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THE Canadian MINING REVIEW

Established 1882

Vol. XIV.—No 7 1895—OTTAWA, JULY—1895 Vol. XIV.—No. 7.

MINING LAWS OF ONTARIO.

ANY person may explore Crown Lands for minerals. Mining lands may be taken up as surveyed locations or staked claims.

Locations range from 40 to 320 acres.

Claims range from 10 to 20 acres on vein or lode.

Locations may be acquired in fee or under leasehold.

Price of locations north of French River, $2 to $3 per acre, and south of it, $2 to $1.50, according to distance from railway.

Rent of locations first year 60c. to $1 per acre, and subsequent years 15c. to 25c. per acre.

Rent of claims, $1 per acre each year.

Claims must be worked continuously.

Royalty on ores specified in the Act, 2 per cent. of value at pit's mouth less cost of labor and explosives.

Royalty not charged until seven years from date of patent or lease, nor (as provided in s. 4 (3) of the Mines' Act, 1892), until fifteen years in the case of an original discovery of ore or mineral.

Original discoverer of ore or mineral on claim entitled to stake out a second claim.

Crown Lands sold under provisions of mining laws in force prior to 4th May, 1891, exempt from royalty.

Copies of the Mines Act, 1892, Amendment Act, 1894, may be had on application to

ARCHIBALD BLUE,
Director Bureau of Mines

TORONTO, May 25th, 1894.

CONDITIONS
OF
Obtaining Government Drill to Explore Mines or Mineral Lands.

Owners or lessees of mines or mineral lands in Ontario may procure the use of a Government Diamond Drill, subject to the provisions of the Rules and Regulations relating thereto, upon giving a bond for payment to the Treasurer of the Province, of costs and charges for (1) freight to location, (2) working expenses of drill, including labor, fuel and water, (3) loss or breakage of bits, core lifters and core shells, (4) wear or loss of diamonds, (5) other repairs of breakages and wear and tear of machinery at a rate per month to be estimated, and (6) an additional charge of $50 per month after the mine or land has been shown, through use of the drill, to be a valuable mineral property.

Of the aggregate of costs and charges above enumerated, excepting the sixth item, forty per cent. will be borne by the Bureau of Mines in 1894, thirty-five per cent. in 1895, thirty per cent. in 1896, and twenty-five per cent. in each year thereafter until the end of 1900. All accounts payable monthly.

For Rules and Regulations *in extenso* governing the use by companies and mine owners of Diamond Drills, or other information referring to their employment, application may be made to ARCHIBALD BLUE, Director of the Bureau of Mines, Toronto.

A. S. HARDY,
Commissioner of Crown Lands.

Toronto, October 17, 1894.

The Canadian Mining Review
Established 1882

Official Organ of The Mining Society of Nova Scotia; The General Mining Association of the Province of Quebec; The Asbestos Club; and the Representative Exponent of the Mineral Industries of Canada.

B. T. A. BELL, Editor. Published Monthly. OFFICES: Slater Building, Ottawa.

VOL. XIV., No. 7 JULY, 1895. VOL. XIV,, No. 7

The Outlook for Canadian Phosphates.

It is only necessary to remember that the products of nature are the sole sources of our food, and that they at the same time furnish all the raw materials of art, in order to understand that agriculture is the rock upon which nations build their riches. The Canadian farmer made of the same material as the great majority of his class. If he were left to himself, his methods of work would differ but in trifling details from those of the ancient Romans. He continues to draw upon his immense natural reserves without a thought of the future, and it is only when crops begin to fail, and general signs of exhaustion begin to make themselves manifest, that he consents to listen to the teachings of science. Even then he is too prone to look with suspicion and distrust upon those who would enlighten him. He admits the facts, but cannot understand the reason why his annual crops are no longer so abundant, nor of so good a quality as they were thirty or forty years ago.

This ignorance cannot, of course, continue, because we live in an age of thought and rapid intercommunication. The last barriers of prejudice must be beaten down by experience and example, and before long every farmer must realize that agriculture can only remain a profitable pursuit on the condition that he yearly obtains from his acres a maximum and cheap return. In order to succeed in this, he must restore to the soil those elements which it once contained in abundance, but which, in the process of nourishing the plants, have been partially taken away.

It has been definitely and satisfactorily established, that the food value of all vegetable growths is derived from their starch, gluten, sugar, gum and some organic acids, while the value of animal food is due to albumen, fibrine, fats and small quantities of divers saline matters. All these constitute what are known as proximate principles, the ultimate composition of which is made up of such simple bodies as carbon, hydrogen, oxygen, nitrogen, calcium, potassium, sodium, iron, phosphorous and sulphur. This proves conclusively that the elements of our food are taken from the air, the water and the soil, and so fitted together by the plants as to produce the food of those animals termed graminivorous, which, in their turn, afford to us the vast bulk of our animal sustenance.

