, concessions, etc. Actual work first began at the portal of the tunnel in Carson valley, 3½ miles from Dayton, on October 19, 1869. The work was carried on by hand until September, 1872, when diamond drilling was begun and tried rather unsuccessfully. In 1874 Burleigh drills were introduced, operated by compressed air generated in a compressor made by the Societe John Cockerill, of Seraing, Belgium. The tunnel was completed July 18, 1878, when the Savage vein was cut 20,000 ft. from the portal and 1,922 ft. below its outcrop. The tunnel inside of the timbers was 10 ft. high by 14 ft. wide, divided into two passageways by a central row of posts. The rate of progress varied greatly, ranging from 19 to 417 ft. per month, the average monthly rate from start to finish being 192.3 ft.

The Tequixquac Tunnel.

The Tequixquac tunnel, which now forms the most important link in the drainage system of the Valley of Mexico, was begun during the reign of the Emperor Maximilian. The work was stopped, however, at the fall of the Empire and was not resumed until 1885; even then the want of funds prevented any material progress until March, 1888.

This tunnel is 6¼ miles in length, driven through a mass of sand, mud and soft calcareous sandstone. It is brick lined throughout, the section is ovoid, with an extreme width of 13 ft. 9 in. and a height of 14 ft., and the tunnel has a gradient of 1 ft. in 1,388. The calculated flow of water is 450 ft. per second, or 200,000 gal. per minute. At first the headings were driven in the centre, but the bottom heading system was soon adopted of necessity. The greatest completed tunnel advance in any one month was 182 ft., and the greatest distance that any single heading was driven in a calendar month was 656 ft.

The Shoshone Tunnel.

The Shoshone tunnel, 1906-1910, is owned by the Central Colorado Power Co. Its intake portal is on the Grand River 12 miles above Glenwood Springs. The tunnel is 12,453 ft. long, 12 ft. high and 16 ft. 8 in. wide, and is driven wholly through hard metamorphic granite.

Where timber supports were necessary vertical posts and a three-piece arch were employed, all of which were afterwards completely covered by concrete lining. Driving was carried on from seven crosscut adits, as well as from both the intake and the discharge ends.

The cost of the tunnel, not including concrete lining, $927,653, was divided as follows:

Construction Costs of Shoshone Tunnel per Linear Foot of Tunnel.

Test drifts	$0.45
Drilling and blasting	20.66
Trenching and grading floor	1.15
Track work	1.76
Mucking and loading	17.28
Hauling	2.88
Dumping and maintenance	2.18
Blasting supplies	8.35
Drill steel	2.91
Sharpening and repairing	4.60
Timbering, temporary and permanent	3.87
Light and wiring	1.57
Ventilating	.59
Pipe, air hose and connection	.85
Power drills	2.94
Hoists and trestles	.96
Pumping	.21
Sundries	.28
Total construction costs	$74.49
Overhead costs, including surveying, management, office, etc.	30.91
Total cost per linear foot	$105.40

ONTARIO'S MINERAL PRODUCTION FOR HALF YEAR.

The statistics of Ontario's metallic production for the half year ending June 30th, 1914, have been compiled by the Bureau of Mines. As in most other industries the production as a whole for the half year shows a decrease. Copper, nickel, cobalt and cobalt and nickel oxides show an increase, but there is a decrease in gold, silver, iron ore and pig iron. However, there is likelihood of the gold output being increased in the near future. Trade depression does not affect the "market" for this metal.

Summary of Metallic Production for Half Year Ending 30th June, 1914, Showing Comparison With Production for Similar Period, 1913.

Product.	Quantity.	Value.	Same period 1913
Gold, oz.	99,269	$2,011,069	$2,171,147
Silver, oz.	13,379,044	7,053,418	7,693,713
Copper, tons	8,357	1,197,059	832,645
Nickel, tons	13,105	2,872,843	2,514,414
Iron ore, tons	47,160	118,119	141,324
Pig iron, tons	343,408	4,429,664	5,051,840
Cobalt and Nickel.	129	22,581	7,374
Oxides, lbs.	757,268	379,152	186,347

NOT AS EXPECTED.

A London Post correspondent has received a letter from a high German officer saying: "The war is not going quite as we expected, and the resistance of the allied forces is extraordinary. We are beginning to fell nervous as to results.

"The German losses are so terrible that the Emperor has forbidden their disclosure. Our generals have been wantonly wasteful of our men, who have been mowed down in thousands. While it is impossible to say what our losses are, I estimate them at between 340,000 and 500,000. If they continue at this rate, we shall be quite unable to meet Russia with any hope of success."

CANADIAN COAL AND COKE CO.

At the annual meeting on Sept. 10, the following directors were elected for the ensuing year: Hon. Senator Curry, Montreal; Hon. Senator Mackay, Montreal; J. W. McConnell, Montreal; H. A. Lovett, K.C., Montreal; T. H. Saunders, Cleveland; D. W. Campbell, Montreal; R. M. Ballantyne, Montreal; O. W. Donner, Montreal; W. M. Dobell, Quebec City; John T. Ross, Quebec; A. H. Cook, K.C.; Hon. W. B. Ross, Halifax, N.S.; H. Beverley Robinson, Montreal.

NIPISSING.

Shipments of bullion from the Nipissing for the month of August was only $69,855, owing to the condition of the silver market, but production was as high as ever, viz., $212,965. The remainder of the Nipissing and customs ore is being stored.

The first discovery of coal in the United States was made by Father Hennepin, a Jesuit missionary, who in 1679 reported the occurrence of "cole" on the banks of the Illinois river, near the present city of Ottawa. The first record of coal mining in Illinois refers to the shipment of a flatboat load of coal mined in 1810 at a point on the Big Muddy river in Jackson county, Illinois.

KITSAULTE COPPER CAMP, SKEENA, B.C.

The following notes on mining properties situated in Kitsaulte copper camp, Alice arm, Observatory inlet, Skeena mining division, have been taken from a report made to the Provincial Department of Mines, Victoria, B.C., by Mr. D. G. Forbes, who was commissioned by the department to make an investigation of mining properties and conditions in the camp under notice:

"Near the headwaters of the Kitsaulte river and on its west bank, some 16 miles in a direct line from Alice arm, Observatory inlet, a considerable number of mineral claims have, during the last two years, been located at elevations ranging from 700 to 3,500 ft. above sea-level. The trail at present followed to these properties is about 22 miles in length and is impassable for horses after the first five miles. These claims have nearly all been located on a mineralized zone in quartzite interspersed with diabase intrusions. This zone has a probable width of 5,000 ft., and the prospectors state it can be traced on the surface for more than four miles. It forms the backbone of a spur of the mountain range in which the Kitsaulte river has its source, and lies between that river and Evendsen creek. The mineralized belt is bounded on the south-west side by red porphyry and on the north-east side by slates. The ore occurs in a quartz gangue, sometimes in the quartzite and at other times bounded by diabase, but does not appear to have regular walls; although its limits are fairly well defined when it occurs in diabase rock. The mineralization is chalcopyrite and pyrite, the latter being predominant in the quartzite and the former scarce. The mountain is heavily covered with decayed vegetation and standing timber of poor quality, and there are very few exposures of rock in place.

"**Red Point Mineral Claim.**—This claim was one of the first located in the district. The surface has been broken away, leaving a series of bluffs from 50 to 75 ft. high, extending about one-third of the width of the claim. In these bluffs, which are heavily stained with iron, two bodies of ore, consisting of chalcopyrite and pyrite in a quartz-gangue, have been located about 350 ft. apart. Examination of these bluffs can only be made by going down on a rope, after the overhanging vegetation has been removed, and they have not been thoroughly prospected. The attention of the owners has been devoted chiefly to stripping and making trails in connection with the two exposures of ore mentioned, and very little actual work has yet been done to determine the value and extent of the ore-bodies.

The first of these discoveries was made in what is known as No. 1 Bluff, at an elevation of 1,700 ft. above sea-level, and shows from 14 to 16 ft. of siliceous ore near the top of the bluff. It appears to dip to the east into a sag in the bluff, but has not been found at a lower elevation. A sample was taken from this exposure, and assayed: Copper, 5.9 per cent.; silver, 2.5 oz., and gold, $6 to the ton. No effort has been made to follow this ore.

"At No. 2 Bluff more work has been done than at the first discovery. At an elevation of 1,750 ft. the face of the bluff has been stripped for 38 ft., disclosing irregular bodies of diabase rock alternating with siliceous ore. A tunnel has been driven 15 ft. into the face of the bluff in ore, and now shows at the face 2 ft. of ore, from which a sample was taken which assayed: Copper, 4.6 per cent; silver, 0.6 oz., and gold, 80 cents to the ton.