Some rough idea of the actual quantity of mineral matter annually withdrawn from the soil by our food plants, may be arrived at if we take a given weight of any cereal, say, for instance, wheat, and burn it until it is reduced to a perfectly white ash. If we next weigh this ash very carefully, we shall ascertain that its weight will represent about two and one-fourth per cent. of the material burned, and if we make a chemical analysis of it, we shall find it to be mainly composed of phosphates of potash, magnesia and lime.

It has been estimated, in a rough and essentially approximate manner, that the total area of soil under cultivation for cereals and grasses, in North America, and in Europe, is 1,000,000,000 acres, and that the crops attain an average of about one ton per acre. It has also been roughly estimated that the average depth of the soils over this area is in the neighborhood of nine inches, and analyses have shown that their average contents in phosphates are about 4,000 pounds per acre. The total amount of phosphates contained in these soils is, therefore, 2,000,000,000,000 tons.

If every ton of crop deprives the soil of at least forty pounds of phosphate, as it certainly does, it follows that the 1,000,000,000 tons of crop use up 20,000,000 tons of phosphate every year. As the natural effect of our social and sanitary arrangements, only about half this quantity is recovered from the refuse of farms and cities and returned to the soils; the other half is carried away and lost. This creates a yearly deficit of 10,000,000 tons of phosphate, and in the ordinary course of events the lack of this most essential constituent would entail sterility of all these soils in the next 200 years.

This very serious fact has led to the use of a number of phosphatic substances for the purpose of restoring fertility to the lands, but it has been proved that the total quantity of such substances used in various forms does not amount to more than about one-third of the average amount yearly drawn from the soil, and it consequently follows that there is an actual and crying necessity for at least three times the present consumption of natural phosphates.

The phosphate deposits of Canada are exceptionally rich, and exceptionally extensive, and that they are so has been known for a considerable number of years. They have been more or less extensively exploited by various companies which have been formed for the purpose, but have hitherto been of no direct benefit to Canadian agriculture, since they have been sent abroad and sold in European markets. This is the reason why so few of the mining companies have ever paid a dividend on their capital. The demands of the European market have been confined to the highest obtainable grades of Canadian phosphates. With these high grades, the European fertilizer manufacturers have been able, by judicious mixtures, to enrich and make marketable the poorer qualities of phosphate produced in their own countries. So long as Canada was the sole producer of phosphates ranging from 80 to 90 per cent., as she virtually was up to within a period of five or six years ago, her miners continued to spoil her mines, and to squander her resources in order to supply this unfair demand; but, in the year 1888, the discovery was made in Florida of enormously rich and accessible deposits of phosphate rock, and from that date down to the present time, the mining of phosphate in Canada has gradually dwindled away, and has now become a dead letter. As this result has not only involved the loss of large capital, but has thrown a very large number of miners and laborers out of employment, it is worth while to look a little more closely into the circumstances which have slowly, but surely, led up to it

It will be remembered that the first serious attempt to develop the phosphate mines of Florida was marked by the outbreak of a perfect fever of speculation. The difficulties between the Coosaw Company and the South Carolina State authorities had only just arisen, and as the temporary suspension of this company's gigantic operations threatened

a considerable decrease in production, buyers became anxious to secure their needed supplies, and the miners advanced their prices. To the initiated, this was an intelligible and natural situation: on the one hand there was the deficiency by the Coosaw Company; on the other, there were the customers of this company anxious to supply their needs and ready to abide by a rise in price rather than be left unsatisfied. A fictitious activity was thus imparted to the entire phosphate industry, of which few, if any, of those who rushed into the Florida fields took the trouble to ascertain the true inwardness. They ignored the all-important fact that the actual demand for consumption of the entire world for mineral phosphates does not attain more than 2,500,000 tons, including all kinds and qualities. They repeated the mistakes of the Canadian miners: and, in lieu of awakening the interest of American farmers, turned their attention to Europe as a more proper, because supposed unlimited, consumer.

The result of such a "boom" and of such ignorance has been widespread and deplorable. The foreign buyers who were at first so skeptical of the existence and value of these Florida deposits, became seriously concerned at their abundance, and their anxiety for future supplies changed to apprehension when they saw themselves menaced with a glutted market. They knew and understood the impossibility of finding an outlet, in any of the ordinary channels of trade, for such a flood of material as that with which they became threatened, and they took advantage of their knowledge to break the market. So thoroughly did they master the situation that the hapless miners are now entirely at their mercy, and we are confronted by quotations which have not only closed Canada's mines, but have brought ruin to the miners of South Carolina, despite their natural advantages.

Nor must it be supposed that this state of affairs has resulted in a serious increase in the consumption of American phosphates. In the year 1890, for example, the total output from all the American mines amounted to about 600,000 tons, and the average prices were $5 per ton for that which contained 60 per cent., and $10 per ton for that containing 75 to 80 per cent. phosphate of lime, both free on board cars, at the mines.

In the year 1892 the sales were increased by 18 per cent., or in other words, there were sold about 700,000 tons. This surplus of only 100,000 tons had such an extraordinary effect upon the markets of the entire world, that its disposal entailed a fall in price to $3 and $4 per ton for the respective qualities mentioned.

This remarkable disturbance caused by this slight excess of exceptionally high-grade and good quality, graphically illustrates the present want of flexibility in the fertilizer markets, and not only argues badly for the immediate future, but should be a significant warning to producers not to overstep the bounds of prudence.

This warning is additionally emphasized by the recent discoveries of inexhaustible deposits of excellent phosphates in Algiers and Tunis, which can be very cheaply mined and marketed, and it is a very serious question whether the disturbed equilibrium can be restored, and whether phosphate mining can ever again become an exceptionally profitable undertaking. The operation of the law of supply and demand is always absolute and inflexible, and it is now making itself felt in this, as in every other phase of commercial affairs.

The only avenue of escape left open to the phosphate miners of Canada is in the direction of creating a local market for their product, and especially for their lower qualities, which, while the cost of transportation would render them unfit for sale in England or Germany, are just what is required for the manufacture of fertilizers for home consumption. It would certainly be wiser policy for Canadian miners to dispense with all their present expensive processes of hand selection and cobbing, and to rest content with such an assortment at the quarry-side as would insure an average grade of, say, about 60 per cent. of phosphate. The proportion of this quality to the total matter removed from the mine would be about double that of the pure apatite which has hitherto been solely sought after, or to put it in other words, instead of ten, their output could be placed at nearly twenty per cent. without increase of cost.

The phosphate miner, as we have seen, does not sell his product to the farmer, but to the manufacturers of fertilizers, who first grind it to an extreme fineness, and then mix the powder with about its own weight of weak sulphuric acid. A more or less soluble article is thus obtained, which is the basis of all artificial fertilizers, and which is popularly known as superphosphates. The reason why this acidulated compound is preferred to the raw material is to be found in the generally admitted fact that Canadian apatite is very sparingly and very slowly soluble in the water in the soil, and that no element can penetrate into the interior of a plant unless it be in solution.

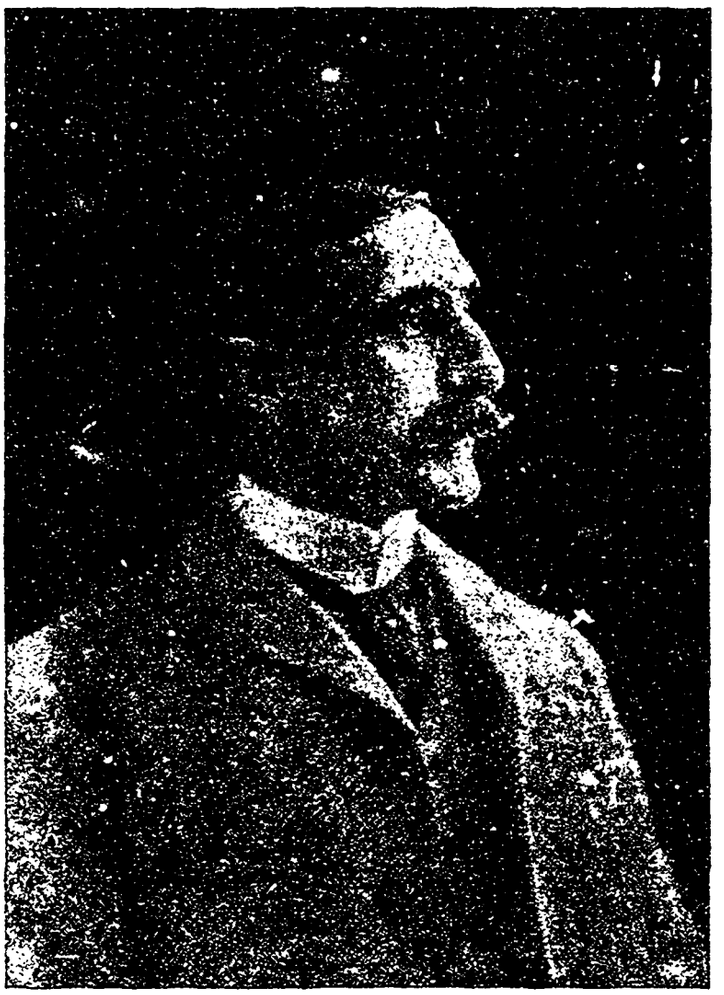
A great many attempts to use it as a direct fertilizer have demonstrated that its availability entirely depends upon the fineness of the powder to which it may be reduced, and the nature and composition of the soil in which it is to be employed, and it is a matter of the greatest difficulty to attain the requisite degree of disintegration by any sufficiently cheap mechanical means. In this respect we are, in fact, not very much farther forward now than we were in 1857, when Liebig recognized the difficulty and proposed to solve it, by adopting a chemical method of decomposition which enabled the farmer to obtain practical results from the use of mineral phosphates within one year, instead of waiting three or four. That the chemical treatment does not in reality do anything more than break up the primary molecular formation of the tricalcic phosphate, is proved by the fact that superphosphate of lime is only soluble in water so long as the mono-calcic form retains its ascendency. Directly it reaches the soil, especially where carbonates are in abundance, the free phosphoric acid unites with various earthly bases and becomes insoluble. To put it plainly, therefore, the issue so far as the farmer is concerned, revolves upon a matter of time and of money. He might buy a ton of raw phosphates, ground as finely as possible, and containing, let us say, fifty-five per cent. of tricalcic phosphate for $10. If his land were tolerably acid, and this of course is seldom the case, he might get a rapid return; but if it were not, his raw phosphate would only decompose very slowly, and he would have to wait several years before obtaining any appreciable results from his outlay. On the other hand, if he buys a ton of superphosphates for $20, containing only thirty per cent. of calcic phosphate made soluble, and applies it to a phosphate-barren soil, he produces the desired effects on his crop the same year. The mere decomposition of the tricalcic phosphate into the acid salt ensures an absolute state of division which is maintained despite the subsequent reversion, and an intimate and immediate contact with the acid sap of a greater number of root hairs being thus facilitated, the ready absorption of the dissolved phosphate by the plant is naturally assured.