"From the above-mentioned point the bluff is nearly vertical for about 60 ft., and shows ore in many places where it has been broken. At an elevation of 2,025 ft. an exposure of ore 20 ft. wide has been laid bare at the top of the bluff, from which a sample was taken as an average across the face, and this assayed: Copper, 8.5 per cent.; silver, 1.3 oz., and gold $7.60 to the ton. One hundred ft. back from the face of the bluff a cut 6 ft. deep, 5 ft. wide and 20 ft. long has been excavated across the ore, the eastern half of the cut showing the best ore. A sample was taken from the eastern half of this cut, and it assayed. Copper, 4 per cent.; silver, 1.4 oz., and gold, $9.20 to the ton. A sample taken from the western half assayed: Copper, 0.7 per cent.; silver, 0.2 oz., and gold, $1.20 to the ton.

"One hundred and seventy-five ft. from the face of the bluff the surface soil and the standing and fallen timber had been cleared off and the quartz exposed again, but had not been broken into. This body of quartz has a strike of N. 45° W. (magnetic), and has been traced farther up the hill toward the Red Point Extension claim. It does not appear to have any distinct walls, and, as far as development has gone, appears to be vertical.

"**Red Point Extension.**—On this claim no work has been done, but a natural exposure in a small bluff shows ore 10 ft. wide, from which a sample was taken, assaying: Copper, 3.1 per cent.; silver, 0.6 oz., and gold, 80 cents to the ton.

"**Combination Mineral Claim.**—On this claim two exposures of ore have been located about 150 ft. apart. No. 1 cut shows 7 ft. 6 in. of quartz containing chalcopyrite and pyrite, with a parting in the centre of 18 in. of vein matter. Sufficient excavation has not been made to expose the limits of this ore; it has an apparent strike of S. 33° W. A sample was taken from the western half, and it assayed: Copper, 3.9 per cent.; silver, 2.2 oz., and gold, 60 cents to the ton. Sample taken from the eastern half of this outcrop assayed: Copper, 1.9 per cent.; silver, 1.2 oz., and gold, 60 cents to the ton.

"Cut No. 2 in the side of the mountain shows 5 ft. of very much oxidized ore, apparently on the foot-wall side; the ore dips slightly to the south, its strike being S. 36° W. The elevation is 2,125 ft. above sea-level. A tunnel has been driven about 30 ft. below this cut, which found ore; at a distance of 34 ft. 6 in. from the portal 15 ft. of mixed ore was passed through, the tunnel being then continued for 17 ft. in country rock. A drift was started on the west side of the tunnel on the best ore, and followed a slip for 33 ft., the face of the drift being in diabase. At a distance of 17 ft. from the tunnel in this drift a small crosscut was driven 10 ft. to the north-west, the face of this crosscut being still in ore. The ore on the dump at this tunnel was sampled, and gave upon assay: Copper, 5 per cent.; silver, 2.8 oz., and gold, 80 cents to the ton.

"The ore in this tunnel is very irregular in value, in places being much mixed with country rock; the drift to the west and the small crosscut are almost entirely in solid ore. The ore cut in the crosscut appears to dip to the south at about 80 deg. Its strike was not determined. More exploration work is necessary to determine the limits and value of this deposit; the ore exposed is, however, sufficient to fully warrant a further expenditure on the property."

Summary.

After adding brief information of a number of other mineral claims in the vicinity, Mr. Forbes gives a summary, as under:

"Owing to the limited amount of work done, it is not practicable to give any estimate of the probable ore available in these claims; it is, however, reasonable to expect that there may be some deposits of payable siliceous ore within the limits of this mineralized zone, and the little development work already done points to the Red Point mineral claim as a probable location of payable ore. A diamond drill could be profitably employed to test the orebodies on this claim. On the other claims examined so little work has been done (with the exception of the Combination) that no conclusions could be arrived at as to their possible value.

"On the Combination claim there is some siliceous ore, and an expenditure of a few thousand dollars in the present tunnel would decide whether it is advisable or not to go to the expense of a deep-level tunnel. Some more stripping and exploration work on the surface could also be done to advantage.

"It is essential that the Government pack-trail should be pushed up to the flat on the Kitsaulte above Evendsen creek as soon as possible, as no satisfactory work can be done at present, owing to the cost of getting in supplies (30 cents a pound) and the time wasted in packing, practically 15 miles, on men's backs."

BUTTE AN OPEN CAMP NOW.

Hereafter Butte will be an open mining camp, and miners may belong to any union or none. This was decided on at a meeting of mine operators on Tuesday evening, and a statement of the new policy was issued and signed by all the companies, except the Davis Daly, which was not represented at the meeting. The signatories declare that the existing scale of wages and rules as to hours will continue in effect. Contracts with all other organizations will also be carried out.

The companies say that the attitude of the new Miners' Union toward employers, as expressed in notices and their constitution, put that organization beyond the possibility of being recognized or dealt with and its jurisdiction will not be recognized.

It is claimed by the companies that fully 80 per cent. of the working men approve of the action of the companies.

After two days' holiday the mines have resumed operations. Silver Bow mine of Anaconda, with 150 men, started up Tuesday. It is understood Anaconda has 500 armed men and several modern machine guns around the Hill properties. The mines are equipped with searchlights, and the miners have to pass a line of sentries in going to work.

Some ten thousand miners, until recently all members of Butte's Miners' Union No. 1, of the Western Federation of Miners, but now divided between that organization and the newly formed Butte Mine Workers' Union, were notified that from the viewpoint of their employers it made no difference whether they belonged to either organization or none. This decision, signed by the 12 companies which represent the copper output of Butte, was reached late last night, and the town, tight in the leash of martial law, bristled with excitement today when confronted with it.

"So far as the local union of the Western Federation of Miners is concerned," the statement said, "it became apparent immediately after the dissension of June 13th that the vast body of men employed in the Butte mines were openly in revolt against that organization, and that they would in no circumstances longer be identified with it. Since then that organization has demonstrated its inability to assume control over the underground workers of Butte."

CALUMET AND HECLA.

The Calumet and Hecla Mining Co. has passed quarterly dividend due at this time. Three months ago $5 was declared, a year ago $6.

In a circular to stockholders the directors say:

"In view of the unsettled condition of the copper market in this country, and the interruption of the company's business with its foreign customers, the directors have decided not to declare a dividend at the present time.

"The product of the mine will be curtailed and the wages and salaries of all employees and officers will be reduced. It is planned to continue operations on three-quarters time rather than to discharge any large number of men, and by keeping the entire force at work part of the time it is hoped that the organization of the company may be kept intact and a lesser hardship imposed on them."

But once before since 1871, when dividend payments were started, has Calumet and Hecla, the premier dividend payer among the North American copper properties, been obliged to pass its dividend. This was in April, 1884, when the directors decided to omit the dividend payable the following month. For a period of 30 years, therefore, the company has had an unbroken record. It is to be noted, however, that in 1889, 1894 and 1901 the company paid but three dividends in the twelve months.

GERMAN PATENTS.

Ottawa, Sept. 8.

Definite announcement by the Government on the question of German and Austrian patents held in Canada may be expected within the next few days.

Action has been delayed pending receipt of the rules adopted by the British Government in regard to patents held in the United Kingdom. These have now been received from the Hon. G. H. Perley, acting high commissioner, and are before the Government.

They provide for the suspension of patents held by subjects of enemy states during the continuance of the war and for six months after its conclusion. It is probable that action by the Dominion Government will be along similar lines.

The Government have been notified that Norway has extended by nine months the period during which patents may be received. The prolongation applies till June 30, 1915.

STEEL PLANT ERECTION.

The erection of the Fort William plant of the Steel Company of Canada, on which construction was started last year and not completed owing to the dull season of manufacturing, has been resumed and a large gang of men are hard at work on the completion of the building. J. O. Callahan, general manager of the Steel Company, and B. H. Pratt, of the contracting firm, are at present in the city, superintending the work of construction, and have stated the plant will be ready for operation between November 15th and December 1st of the present year.

COPPER.

New York.

The copper market continues quiet, and no large orders are in sight. A few sales are being made for domestic delivery on basis of 12½ cents a lb. Export demand is light. England and France are taking copper, but in small amounts. One producer figures that the brass companies are operating from 65 per cent. to 70 per cent. of capacity.

RECRYSTALLIZATION OF LIMESTONES AT IGNEOUS CONTACTS*

By C. K. Leith, Madison, Wis.

At the outset I would like to make it clear that I do not enter this discussion in a controversial spirit, but in an attempt to contribute something helpful to an understanding of a difficult problem. I have too high regard for the sterling quality of the work of the men who have studied this subject in detail to offer anything in the way of essential contradiction to their statements of fact. Difference of opinion arises from differing valuation of the possible alternative hypotheses which these facts suggest.