These views will be endorsed by all the officials of the agricultural experiment stations who have made the comparative use of the finely ground raw mineral phosphates and of superphosphate, their results with the former having fully confirmed the conclusions formulated in 1857 by De Molon, who, after very extensive trials of ground raw coprolite in many different departments of France, said that:—

(1) Raw phosphate might be used with advantage in clayey, schistous, granitic and sandy soils rich in organic matter.

(2) If these soils were deficient in organic matter, or had long been under cultivation, it might still be used on them in combination with animal manure.

The term soluble, as applied to phosphate, must be accepted in a relative sense, and the use of both raw and manufactured articles is a matter which calls for intelligent discrimination on the part of the farmer. He might find that in one portion of his lands raw phosphates mixed with his compost heaps would soon dissolve and yield very profitable and rapid returns, while in another portion, owing to a different constitution of the soil, they would remain inert for an indefinite period.



Mr. J. R. COWANS, Springhill, N. S ,
General Manager, Cumberland Railway and Coal Company, Ltd.

Within the past few years, the rapid development of the fertilizer industry has led to the introduction of a concentrated material known as "high grade supers," which is made to contain forty-five per cent. of phosphoric anhydride (P_2O_5) in a "water" and "citrate" soluble form, and which should soon entirely supplant the weaker "supers" in general use. The plan upon which it is produced is perfectly scientific and rational, since it consists in dispensing with oil of vitriol and using in its place phosphoric acid as the solvent of the raw phosphate.

In the manufacture of superphosphates as now carried out, the desired solubility, either in water or in citrate of ammonia, is attained at the cost of doubling the bulk of the raw material by the addition of sulphuric acid, which practically serves no other purpose and has no other value than that of a dissolvent. If such raw material, therefore, contain sixty per cent. of tricalcic phosphate, the "super" can only contain thirty per cent., and this, from the agricultural consumer's standpoint, is certainly an anomaly, and, apart from any question of solubility, must remain so for two reasons:—

(1) A ton of sixty per cent. phosphate of lime, finely ground, but insoluble in water or citrate of ammonia, can be purchased at some central point for say $10.

(2) A ton of superphosphate, containing only thirty per cent. phosphate of lime, cannot be purchased at the same spot for less than $15.

In the one case, freight is paid upon only forty per cent. of waste material, whereas in the other, it is paid upon seventy per cent. of practically valueless matter.

That a legitimate profit should attach to the manipulation of an inert, and its transformation into an active body, is beyond question, but there is no reason why such enormous and unreasonable benefit should be derived from the trade in fertilizers by the railroad companies or other public carriers.

The reactions involved in the process of superphosphate mixing have served to demonstrate that the cheapest and best known method of making liquid phosphoric acid from calcic phosphates is by driving it from its combination with lime by means of the stronger oil of vitriol, and by utilizing many low-grade phosphates which now, for lack of a sufficiently cheap freight, have practically no market value.

The feasibility of treating Canadian low-grade phosphate ores was very fully discussed at the Baltimore meeting of the American Institute of Mining Engineers, in February, 1892, and it has been demonstrated on the small scale that in comparison with our present staple superphosphate, which barely contains the equivalent of thirty per cent. of bone phosphate of lime made soluble, it has the advantage of a lower manufacturing cost, and contains the equivalent of ninety-nine per cent. or more than three times as much bone phosphate of lime, made equally as soluble and available. It could, therefore, be distributed at an economy of two-thirds of the freight now actually paid for useless material, and this is a consideration of the highest consequence, since the farmers must all have phosphate, and since the raw material is confined to an area somewhat remote from the large mass of consumers.

If the present results of phosphate mining enterprises have been very disappointing and discouraging, that fact should only spur us on to exercise all our ingenuity in order to make our products more available for the world's needs.

EN PASSANT.

We regret to record this month the sudden and untimely death of Mr. J. Fraser Torrance, Mining Engineer, of Montreal. The deceased gentleman was a graduate of McGill, and was for a number of years, we believe, on the staff of the Canadian Geological Survey. Mr. Torrance, who was engaged in opening up a gold claim for Montreal capitalists in the Rat Portage district, was found dead in bed in his cabin at the mine.

Mr. J. Keith Reid, Montreal, has just issued an excellent map of the Slocan mines, Kootenay district, British Columbia, which, we are confident, will be found of great service by mining men and capitalists interested in that important mining country. The map has been compiled from special surveys and is beautifully lithographed in colors, the size being 36 x 60 inches.

Mr. A. Blue, and his associates in the Bureau of Mines, Toronto, are to be commended for the prompt issue of their report upon the mineral industries of Ontario for the year 1894. The volume, as in former issues, contains much serviceable statistical information, as well as a number of valuable contributions bearing upon the occurrence of minerals and their exploitation in the province, the whole excellently gotten up and handily indexed for reference. In his opening remarks Mr. Blue says: "The statistics of the sale and lease of mineral lands, as well as those of the production of ores and other minerals, indicate a condition of inactivity in the mining industry of the province which is no doubt a consequence of the depression in business and inertness of speculation so noticeable in other countries, but especially in Great Britain and the United States, where mining enterprise has heretofore been so brisk. Signs of revival however are beginning to appear in those countries, and increased attention is likely to be given to mining operations here as well as elsewhere. The gold fields of the province are attracting greater notice, and during the past year the Rainy Lake region especially drew many explorers and capitalists towards it. Numerous discoveries of gold-bearing ore are reported there, four or five locations are being actively developed, and one gold-mill is nearly ready for operation. In the Lake of the Woods district the mine and mill on Sultana Island have been worked continuously, and it is claimed that free-milling ore is obtained throughout the entire extent of the workings, now about 200 feet underground. Three other promising properties are in course of development with British, American and Canadian capital, and it is proposed to put a mill on each of them this year. At the present time a mill is in course of erection at Harold lake, near the upper waters of the Seine river. The Ophir mine and mill in Galbraith township were operated only during a portion of the year, owing, it is said, to an insufficiency of paid-up capital; but the engineer in charge claims that the work done in the mine has proven it to be a good property. The death of one of the principal shareholders, which occurred recently, will doubtless for a time leave the affairs of the company in an unsettled state. The Creighton mine in the township of that name was idle the whole year, but towards the close of it fresh exploratory work was commenced with a diamond drill, and it is reported that a strike of considerable promise has been made; operations to more satisfactorily prove the extent and quality of the ore body are now in progress. In the Lake Wahnapitae district a location taken up by Mr. Rinaldo McConnell of Mattawa has attracted much attention by the exceedingly rich samples of ore taken from it. A company has been organized to work the property, and a shaft is in course of being sunk upon the vein. In the Marmora district little has been done. Only one property, the Ledyard mine in Belmont, was worked during the year. Some good ore was raised, and a second-hand Huntington mill was set up, which however, gave little or no result. A new Huntington mill has been purchased, and will be running in the course of a few weeks. The gold mill built at Marmora to treat arsenical ores by the Walker-Carter process has been closed down for want of ore to treat. Early in the year the staff of the Bureau was strengthened by the appointment of Dr. Arthur P. Coleman, of the School of Practical Science, as geologist and mineralogist. Dr. Coleman is required to occupy three of the summer months in geological field work and to make a report thereon, besides other duties of an advisory or special character which do not interfere with his professional functions at the school. Last summer was occupied by him in examining the Rainy Lake gold-field, and the belt of country northward of it along the Manitou and Wabigoon waters to the line of