Some degree of recrystallization in limestone contact zones has been recognized by many investigators. Earlier investigators, for the most part, assigned an important, if not the most important, role to recrystallization in development of these zones. With the growing recognition of introduction of ores and gangue materials into the contact zone from igneous rocks through the medium of primary magmatic solutions, there has been a tendency to ascribe to this process most, if not all, of the chemical and mineralogical characteristics of the contact zone. This has involved a correspondingly diminished emphasis on recrystallization of substances already there as a factor in the process, and in some cases even the complete elimination of this hypothesis. From detailed study of a few contacts, casual observation of others, and a general familiarity with the literature, some of us have been led in recent years to raise the question whether the pendulum has not swung too far away from recrystallization toward direct introduction from igneous sources, and to argue for more recognition of the part played by recrystallization. The inevitable sequence has been that those of us who have taken this view have been charged, at least by inference, with emphasizing recrystallization to the total exclusion of the alternative process. Scientists, like other men, like to classify and pigeon-hole views under simple and definite designations, leaving out qualifications which would tend to make the classification more difficult to state. This has made the problem seem more definite and simple, but has tended to obscure the fact that the disagreement is primarily not one relating to essential facts, but one of emphasis. The relative importance of processes seems to vary greatly in different districts. Until many other contacts have been carefully studied, agreement as to the relative importance of processes in general is perhaps not to be expected.

Evidences for recrystallization, briefly summarized and without qualification, are as follows:

1. So far as there is recrystallization it relates mainly to part of the silicate minerals and the residual carbonates of the contact zone. By no stretch can it explain the metallic minerals. The development of silicates from the lime or magnesia carbonates involves the elimination of all the carbon dioxide and some of the lime and magnesia, with recrystallization into silicates of part of the lime and magnesia together with other impurities which may be present, such as silica, iron, kaolin, and other substances. In certain districts the composition of part of the silicate zone (usually the outer part) corresponds approximately to the composition of the original carbonate rock, minus carbon dioxide and a part of the lime and magnesia. No analyzed samples have shown exact correspondence. It would be difficult to find exact correspondence because of later replacements, because of original variation of beds, and because of difficulty of confining sampling only to the recrystallized zone; but in some cases there is a remarkable tendency toward the constancy of silica-alumina ratios in comparison of original limestones and the supposedly recrystallized phases. The ratio is not absolutely maintained, but the variation in the silica-alumination is slight as compared to the variations which are found in the parts of the contact zone in which materials have been clearly introduced. It would be remarkable if substances brought in at random from magmatic sources should approximate so closely the composition of residual impurities of limestone. A most striking case of this, which has been worked out quantitatively on a large scale, is the contact metamorphism of cherty iron carbonates by great masses of gabbro in the Lake Superior country. Here the iron-silica ratio of the altered phase corresponds almost exactly with that of the original carbonate rock, the change being merely an elimination of carbon dioxide. Analyses have been taken from many thousands of samples brought up in drill cores and in continuous sections across the formation.

2. Secondary silicates of contact zones have often been found to be localized along cherty beds or around fragments of chert in the carbonate. Again the Lake Superior region furnishes an illustration in that cores brought from a depth of many hundred feet, where there has been no chance of surface alteration, and at some distance from the intrusive, show the development of secondary iron silicates, principally grunerite, along contact of carbonate and siliceous layers, in a rock which is so dense there is little or no possibility for the introduction of these substances from without. The ratio of silica to iron has been almost exactly maintained. And yet these are clearly developed under influence of intrusives.

3. The similarity of secondary silicates in limestones and marbles far removed from igneous contacts to some of those developed at contacts is also suggestive evidence of recrystallization along contacts.

4. Elimination of carbon dioxide and lime is postulated under either hypothesis, "replacement" or "recrystallization." The natural consequence of elimination is recrystallization of the residual materials, whether or not these are supplemented by accessions from magmatic sources. There is no good *a priori* reason why accessions should always exactly balance elimination, especially when the physical conditions of intrusion are considered—and there is no satisfactory quantitative proof that they have. Under physical conditions which have been supposed to attend the earlier stages of intrusion of a magma it is easy to conceive of pore spaces caused by elimination to be closed as fast as formed, thereby reducing volume, and, in fact, it is usual to conceive of the pressure actually being a factor in the elimination. Under the replacement hypothesis we find it necessary to assume that whatever the pressure conditions were, whether those tending to close up openings or not, the materials taken out and those introduced were delicately balanced in

*A paper presented at the New York meeting, A.I.M.E., February, 1914.

volume; that just enough is introduced in any one place to take the place of that which is left.

5. The reduction in volume required by the recrystallization hypothesis cannot in most cases be disproved. So far as original textures are retained, as they are in some districts, then it is possible to infer, rightly I think, that the volume has not been considerably reduced, and therefore, that elimination has not taken place except by equivalent introduction of new materials. But the supposedly recrystallized substances are usually in a structurally amorphous zone which may well be the residual of an original mass many times greater. Opponents of the recrystallization hypothesis have argued that the necessary elimination of substances, and consequent reduction of volume, is too large to be reasonable. The reasonableness or unreasonableness of this is a difficult point to argue. It is largely a matter of personal opinion. To me it does not seem inherently improbable. Elimination is equally necessary to the alternative hypothesis of introduction of the materials from magmatic sources. Without elimination it is necessary to assume an enormous increase in volume to take care of enough new material to give an average composition of the contact phase.

6. Discrimination of two phases of contact metamorphism is essential to an interpretation of conditions of formation of contact zones.

Students of contact metamorphism may to much advantage study the mathematical theory of heat conduction as applied to an igneous contact. We are indebted to Professors Ingersoll and Zobel for an illuminating discussion of the principles of heat flow from an igneous rock of given dimensions into surrounding limestone. Their conclusions, which seem to be well based on general physical principles, are especially interesting in showing the remarkably slow progress of a heat wave into the limestone. Quoting from Ingersoll's and Zobel's discussion of a hypothetical case:

"The conclusions to be drawn from the curves are: first, that the cooling is a very slow process, occupying tens of thousands of years; second, that the boundary-surface temperature quickly falls to half the initial value and then cools only slowly, and also that for a hundred or more years there is a large temperature gradient over only a few meters and a very slow progress of the heat wave; third, the maximum temperature in the limestone, or the crest (so to speak) of the heat wave, travels outward only a few centimeters a year. The mass behind it will then suffer a contraction as soon as it begins to cool, and the cracking and introduction of mineral-bearing material is doubtless a consequence of this."

Especially significant is the inference from the curves of heat flow that in advance of the heat wave the rock is tending to expand, therefore, to be compressed, whereas, following it during a long period of time there is contraction and the development of cracks. These conditions seem to favor two principal phases of contact metamorphism.

As the igneous mass advances into limestone it presumably is exerting mechanical pressure, judging by deformation at some contacts, and at the same time sending out heat into the surrounding rock, which, itself, increases the pressure. It is difficult to avoid the conclusion that for a time at least the adjacent rocks are under considerable pressure and that this pressure would favor elimination. It does not seem at all necessary or probable that under pressure this elimination should be immediately followed by introduction of other substances from the magma, or, putting it in another way, that substances from the magma should always so closely follow elimination as to replace molecule by molecule the original materials and thereby prevent any reduction of volume. As the crest of the heat wave advances into the surrounding limestone, lower temperatures follow, with the result that there is contraction and the development of openings. This contraction may effect not only the limestone but the intrusive itself. Into such openings the magmatic solutions may freely enter, and there are deposited the ores and some of their gangue materials. At the same time these solutions may replace the materials of the surrounding rock to a greater or less extent.

That contact metamorphism of limestone has been accomplished in two successive phases has been pretty well proved at certain contacts. It seems probable that when attention is directed specifically to this feature it may be found at others. The first phase seems to be characterized by the production of an amorphous, homogeneous, silicate mass, not definitely associated with fissures. In some cases this is discriminated sharply from, in other cases it merges gradually into, a phase characterized by sulphides and other ore-bearing minerals with their gangue materials, which occur much more largely in fissures. These fissures may often be seen to traverse the silicate zone of the first phase. The minerals of the later phase, both because of their composition and because of evidence of their transportation, cannot be regarded as recrystallizations of materials in place. They afford evidences of introduction from magmatic sources.

The two phases of alteration may merge one into the other both in time and place. The later phase may be expected to obliterate to some extent the earlier phase. Ordinarily the later minerals differ from the earlier ones, but certain silicates, quartz, and other minerals, may be common to both.

I do not attempt to cite evidences in detail from specific localities. My purpose is rather to outline the case for recrystallization. W. L. Uglow, in a recent paper, has cited evidences and references in some detail and in a forthcoming paper will cite more. I do not contend that all contacts will be proved to show important recrystallization or even that all of the illustrations cited in Mr. Uglow's paper are valid ones. I hold only that recrystallization has been proved in enough places and to sufficient degree to warrant its citation as a usual accompaniment of the process of introduction of magmatic materials. In some cases it seems to be important. In others evidence of it is slight or absent, though in these cases it may be masked by the introduction of materials in the second phase of contact metamorphism. Its complete absence in the nature of the case is difficult to prove quantitatively. Advocates of the recrystallization hypothesis have not, so far as I know, held that it was sufficient to explain all contact phenomena. They have offered it only as an explanation of one phase of contact alteration. Failure to consider this hypothesis involves failure to consider the possibilities of a two-phase alteration which seems to me to be the probable key to much contact metamorphism. With the majority of economic geologists, I recognize the conspicuous evidence of the introduction of magmatic materials. My plea is that this hypothesis be not magnified to the exclusion of the recrystallization hypothesis. Quantitative studies of contacts based on adequate sampling have unfortunately been rare. Without them, conclusions can be only qualitative and not exclusive.

THE SAFETY OF UNDERGROUND ELECTRICAL INSTALLATIONS*

By C. M. Means

Considering the hazard involved in mining operations, statistics show that a very small percentage of accidents is chargeable to electricity. These accidents do represent quite a large percentage of those that are preventable and they are the direct result of the introduction, for purely economical reasons, of a dangerous element. The introduction of electricity in mines should decrease the hazard, and in no case should electricity be applied to the mechanical operation of equipment if by so doing the dangers incidental to mining are increased.

The greater number of accidents are the result of persons coming in contact with exposed conductors at potentials varying from 250 to 500 volts direct current. The use of alternating current at higher potentials than these is quite common in large mines, but it is very rare that an accident happens from this source. This is explained by the fact that where these high voltages are warranted, proper precautions are taken, and the installations are directed by those who fully appreciate the dangers incidental to the work. Direct current is in much more general use than alternating current because of its adaptability to haulage locomotives and the low cost of installation in small operations. We are, however, coming to a more extended application of alternating current for the operation of mechanical devices used in connection with mining.

Our underground direct-current wiring system is an evolution from the surface trolley and feeder systems. This is probably due to the fact that our earlier successful applications were electric locomotives, which required the use of a trolley wire. The trolley current has been almost banished from industrial establishments on the surface because of the hazard involved, yet we use it indiscriminately underground, where the dangers from accidental contact or fire are infinitely greater. This does not mean that the underground trolley systems should be eliminated, but it does imply the proper safeguarding of such equipment as is necessarily a part of the trolley systems.

It is a fact that the men now employed in the installation and maintenance of mining equipment may be in many cases incompetent or not thoroughly familiar with the work, but they are the men who must do the work and, in order to do it properly, it is necessary that they be educated and guided in their task. Men who have been trained in industrial plants on the surface do not care to take up mining work, and the men to do underground electrical work must be recruited from men actually working in the mines. These men have no training except that gained from association with men engaged in the work. The result is, they do their work in such a manner as seems to them the most expedient with the results to be attained, and not in keeping with any clearly defined method or studied system.

For all electrical work on the surface we have the rules of the Underwriters' Association. Electricians and wiremen familiarize themselves with all requirements of the Underwriters, and the result is that their work is done in a thorough and safe manner. A complete set of electrical rules similar to those of the Underwriters' Association, but made applicable to underground work, would go a long way toward solving the problem, if they were made suitable for, and received, general application.

These rules would naturally be evolved from all data available and an investigation of all electrical accidents over a period of time; and a complete analysis should be made of causes, as well as methods to prevent a recurrence in the future. We have available the rules contained in the bituminous mine law of Pennsylvania and other States, rules of the Underwriters' Association, and rules of certain mining corporations and municipalities, that could be used for a basis. Any set of rules, no matter how carefully compiled, will naturally meet with a considerable amount of opposition and criticism, and a large part of the criticism will be warranted. This very feature will result in devising a set of rules that will meet the situatoin in its entirety, and make it possible to almost eliminate this class of accidents.

The problem of working out such a set of rules is a very formidable one, but no more difficult of solution than that which the Underwriters' Association has already solved or is successfully solving. It is fully apparent that additions or changes must be made from time to time to keep pace with an industry that is continually being developed and expanded.

The electrical rules contained in the bituminous mine law of Pennsylvania have been in effect something over two years, but last year represented the first opportunity we have had to judge the operation and effect on fatalities resulting from the use of electricity. While the exact records are not available, it is safe to say there will be a material decrease in the number of fatalities resulting from the use of electricity in this district, and this in face of the fact of a very material increase in the use of electrically driven devices used in the production and transportation of coal.

These rules represent a first step in the standardization of electrical equipment and wiring as applied to underground workings, and the results stated are conclusive proof of what can be done along this line. These rules have resulted in the education of the men who do the work, and they now know, in a general way, what they are required to do. Prior to the enactment of this law, the use of electricity in mines was tolerated but not authorized, and not subjected to any rules or regulations. It is only natural to suppose that this resulted in installations of all kinds. Some installations represented an unnecessary expense in doing everything possible to meet every restriction that might later be placed on the work, but a large number of the plants were put in simply to do the work, with very little regard to the safety of the employees. This is all changed now, and each operator knows what is required, and, wherever possible, meets all of the provisions contained in these rules.

These rules met with more or less opposition when first incorporated in the mining law, but they now meet with the favor of all progressive mining companies and have been of material value to all concerned.

Instead of restricting the use of electricity, these rules have caused a very material increase in this method of transmitting power to operate the different

*A paper presented at the New York meeting, A.I.M.E., February, 1914.

mechanical devices used in the production of coal, and are of material value to the coal industry in this region, as well as to electrical and kindred industries.

When the Underwriters' Association introduced rules governing electrical work, inspectors were employed to see that the work was done in keeping with the standard suggested by their code. Formerly these inspections covered all work done where insurance was carried, but as the workmen became more skilled the inspections were less comprehensive, and under certain conditions were omitted entirely.

For a period of time it will be necessary to employ a certain number of electrical inspectors for underground work to see that the rules are complied with. An inspector would be of little value unless he had a definite set of rules on which to base his recommendations. His duty will be to act largely in an advisory capacity and to interpret the rules laid down. The mining departments of the different States employ a certain number of mine inspectors, who can take care of the electrical work after they get entirely familiar with the rules and application, except where new schemes or unusual installations are involved. It may require some little time for these inspectors to become sufficiently familiar with electrical equipment and its operation, but a knowledge of this phase of the situation will be just as essential and as readily acquired as that of ventilation.

In the bituminous fields of Pennsylvania the mine inspectors paid very little attention to the electrical equipment so long as the use of electricity was simply tolerated, but just as soon as its use was authorized, and rules formulated covering the work, they familiarized themselves with the rules and their application, and in the average installation they are able to judge intelligently as to the safety of the equipment.

It is not within the province of this paper to suggest who should work out a proper set of rules or how they should be applied. The increased safety that would be secured would fully warrant the co-operation of the government. Electrical manufacturing companies should be very much interested because of the commercial advantages gained by reducing the hazard, thereby popularizing the use of electrically operated devices. The mining companies should also be interested because of the reduced hazard to employees and property that would naturally follow. A more extended application of electricity would be warranted with reduction in costs of operation. All safety organizations, as well as engineering societies, would be interested.

Taken in its entirety, considering the increased safety that would naturally follow, the commercial advantages to be gained, and the large number of interests involved, the expenditure of the necessary time, labor and money is fully warranted in the formation of a proper set of rules covering this work.

MANGANESE.

For commercial purposes materials containing manganese are separated into four classes—(1) manganese ores, (2) manganiferous iron ores, (3) manganiferous silver ores, and (4) manganiferous zinc residuum. Though manganese forms a part of about a hundred minerals and is a relatively widespread element, practically all the manganese of commerce is derived from material containing one or more of the minerals polianite, pyrolusite, psilomelane, wad, manganite, braunite and franklinite.

Manganese ore is mined in Canada at New Ross, Nova Scotia.

TESTING OIL SHALES

According to E. G. Woodruff and David T. Day in a bulletin published by the U. S. Geological Survey, it has been known for many years that highly bituminous shale, or oil shale, occurs in the Green River formation of the Uinta Basin in Colorado and Utah. Eldridge, who studied the gilsonite veins in this region in 1901, incidentally mentions the shale. He states that the Green River formation includes "shales and limestones, bituminous, locally in a degree to be of economic value." Since the publication of that paper reports have been current from time to time that this shale is rich in petroleum, and that it compares favorably with the Scotch oil shale which has been successfully utilized in the commercial manufacture of petroleum products for half a century.

In order to determine the geographic distribution and thickness of the shale E. G. Woodruff, assisted by W. P. Woodring, carried on in the summer of 1913 a reconnaissance survey of a part of the area occupied by the Green River formation in Utah and Colorado and in collaboration with D. T. Day made field tests to determine the amount of oil and other distillation products that can be obtained from the shale. Later Mr. Day made laboratory tests of some of the same shale and also examined the oil obtained in the field in order to determine its quality and to see if by better methods of distillation its quality could be improved.