the Canadian Pacific Railway. His report and the geological maps accompanying it will be found especially valuable to prospectors in that field. The maps have been prepared in the office of the Director of Surveys. The one of the Rainy Lake district is based upon the map of the Geological Survey accompanying Dr. Andrew C. Lawson's report of 1887-8, with additions showing recent surveys of townships and mining locations from the office maps in the Department, and some corrections in the geological coloring by Dr. Coleman. The map of the Manitou and Wabigoon rivers tract is prepared from departmental surveys. The nickel and copper mines in the Sudbury region have been actively worked during the year, and as the statistics show the production of matte was much larger than in either of the tpreceding years. wo It is gratifying to know that the severe tests to which nickel-steel armor plate has been subjected continue to show its superiority to all other kinds of plate. Development work was carried on at the Point Mamainse copper locations on Lake Superior for the greater part of the year, and as a result of the extent and richness of the finds of ore it is expected that substantial mining operations will be undertaken this year. The growing interest taken in our northern Ontario, both as a field for settlement and mining enterprise, required that all the trustworthy information relating to it in many volumes of official reports and elsewhere should be searched out and presented in suitable form. This work has been undertaken by the secretary of the Bureau, Mr. T. W. Gibson, and the valuable paper on The Hinterland of Ontario is the result of his labors. The diamond drill purchased by the Government last year and placed in charge of the Bureau has been steadily employed since the time that it passed the customs in exploring an iron-ore property in the County of Frontenac. Information as to the steps taken to select and purchase the drill and the work done with it is presented in the report. There are sanguine hopes, it may be added, that the iron industry will assume active form in the province this year. At the last session of the Legislature provision was made for summer mining schools at Sudbury and Rat Portage, at which practical instruction might be given for the benefit of miners, prospectors and others employed or interested in mining pursuits. Classes were opened at Sudbury, Copper Cliff and Rat Portage, with an aggregate regular attendance of fifty-one. The report of the instructors in charge shows the scope and character of the work undertaken, and the favor with which the project has been received."

A decision of the utmost importance to shareholders and speculators has recently been delivered by the Judicial Committee of the Privy Council—the court of last resort for Britons. It settles definitely and forever the long disputed point whether "buying for a rise and selling for a fall" is or is not a gambling transaction in the eye of the law. From 1882 to 1886 a Montreal broker named Forget effected deals in stocks and shares for a clerk named Ostingy, a man of small means. In 1890 a balance appears to have been struck, showing Ostingy indebted to Forget in nearly £400. In each of two trials in the courts the shareholder was worsted, the judges holding the view that the transactions partook of the nature of a gamble, and established no debt which a court of law would recognise. Ostingy pleaded the statute of limitations, but his principal defence was, that the orders being given without any real intention of buying stocks, the transactions were illegal and could not form the basis of an action. The Lord Chancellor, who delivered judgment, dissented in toto from the finding of the Canadian courts. It did not matter (he said) whether the broker knew that Ostingy's object was speculation and not investment. Such contracts were sometimes spoken of as "gambling on the Stock Exchange," but it certainly did not follow that the transactions involved any gaming contract. A contract could not properly be so described because it was entered into in furtherance of a speculation. It was a legitimate commercial transaction, and one of everyday occurrence, to buy a commodity in the expectation that it would rise in value, and with the intention of realizing a profit by its re-sale. The legal aspect of the case was the same whatever be the nature of the commodity, whether it be a cargo of wheat or the shares of a joint stock company. Nor, again, did such purchases and sales become "gaming contracts" because the person purchasing was not possessed of the money required to pay for his purchases, but obtained the requisite funds in a large measure by means of advances on the security of the stocks or goods he had purchased. That also was an everyday commercial transaction. After other observations, the Lord Chancellor said their Lordships thought the judgment of the courts below ought to be reversed, with costs. But in regard to the costs of the appeal, they considered that as Forget was allowed to prosecute it, notwithstanding the small amount at stake, upon the ground that it involved a question of wide general interest, he (Forget) should bear the costs of the appeal on both sides.