Field tests were made in a portable still designed by Mr. Day and operations were at first carried on under his immediate supervision. The basic principle of the operation was to heat the shale, thus vaporizing the volatile hydrocarbons and destructively distilling the other forms of organic matter present in the shale. The distillation products were conducted through a pipe to a condensing coil, where the heavier products were liquefied and conducted into receivers and the gases permitted to escape.

The retort into which the shale was charged consisted of a section of 12-inch iron casing pipe 4 ft. long, having flanges screwed on the ends and a removable iron plate with asbestos gaskets fitted to each end of the retort. On one side of the retort there was fitted a small steam dome a pressure gauge, and a safety valve. From the top of the dome a pipe led to a block-tin condensing coil in a small water-filled tank. The coil discharged into Wolff bottles set in series and provided with stopcocks so that the liquids could be drawn off without interfering with the operation of the condenser. During the operation the retort was suspended from iron supports in a narrow trench, covered with iron plates and earth, and a flue erected at the back. Heat was obtained from a wood fire placed under the retort.

The operation consisted of removing the head, charging the retort with shale broken into pieces not larger than 4 in. in diameter, and replacing the head. Fire was started to give a gentle heat at first and was gradually increased until the lower part of the retort became red hot; then the fire was held constant until near the close of the process, when it was increased for a short time and then allowed to subside. Water vapor, gas, oil and gas, and finally only gas was the order in which the products were obtained. From seven to eight hours' heating was required for a charge. The liquid products were sealed in cans and shipped to the Washington laboratory.

The amount of oil obtained in the various tests ranged from 10.4 gl. to 61.2 gl. to the ton.

As a check on the field work and also for the purpose of making tests which required special apparatus, samples of shale were distilled under the supervision of Mr. Day. The laboratory tests included distilling the shale in a regular distilling flask, using 100 grams for a charge. The flasks were heated electrically in the usual way and it was found possible to continue the heating until the glass melted. It was found also that when this stage had been reached practically all the volatile matter had been distilled from the shale, leaving a crumbling dry coke. The gases given off were collected and also the ammonia water. The percentage of ammonia was determined in the general chemical laboratory.

The shale oils obtained in Scotland and elsewhere and those obtained in the present series of distillations are characterized by a large proportion of unsaturated hydrocarbons, involving a considerable loss when these oils are refined. In refining them it is not necessary to remove all these unsaturated hydrocarbons but only those which prevent the manufacture of comparatively colorless and odorless oils by the usual refining process. The proportion of these compounds differs greatly in shales from different parts of the world.

BOOK REVIEWS

IRON ORES OF LAKE SUPERIOR—By Crowell & Murray — The Penton Publishing Company, Cleveland, Ohio—For sale by Book Department, Canadian Mining Journal.

This is the second edition of a very useful work on the Iron Ores of the Lake Superior region. It is largely a compilation of material which has appeared in the various trade journals, geological reports, and technical societies' transactions. The material has been rewritten and corrections made.

The several chapters deal with the early history of the region, geology, mineralogy, production of ore, dock equipment, classification of ores, beneficiation of ores, methods of analysis, fuel, engineering, location and description of mines.

Several maps accompany the text. Interesting features of the volume are the description of methods used in exploring, mining and transporting the ore.

A useful part of the book is the statement of production and character of ore from each mine in the Lake Superior district.

RECENT COPPER SMELTING—Edited by Thos. T. Read—Published by the Mining & Scientific Press, San Francisco, and the Mining Magazine, London—Price $2.50—For sale by Book Department, Canadian Mining Journal.

This is a compilation of recent articles on copper metallurgy, and is intended to present in convenient form the views of well known engineers on current practice in all parts of the world.

Most of the articles have appeared in the pages of the Mining & Scientific Press during the past four years. Some are from the publications of the American Institute of Mining Engineers.

As the metallurgy of copper has made great strides in the last decade, it is very difficult for the copper metallurgists to keep in touch with practice as it is developed. Greater advance has been made in the metallurgy of copper than in any other metal during recent years. These advances are indicated in publications of the technical journals and mining institutes. A real service has therefore been done by Mr. Read in putting together papers on the subject which are otherwise not readily available.

CRYSTALLOGRAPHY—By T. L. Walker, M.A., Ph.D. Professor of Mineralogy and Petrography, University of Toronto—Price $2.00—McGraw Hill Book Co.—For sale by Book Department, Canadian Mining Journal.

This book has been written to present a connected elementary statement of Crystallography along the lines developed by Dr. Victor Goldschmidt, of Heidelberg.

HANDBOOK OF MILLING DETAILS—Compiled from the Engineering & Mining Journal, by the Editorial Staff—Price $4.00—McGraw Hill Book Co. —For sale by Book Department, Canadian Mining Journal.

This book is a collection of articles that have appeared in the Engineering & Mining Journal during the last two or three years under the general head of "Details of Metallurgical Practice." The character of the book is in all respects the same as "Handbook of Mining Details."

The compilation covers the publications from November, 1909, to December, 1913, inclusive.

It is a handbook that is a more or less random collection of useful information, rather than a treatise.

While the major part of the book is devoted to milling, there is also some information included concerning smelting and refining practice.

USEFUL MINERALS AND RARE ORES—By Alex. McLeod,—Jno. Wiley & Sons, Renouf Publishing Co., 25 McGill College Ave., Montreal, Canadian agents —Price $1.25—For sale by Book Department, Canadian Mining Journal.

This book has been written to furnish simple means for the determining of useful minerals. Practical instructions that will aid in the search for and the determining of the useful minerals and rare ores, are given. The author claims that absolutely no skill is required to carry out any of the tests, and the apparatus required is very inexpensive.

Among the subjects dealt with, are: Prospectors' pan, the streak of minerals, hardness, prospecting hints, preliminary tests, surface changes, surface indications, apparatus and chemicals required for testing, hints on testing, methods of testing for the several metals, tables for determination of minerals, distinguishing tests for minerals which resemble one another.

This little book is not intended for mineralogists, but should be useful to those without experience who wish a guide in the search for minerals.

THE MINING WORLD INDEX OF CURRENT LITERATURE—Vol. V. First Half Year, 1914—By Geo. E. Sisley, Associate Editor Mining and Engineering World, Chicago.—For sale by Book Department, Canadian Mining Journal.

This volume covers the world's literature on mining, metallurgy and kindred subjects, and embraces all reference of any importance to the literature of the field it exclusively represents. It is of great assistance in the search for information. The plan is simple and the list of articles complete.

THE APPLICATION OF KICK'S LAW TO THE MEASUREMENT OF ENERGY CONSUMED IN CRUSHING

By S. J. Speak.

Mr. H. Stadler, in his paper "Grading Analyses and Their Application," states Kick's Law as follows:

"The energy required for producing analogous changes of configuration of geometrically similar bodies of equal technological state varies as the volumes or weights of these bodies."

In other words this law says that to break 1 cu. in. of material into two pieces will require ten times more energy than is required to break a piece of exactly similar material of 1/10 cu. in. size into two pieces. With one limitation to be mentioned below this is a statement of a mathematical fact, and, therefore, indisputable.

The law assumes that the tenacity of a material is a constant quantity, which is not absolutely correct. The assumption is sufficiently true for sizes appreciable by the naked eye, but for finer sizes it has been known for many years past not to hold good. The following figures taken from a paper by Gibson & Gregory on "Notes on the Tenacity of Spun Glass," will serve as an example to show the enormous increase in tenacity as such threads become fine.

Diam. in mm.	Tenacity in dynes per sq. cm.
0.009	60×10^7
0.0082	83×10^7
0.005	97×10^7
0.0042	126×10^7
0.000315	405×10^7
0.000186	424×10^7

A similar increase in tenacity has been found in testing fine metallic wires, though to a smaller extent.

Quincke suggested that the great increase observed in the case of metals was due to a surface tension analogous to that observed in liquids, but, whatever the true explanation, it is a well-established fact that fine particles have a greater tenacity than large particles. This being so, Kick's Law becomes more and more inaccurate as the sizes become smaller, even with a material which is otherwise perfectly isotropic; but the discrepancies are probably not very marked until sizes as small as 200-mesh are reached. We may, therefore, apply Kick's Law to the ordinary problems of ore crushing, in so far as this particular point is concerned.

However, though in itself approximately correct, Kick's Law may not be strictly applicable to the problems of ore crushing, because the stipulated conditions of "equal technological state" do not exist in the various stages of crushing an ore. Consider, for instance, a piece of ordinary oxidized auriferous quartz, 4 in. in diam.; it may contain scores of small vugs partly filled with oxide of iron in powdery form, and also small cracks filled with clay. When such a piece is submitted to crushing, the first fractures will take place mostly at cleavages and other weak places. The tenacity of a piece of such ore 4 in. in diam. will, therefore, be relatively less than that of pieces say 1/10th in. diam., because the latter will possess the same original lines of weakness which would already have been taken advantage of at the initial crushing. Further, by the time such a piece of ore was crushed to, say, 10-mesh in water, the greater part of the clay, etc., in the ore would be washed away as slime, and would thus have been converted into slime without any real consumption of energy.

The author has noticed on plotting various screen analyses that the product of a machine re-grinding sands or middlings contains relatively less slime than if the same machine were treating original ore. The only apparent reason for this is that the original ore contained some natural slime, whereas the sand or middling product had previously been nearly freed from such material.

As a further illustration of the difficulties of obtaining "equal technological state," we may refer to the problems of ore dressing. It is often found that after a particular ore has been crushed through a certain aperture, the bulk of the mineral is freed from the gangue. Suppose the mineral be galena, the gangue be quartz, and the mesh 60; in such a case many of the particles larger than 60-mesh would consist of quartz and galena, whereas most of the smaller particles would consist either of quartz or galena, so that if, as seems probable, the attachment of the galena to the quartz is a plane of weakness, the exact condition of equal technological state is not maintained. Mr. Stadler maintains that Kick's Law would apply, but the argument he advances in support of his contention overlooks the point that the plane of attachment of one mineral to another is in all probability a plane of weakness.

In general, regarding the application of Kick's Law to ore crushing, it seems reasonable to conclude:

(1) That it will tend to over-estimate the energy consumed in coarse crushing.

(2) That it will tend to under-estimate the energy consumed in the grinding of non-slimy sand into slime.

(3) That it will tend to over-estimate the work done in making slime from such ores as contain slime as an original constituent.

These conclusions seem to be borne out by what is noticeable in actual practice. Consider, for example, the following instance.

Mr. Stadler mentions that the relative efficiency of stamps decreases rapidly from 78.3% for 9-mesh screen to 39.2% for 1,200-mesh, and to 33.1% for 1,600-mesh. The more one thinks about the action of stamps, the less can one believe that this apparent falling off in efficiency is solely due to the unsuitability of stamps for fine crushing.

However, although Kick's Law may not be strictly applicable to all the problems of ore crushing, there has not yet appeared a more rational basis on which to work. Rittinger's Law, as commonly formulated, viz., that "the work of crushing is proportional to the reduction in diameter" is open to the same objections as above stated against Kick's Law, besides other much more serious objections.

Stadler's adaptation of Kick's Law to ore crushing is, perhaps, marred by the employment of the term "energy unit," but otherwise is a fairly serviceable method, and will, no doubt, become increasingly used.

*A paper presented at a meeting of the Institution of Mining and Metallurgy, May 21, 1914.

PERSONAL AND GENERAL

Mr. E. R. Davidson, of Spokane, Washington, manager for the Eagle Mountain Mining Co., of that city, was recently at the company's Eureka group property in Ainsworth mining division, B.C.

Mr. John A. Finch, of Spokane, one of the largest shareholders in the Standard Silver-Lead Mining Co., operating near Silverton, Slocan lake, B.C., has been visiting Mr. Geo. H. Aylard, the company's general manager, at his home in Victoria, B.C.

Mr. W. S. Hawley, manager for the Silver Hoard Mining Co., of Spokane, last month spent several days at the company's mine in Ainsworth camp, B.C.

Mr. O. E. LeRoy, of the Geological Survey of Canada, was lately on an official visit to British Columbia. From Victoria he returned to Alberta via Vancouver and Nelson.

Mr. John McMartin, of Cornwall, Ontario, has been in British Columbia for a short time, looking into conditions at the Motherlode gold mine at Sheep creek, Nelson mining division, in which he is largely interested.

Mr. W. Manning has been examining the Yankee Girl mine for the Texas people who are operating it. This mine is situated near Ymir, B.C.

Mr. Wm. Thomlinson has lately been in Boundary and Similkameen districts, British Columbia, arranging for obtaining representative collections of ores for the Panama-Pacific Exposition in 1915.

Mr. W. R. Wilson, of Fernie, B.C., general manager for the Crow's Nest Pass Coal Co., of Toronto, has notified employees of the company that the positions of all who enlist for service in the war against Germany and Austria will be open for them on their return to the Crow's Nest district.

A number of mining engineers from Kootenay district, British Columbia, have volunteered for service in the European war and have left for the East en route to England. They include Messrs. Thomas Brown, Jr., A. W. Davis, A. J. L. Evans, R. G. McFarlane, C. B. North, B. T. O'Grady, G. E. Revell, L. B. Reynolds, and G. B. Webster.

Mr. J. B. Tyrrell has recently been working in southern British Columbia on the question of the occurrence of oil in paying quantities.

In consequence of the war, the Comite des Forges de France has been obliged to cancel all arrangements for an autumn meeting of the Iron and Steel Institute in France this year. Under the circumstances, the Council has decided that it would be advisable to postpone for the present the organization of any alternative arrangements for an autumn meeting for the reading and discussion of papers.

Mr. John A. Dawson and Miss Hazel Bigger were married in Ottawa on Thursday, Sept. 3, 1914.

Mr. J. W. Astley has returned to Toronto from the Pacific Coast, where he has been for some time examining mining properties.

M. Beatty & Sons, Ltd., of Welland, recently launched another dipper dredge at their shipyards on the Welland Canal. The steel hull is 107 ft. long, with 36 ft. beam. It is 9 ft. 3 in. deep at the bow and 8 ft. 3 in. at the stern. The boiler is of the Scotch marine type, and is of ample size to furnish steam for the entire plant when working under heavy load. The builders expect to finish work on this dredge early in the fall.

Mr. G. Watkins Evans, consulting coal mining engineer, of Seattle, who during 1912 examined the Ground Hog coal field of British Columbia, and who examined the Matanuska coal field in Alaska for the U. S. Navy during the summer of 1913, is now in Montana examining coal properties.

Mr. Walter E. Segsworth, of Toronto, and Miss Ruby Le Roy, of Markham, were married on Wednesday, September 8.

Francis Glover, mining engineer for the Princeton Coal and Land Co., recently made an examination of the mines of the Columbia Coal and Coke Co., at Coalmont, B.C.

Mr. A. P. Houle has been appointed Professor of Metallurgy at the Michigan College of Mines.

At a meeting of the Board of Directors of the Westinghouse Electric & Manufacturing Co., held in New York City, Wednesday, August 26th, Mr. Henry D. Shute was elected treasurer to succeed Mr. T. W. Siemon. Mr. Truman P. Gaylord, district manager of the Electric Co. at Chicago, was elected acting vice-president to succeed Mr. Shute.

Messrs. Fraser & Chalmers, of Canada, Ltd., have just received an order from the Siemens Co. of Canada for a 188 h.p. Terry steam turbine, running at 3,600 R.P.M., fitted with Falk gearing reducing speed to 1,200 R.P.M., suitable for direct coupling to a Siemens exciter generator.

The Canadian General Electric Co. has issued a bulletin on Centrifugal Compressors, by Louis C. Lowenstein.

OBITUARY

Edward Leigh Goodwin, son of Dr. Goodwin, Director of the School of Mining, Kingston, died at Sudbury on August 27th. Mr. Goodwin graduated a few years ago from the School of Mining, and was in the employ of the Mond Nickel Co. He was a young mining engineer, who promised to take a high place in his profession, and his many friends learn with regret of his early demise.

McINTYRE.

Toronto, Sept. 9.

It is announced in local mining circles to-day that the deal for control of the McIntyre Gold Mines, of Porcupine, which has been pending for some time, has at last been closed, and that capitalists associated with the Nipissing mine are now practically in control of the McIntyre.

The necessary stock, $1,500,000 shares, has been deposited in escrow, and will be paid for should the examination of the McIntyre property verify the statements that have been made by the vendors.

It is understood that in addition to buying a controlling interest in stock, the new owners have taken from President Freeman $90,000 worth of bonds, and that only on this basis could the deal have been put through.

Reports from the McIntyre have been very favorable of late, and it is the expectation that the new control will bring to the stock prestige which it has hitherto lacked.

A PICKING TABLE SCREEN.

Roberts and Schaefer Co., engineers and contractors, have issued a bulletin illustrating and describing the Marcus patent picking table screen. This screen marks a decided step in advance in the preparation of coal. Not only does it size the coal as well or better than had been done by means of the inclined shaking screen, but it also permits the hand picking and removal from the coal of all foreign matter.