In comparing the four great tunnels, it is interesting to note, says the *Chautauquan*, that time is an extraordinary element in the cost. The oldest tunnel—Hoosac—cost $379 a foot; Mount Cenis, the next oldest, cost $356 a foot; St. Gothard cost $229 a foot, and the most recent tunnel of the four—the Arlberg—cost only $154 a foot. All four were in old-settled countries, with abundant labor, and the very great difference in cost per foot plainly marks the progress of science, because it was the invention and improvement of tools that made it possible to reduce the time and thus the cost. To observe the difference between the work on the three great European tunnels, built by government aid in old-settled countries, it may be well to observe for a moment the work done on a comparatively small tunnel built far from civilization through the Cascade Mountains on the line of the Northern Pacific Railroad. The mountain through which the tunnel runs is 3,790 feet above the sea, and the peak is 1,135 feet above the floor of the tunnel. To understand the magnitude and difficulty of this undertaking it must be observed that the site of the tunnel, at the time the contract for its construction was signed, was an unbroken wilderness. At the then existing terminus of rail connection everything—men and tents, food, horses, machinery, lumber, hospitals, and, in fact, the material of the army—had to be transported over improvised roads 82 miles, through forests through snow and mud, to the east portal of the tunnel, and 87 miles to the west portal. Six months passed before the machinery was on the spot. Rivers had to be turned aside, bridges built, camps established and men and horses collected, fed, housed and cared for nearly 100 miles from a locomotive. The tunnel is 16½ feet wide and 22 feet high, and the entire distance (8,950 feet) was bored through the mountain in 22 months, the rate of progress with the power drills being 413 feet a month, and the cost of the completed tunnel was only $1 18 a foot, and the entire work was completed in 28 months from the signing of the contract in New York city.

At its last annual meeting the Association of Manufacturers of Chilled Car Wheels requested the secretary to prepare an article to the railroad officials of the United States and Canada upon the mode of manufacture and relations they bear to economy in railway practices. The universal use of chilled car wheels upon horse and motor cars, as well as upon the steam roads, is commented on, together with the increase of output of wheels from 10 or 12 wheels per day in 1830 to the product of 100 foundries at the present time. It is stated that "probably no one article has contributed so much to economy in the railway practice of America as that of cast-iron chilled car wheels," and "that there is no other article so universally used on railways and upon which so much depends, that can be produced as cheaply and quickly, and which when worn out, represents as large a per cent. of its first cost." Mr. Lobdell gives a description of the method of manufacturing chilled wheels, including comments upon the iron used and its preparation, the character and qualities of the chilled surfaces and the process of annealing the completed wheels.

Canadian Phosphate for the Canadian Farmer—A Home Market for the Product of our Phosphate Mines in the Use of Canadian Superphosphates.

Proceedings of the Summer Meeting of the General Mining Association of the Province of Quebec.

The annual summer meeting and outing of the members of the General Mining Association of the Province of Quebec, was held in the Chateau Frontenac, Quebec, on Wednesday and Thursday, 27th and 28th June last. A number of delegates were present by invitation, from the Ontario and Nova Scotia Societies. The following were present at the proceedings:—

Mr. John Blue, C. and M. E., (Eustis Mining Co.) Capelton, Que.
Mr. R. H. Brown, M. E., (General Mining Association of London) Sydney Mines, C. B., President of the Mining Society of N. S.
Hon. E. J. Flynn, Commissoner of Crown Lands, Quebec.
Hon. George Irvine, Q. C. (Johnson's Asbestos Co.), Quebec.
Mr. James King, M. L. A. (King Bros.) Quebec.
Prof. Nicol, (School of Mining) Kingston Ont.
Mr. T. W. Gibson, (Bureau of Mines), Toronto.
Mr. G. Y. Chown, B. A., (School of Mining), Kingston.
Mr. H. A. Budden, (Intercolonial Coal Co.), Montreal.
Mr. David McKeen, M. P., (Dominion Coal Co.), Glace Bay, C. B.
Mr. George E. Drummond, (Canada Iron Furnace Co.), Montreal.
Mr. R. T. Hopper, (Anglo-Canadian Asbestos Co.), Montreal.
Mr. L. A. Klein, (American Asbestos Co.), Black Lake, Quebec.
Mr. W. T. Bonner, (Babcock & Wilcox Boiler Co.), Montreal.
Mr. Frank Darling, (Canadian General Electric Co.), Toronto.
Mr. W. F. Dean, (Canadian General Electric Co.), Montreal.
Mr. Lawrence J. Lynch, (Johnson's Asbestos Co.), Quebec.
His Worship Mayor Villeneuve, Montreal.
Mr. J. Burley Smith, (British Phosphate Co.), Glen Almond.
Mr. Daniel Smith, (Hamilton Powder Co.), Brownsburg, Que.
Mr. Frank Shutt, B. A., Sc., Chief Chemist, Dominion Experimental farm, Ottawa.
Mr. John J. Penhale, (United Asbestos Co.), Black Lake, Que.
Mr. C. E. Morgan, (Northey Pump Co.), Toronto.
Mr. J. Obalski, Inspector of Mines, Quebec.
Mr. E. B. Haycock, (Star Gold Mines), Beauce, Que.
Mr. L. G. Gendreau, Beauce, Quebec.
Mr. J. T. Dwyer, (Carrier Laine & Co.), Montreal.
Mr. C. H. Carrier, (Carrier Laine & Co.), Quebec.
Mr. R. W. Prittie, Toronto.
Mr. A. W. Stevenson, C. A., Montreal, *Treasurer*.
Mr. B. T. A. Bell, Editor CANADIAN MINING REVIEW, *Secretary*.
Mr. James Mitchell, (Beaver Asbestos Co.), Sherbrooke, Que.