SPECIAL CORRESPONDENCE

BRITISH COLUMBIA

Efforts are being made to bring about a return to conditions as nearly normal as shall be found practicable in connection with the production of silver and lead bearing ores, particularly in the mining divisions of West Kootenay—Ainsworth, Slocan, and Nelson—that are most seriously affected by the interruption to production following disorganization of the metal markets consequent on the outbreak of war in Europe. Following the vigorous steps taken to prevent a continued interruption to silver mining in Ontario, Mr. Lorne A. Campbell, M.L.A., of Rossland, general manager for the West Kootenay Power and Light Co., in whose electoral constituency is situated Trail, the headquarters of the Consolidated Mining and Smelting Company of Canada's lead smelting and refining and copper smelting industry, actively interested himself in an energetic movement to minimize the unfavorable results of a stoppage of mining operations at a number of mines in the several divisions above mentioned. After having been in communication with the Premier of British Columbia, who is also Minister of Mines for the Province, Mr. Campbell proceeded to Victoria. The following information relative to his visit to the capital of the Province was published in the Victoria Daily Colonist of August 27:

"Strenuous efforts are being made by the mining interests of British Columbia, particularly those in the Kootenay districts, to devise ways and means to meet the new situation as a result of the war, and insure that the producing properties of the country shall not have to discontinue mining operations. To this end several conferences have been held during the last two days between Sir Richard McBride and Mr. Lorne A. Campbell, M.L.A. for Rossland, representing the mining interests of Kootenay.

"In explanation of the position of the silver-lead mining industry, Mr. Campbell said: Prior to the outbreak of war, the mines were in good condition and there were but few clouds on the industrial horizon of the Kootenay districts. With the war and the immediate collapse of order in the financial markets throughout the world, came the disruption of the metal markets, making it impossible to get quotations or ascertain the market value of metals. This situation only revealed an opportunity, as a result of the war, and it is this new position that is now being surveyed.

"Just prior to the outbreak of war, Great Britain secured all the available lead supplied open to purchase. It is assumed that she is still in the market for all the lead she can get. The silver-lead mines of British Columbia produce comparatively very little silver, but they do produce a considerable quantity of lead, which can be refined in the Province. It is to this phase of the matter Mr. Campbell is now engaged in directing the attention of both the Federal and Provincial Governments. His idea is, roughly, that the Federal Government should purchase what silver is produced in British Columbia and make what other arrangements shall be necessary to insure that the mines shall not be closed, to the end that the lead which Great Britain requires shall be supplied in some quantity by the mines of this Province. The question is one which involves many considerations, but Mr. Campbell has received such assurances from Sir Richard McBride as lead him to be hopeful that the problem will be solved satisfactorily."

It is of interest in this connection to note that in 1913 the silver-lead-zinc mines of Kootenay districts produced, according to official figures approximately 2,800,000 oz. of silver, 55,000,000 lb. of lead, and 6,758,000 lb. of zinc.

Ainsworth.

Mining is being continued on a number of properties in this division. During four weeks ended Aug. 27, 1,854 tons of ore from local mines was received at the Consolidated Co.'s smelting works at Trail, chiefly from the company's own mines, the Highland and No. 1.

At the Silver Hoard mine 12 men are employed, and ore is being taken out. While operations are on a smaller scale than had been intended they should be, the Spokane owners of this property are continuing work with fewer men rather than close the mine. As soon as custom ore shall again be received at Trail shipment will be resumed; meanwhile the ore taken out as development proceeds is being stored at the mine.

Work has been discontinued at the Eureka mine, near Sproules, a stopping place on the Kaslo & Slocan railway. The crosscut adit that for some time was being driven under contract did not open any ore. A few men have been sent from Kaslo to the J. L. Retallack & Co. property near Whitewater to work there for a while, but it is unlikely they will remain there many weeks.

Boundary.

Granby Consolidated—President Nichols, of the Granby Consolidated Mining, Smelting and Power Co., Ltd., has issued to shareholders in the company a circular letter, as follows:

"We suppose that no shareholder will be surprised to learn that the directors of the company have unanimously decided to defer action on the question of a dividend under the unprecedented conditions prevailing at this time, when there is no market for refined copper.

"It seemed plain that working for a large output which could not be sold would be very unwise, as it would only postpone the time when normal prices might be resumed. Accordingly the works at Phoenix and Grand Forks were closed on August 7.

"The entire energies of our staff are now concentrated at Anyox, where metal recoveries and value are much higher than at the old mines and smelter.

"The problems involved in accomplishing the most efficient and profitable handling of our business in this new field can now receive the undivided attention of the management.

"If this interval of reduced activity, made necessary by the war in Europe, can be utilized to place the company in position to reap the greatest possible advantage from improved conditions, when they arise, the company will accomplish the most that could be wisely attempted. The spirit of the management is admirable, and every effort will be made to convert the temporary conditions, for which neither the property nor its management is in any wise responsible, into permanent benefit to the company."

Commenting on this communication to the shareholders, Mr. Geo. L. Walker says : "The Granby Consolidated Co.'s mines at Phoenix and smelter at Grand Forks are idle, and the management's attention is being given exclusively to the Hidden Creek operations, where, it is understood, a fair operating profit can be shown even with copper selling around 12½ cents a lb. The cost of producing copper at Phoenix and Grand Forks was probably around 11 cents a lb. As the company was obliged to borrow a large sum of money to complete its Hidden Creek financing, it is not in a position to continue production at full volume under present conditions, which probably would entail the necessity of accumulating a considerable stock of copper. To accumulate 10,000,000 lb. of metal, costing 11 cents a lb., would tie up $1,100,000, and this would severely strain the cash resources of a company in such a position as the Granby Co. is in. The management has wisely passed the dividend, which under normal conditions would have been paid this quarter. There is little doubt that it will be able to make sufficient profit from its Hidden Creek operations to pay the interest on its outstanding bonds and notes. With the return of normal conditions in the metal market, and an advance of three or four cents per lb. in the price of copper, the Granby Co. will be in a position to earn $2,000,000 to $3,000,000 annually. Given those conditions it will be able to liquidate its floating indebtedness very quickly."

Coast.

Portland Canal Tunnels, Ltd.—Recently there was printed in the Journal information relative to progress made in the mine of the Portland Canal Tunnels, Ltd., near Stewart, Portland Canal mining division, and it was stated that the main crosscut adit being driven by the company had by August 6 reached a distance of 3,534 ft. from its portal. It was also shown that at 2,343 ft. from the mouth of the adit the Lucky Boy vein had been intersected, at 2,600 ft. the Melba vein was reached, and at about 3,000 ft. the Richard II. vein was cut; further, that the Lucky Boy drift was in 530 ft., and that a raise from this drift to connect with the surface was up 90 ft. with about 70 ft. more to be put up before the raise would be through. Since then encouragaing progress has been made. On August 24 General Manager Elmendorf telegraphed from Stewart to the company's office in Victoria, to the effect that the crosscut had reached what is known as the green vein. Five days later he advised that the whole face of the adit was in ore of good mill feed grade, and that a sample that had that morning been assayed contained 18 oz. silver to the ton, with gold not yet determined, and some lead. This ore was encountered at about 2,000 ft. below the surface, and its having been proved to occur at that depth is regarded as of much importance to Portland Canal mining division.

WESTERN NATURAL GAS CO.

The directors of the Canadian Western Natural Gas Light, Heat & Power Co., Ltd., have placed the shares on a dividend paying basis by the declaration of an interim dividend of 1 per cent., payable August 31. Books will close from August 25 to August 31 inclusive.

The company, which owns a number of natural gas wells in Southern Alberta, supplies gas to Calgary and Lethbridge, with branch lines to other towns. The gas bearing territory controlled covers over one and a half million acres. The authorized capital is $8,000,000 in common and an issue of 3,950,000 in 5 per cent. debenture stock was made in London a couple of years ago.

PRETORIA MINT TO BE REOPENED.

Pretoria, Aug. 9.

It is officially announced that the Government is temporarily reopening the Pretoria Mint used by the old Transvaal Republican Government for coining South African sovereigns and half-sovereigns. Work is already proceeding in connection with the overhauling of the plant and equipment, and operations will be commenced as soon as possible. The Government's decision is the outcome of a desire to ensure that under no circumstances shall the supply of gold and specie in the Union fall below local requirements. The gold and specie now in the country are sufficient for the Union's needs for a considerable time to come, but it is desirable to make arrangements to supplement the existing gold supplies in case a scarcity should occur.

REA MINE.

According to Mr. S. R. Clarke, the Rea mine has shown that a gold mine in Porcupine can be made to pay very handsomely with a comparatively small initial outlay. The Rea's 10-stamp amalgamating mill cost only $5,000. It crushes 35 tons daily and saves 89 per cent. of the gold, and the monthly return is over $15,000.

The mills of the Dome and Hollinger have a much greater capacity and a more complete recovery; still the example of the Rea should do much to secure the opening of many properties for which large capital is not now available. The war has shown the extraordinary value of gold, and there is nothing much safer or more profitable now than a producing gold mine.

RAY AND NEVADA.

The Ray Consolidated Copper Co. and the Nevada Consolidated Copper Co. have voted to defer action for the time being on the payment of the dividends.

In a letter to stockholders of the Nevada Consolidated Copper Co., explaining deferment of dividends, President Eccles stated as follows:

"The general European war has precipitated a condition which has led to the derangement of markets, transportation and financial facilities in the copper industry. Under normal conditions about 50 per cent. of the copper produced in the United States is marketed abroad, and with the declaration of war this outlet for the copper has become closed for the reasons set forth above. When this condition became apparent your directors determined to curtail operations, and your mines, mill and smelter are now operating on only 50 per cent. capacity."

Political partisans of Felix Diaz have revolted in Oaxaga and other districts in southern Mexico and are in arms against Gen. Carranza's Government, according to information received in New York Tuesday.

COBALT SHIPMENTS.

The one feature in the Cobalt situation is the holding back of silver bullion until such times as the market is less limited and transportation is still more secure.

The arrangements with the smelters appear to be working satisfactorily as ore shipments continue well above normal. The Cobalt Townsite was a very large shipper with no less than four cars of high grade ore and concentrates. The English company is piling up a record production for the year. The McKinley-Darragh were next in importance with three cars and there is every disposition on the part of this company to maintain full production as long as possible.

The Dominion Reduction company has recommended its shipments of cobalt residue to the Canadian smelter, so that it may be inferred that this class of ore can again be transported across the seas. A large tonnage of ores containing a high percentage of cobalt has been held at Canadian smelters awaiting transportation since the war broke out.

The ore shipments from the Cobalt camp for the week ending Sept. 11, were:

	High.	Low.	Tl. Lb.
Cob. Townsite. . . .	330,180	.....	330,180
McKin.-Dar.	258,020	.....	258,020
La Rose	85,090	.....	85,090
Cham.-Fer.	76,560	.....	76,560
Cobalt Lake	64,060	.....	64,060
Dom. Red.	.....	84,900	84,900
Coniagas.	74,310	.....	74,310
	888,120	84,900	973,020

The bullion shipments from the Cobalt camp for the week ending Sept. 11, were:

	Bars.	Ounces.	Value.
Cr. Reserve.	57	66,000.00	$35,000.00
Penn-Can.	3	2,631.44	1,420.98
	60	68,631.44	$36,420.98

The bullion shipments for the year to date are as follows:

	Ounces.	Value.
Nipissing. . . . . (and Customs ore)	2,355,066.61	$1,956,384.63
Dom. Red.	241,041.00	141,612.25
Buffalo.	791,319.77	454,249.50
Cr. Reserve	389,375.00	215,452.00
O'Brien.	101,269.05	57,476.46
Kerr Lake	54,944.75	28,133.74
McKin.-Dar.	12,176.00	6,356.00
Foster Ls. Co. ...	2,187.25	1,141.44
Penn. Can.	9,237.94	5,887.88
Casey Cobalt	2,893.00	1,484.00
Trethewey	2,000.00	1,200.00
Timiskaming.	1,951.00	1,033.05
Bailey.	1,462.00	763.25
Hargraves.	794.00	414.81
City of Cobalt ...	24,121.00	13,616.00
Caribou Cobalt ...	67,972.99	5,714.75
Cobalt Townsite ..	26,933.00	14,766.00
Campbell & Deyell	500.00	295.00
Total.	4,862,189.33	$2,745,758.62

GEO. S. MALLOCH DEAD.

Washington, Sept. 14, 1914.

After being marooned on frozen Wrangels' Island in the Arctic since last January, eight white men and an Eskimo, the remnant of Stefansson's ship Karluk, arrived at Nome, Alaska, on board the United States revenue cutter Bear. Eight members of the expedition failed to reach the island when the Karluk was crushed and three others, George S. Malloch, a native of Hamilton, chief geologist; John Broeddy, seaman, and Bjarme Mammen, assistant topographer, died on the island.

George Malloch was born at Hamilton 34 years ago. After receiving his early education at Upper Canada College, he took a science course at Queen's University, Kingston, graduating in 1902 with the degrees, A.B., and also B.Sc. at the School of Mining in 1906. After graduation he was appointed assistant geologist to the Geological Survey. He spent the following two years in research work in the coal fields of Alberta. In 1909 he pursued his work between the Fraser River and Fort George. The next three years were spent in topographical work in British Columbia. Before joining the expedition as chief geologist and topographer, Mr. Malloch took a post-graduate course at Yale University.

A despatch received from Captain Cochran, of the revenue cutter, says that Malloch and his assistant, Mammen, died of nephritis, while Broeddy was accidentally shot.

Continuing, the despatch says that the survivors, John Munro, Robert Williamson, W. McKinley, John Hadley, E. F. Chaff, R. Templeman, H. Williams, F. W. Maureer, and Eskimos are doing well under the care of the surgeon.

"Party were rescued by the schooner King and Wing, September 7," says the telegram. "Transferred to the Bear, September 8. Bear reached within 12 miles of Herald Island. Clear weather and heavy ice. Unable to land on island, but no signs of life."

The expedition started out about a year ago, under the auspices of the Canadian Government, for the purpose of exploring land north of Point Barrow. During a fog Stefansson and several others went ashore in a boat and the Karluk was carried away from them. Messages since received from him show that he and the other members of his party are alive and conducting the explorations.

When the Karluk was crushed the party saved as large an amount of stores as possible. The eight men reported missing probably lost their lives in making the trip to Wrangel Island.

VIPOND GOLD MINE.

The Vipond Gold Mines Company has completed its new mill, and this is now running satisfactorily. With the installation of the new machinery a very high grade extraction should be obtained. Underground work is being carried out as extensively as possible and there is said to be enough ore drawn to keep the mill going a considerable time.

MARKETS

TORONTO MARKETS.

Sept. 9—(Quotations from Canada Metal Co., Toronto)—

Spelter, 6c. per lb.

Lead, 5c. per lb.

Tin, 45c. per lb.

Antimony, 16c. per lb.

Copper, casting, 14c. per lb.

Electrolytic, 14c. per lb.

Ingot brass, yellow, 10c per lb.; red, 13c. per lb.

Sept. 9—Coal (Quotations from Elias Rogers Co., Toronto)—

Anthracite, $7.75 per ton.

Bituminous, lump, $5.25 per ton.

GENERAL MARKETS.

Sept. 8—Connellsville coke (f.o.b. ovens).

Furnace coke, prompt, $1.70 to $1.75 per ton.

Foundry coke, prompt, $2.25 to $2.35 per ton.

Sept. 8—Tin, straits, 34.00 cents.

Copper, Prime Lake, 12.50 to 12.75c.

Electrolytic copper, 12.20 to 12.30c.

Copper wire, 13.75 to 14.00c.

Lead, 3.90c.

Spelter, 5.85c.

Sheet zinc (f.o.b. smelter), 8.50c.

Antimony, Cookson's, 13.50 to 14.00c.

Aluminum, 19.50 to 20.50c.

Nickel, 40.00 to 45.00c.

Platinum, soft, $48.00 to $50.00 per oz.

Platinum, hard, 10 per cent., $52.00 to $54.00 per oz.

Bismuth, $3.00 per lb.

Quicksilver, $70.00 to $75.00 per 75-lb. flask.

SILVER PRICES.

	New York cents.	London pence.
August—		
25	53⅝	*
26	54⅜	*
27	55	*
28	53⅛	*
29	53	*
31	53⅞	*
September—		
1	53¼	*
2	53¼	*
3	53¼	24
4	53½	24¼
5	53½	24¼
7	†	24½
8	54¾	24 15/16
9	54¾	24 15/16
10	55	25
11	55	25

*No quotations. †Holiday.

STANDARD EXCHANGE.

Sept. 11, 1914.

Following are yesterday's quotations on the Standard Stock and Mining Exchange:—

Cobalt.	Asked.	Bid.
Bailey	⅝	⅜
Beaver	20	18¾
Buffalo	..	75
Chambers	..	10
Cobalt Lake	50	..
Coniagas	..	6.50
Crown Reserve	1.15	1.10
Gould	1	½
Great Northern	4¼	..
Hargraves	2	..
La Rose	..	425
Little Nipissing	..	70
McKinley	40½	..
Nipissing	5.25	4.95
Peterson Lake	23¼	..
Timiskaming	8	7½
Trethewey	15	..
Wettlaufer	..	5
Porcupine—		
Crown	85	75
Dome Extension	5½	5
Dome Mines	18.00	16.40
Jupiter	..	5¼
McIntyre	35	28
Preston	1¼	¼
Rea	..	10
Vipond	17¼	..

SALES.

Cobalt.	High.	Low.	Last.	Sales.
Bailey	½	..	..	500
Crown Reserve	1.14	..	..	100
Nipissing	5.05	..	..	40
Timiskaming	7¾	..	..	1,000
Porcupine—				
Wettlaufer	5½	..	..	500
Dome Extension	5¼	..	..	10
McIntyre	28	..	..	250