The proceedings opened at eight o'clock in the Chateau Frontenac, the President in the Chair.

NEW MEMBERS.

The following were elected to membership:—
Mr. James Foley, (Petroleum Oil Trust Ltd), Montreal.
Mr. W. T. Bonner, (Babcock & Wilcox Boiler Co.), Montreal.
Mr. Lawrence J. Lynch, (Johnson's Asbestos Co.), Quebec.
Mr. D. G. Loomis, Sherbrooke, Que.

STUDENT MEMBERS.

The following were duly elected student members:—
Mr. F. H. Bacon, McGill College, Montreal.
Mr. A. Boyer, Polytechnic School, Montreal.

AMENDMENT TO CONSTITUTION AND BY-LAWS.

The President gave notice of motion of amendment to Constitution and By-Laws, changing the number of meetings during the year to two instead of three as at present.

FALL MEETING POSTPONED.

On motion the autumn meeting was postponed, and the next meeting of the Association will therefore be held in Montreal in January next.

This concluded the business session.

The President having left the chair, the Hon. E. J. Flynn, Commissioner of Crown Lands for the Province and an honorary member of the Association, was unanimously voted to preside over the open session which was convened immediately on the conclusion of the business meeting.

ADDRESS BY THE HON. E. J. FLYNN.

HON. E. J. FLYNN—I desire to express my pleasure at being present at this meeting, and also my sense of the honor done me in asking me to take the chair. I have had previous experience of a meeting of this kind, having been present at the convention which took place in January 1894 in the city of Montreal. I must congratulate the Mining Association of the Province of Quebec on the good fortune that it has had in convening here in the old city of Champlain, the representatives of the various mining associations of the Dominion of Canada. From discussion comes light, and you have met here for the purpose of discussing some topics connected with the mining industry. The subject of mining is a vast subject, and one with which it would be utterly impossible to deal at one meeting of this kind. I notice, therefore, that on your programme for the present occasion you have given great prominence to one topic—that of phosphate mining, which is to be treated from three or four points of view. The practical aspect of the question is one which is certainly deserving of your attention and consideration as well as of that of the governments of the Provinces and of the Dominion of Canada, for, as you are well aware, the phosphate industry has for some time past been in a languishing condition, owing to circumstances over which neither those more immediately interested nor the governments have any control. Now, I see a new idea has been thrown out—that of having for the product of our phosphate mines, a home market. This idea is in keeping with the policy which prevails throughout the Dominion of Canada, that of preserving, protecting and developing natural resources which exist in the several Provinces, and in none in a higher degree than in the Province of Quebec. (Applause.) I desire to indorse this idea of a home market for our phosphate. It is part of the policy of the government of Quebec to develop the agricultural resources of the Province, and I regret that Hon. Mr. Beaubien, who is the minister more praticularly charged with that branch of public affairs, is unavoidably absent from this meeting, as he would, if possible, have taken a deeper interest in the subject under discussion than I do myself. My own department in the government covers the woods and forests, the inland fisheries, and the mines of the Province, and the policy of protection and development which it has been my aim to enforce in the administration of these portions of the Provincial domain is the same policy, I am glad to see, which is to be propounded here in connection with the phosphate industry. There is no doubt that the matter is one of great public importance, for it would be an undoubted benefit to the people of Quebec if our phosphate could be used as a fertilizer in those parts of the Province where, as is well known, the soil is in very great need of having some of its elements restored of which it has been deprived by the cropping of many years.

The question of how phosphate should be applied as a fertilizer is one which I hope will be dsscussed by the gentlemen who are to speak. I have seen it stated that great differences of opinion exist as to whether phosphate can be utilized as a fertilizer without having first been converted into superphosphates by treatment with sulphuric acid, it has been proposed to use simply the crushed phosphate, without any preliminary treatment, but in a report issued under the auspices of the government it is stated that nothing had yet been found to satisfactorily prove the valueof this method. This is a very practical aspect of the question, and as administrator of the Crown Lands Department I should be glad to have some enlightment on the point, with the view of assisting in the promotion of the phosphate industry.

I shall listen, gentlemen, with great pleasure to your deliberations, and I trust that much good will follow from your meeting, not only in the greater diffusion of knowledge and enhanced value of our mines, but in the stimulus which will be given to the agricultural interests of the Province. I may express the hope also that you will be able to combine pleasure with usefulness, and that when you leave the old historical city of Quebec, you will take with you the happiest reminiscences of your sojourn here. (Loud Applause).

The Use of Electrical Apparatus in Mining.

MR. W. F. DEAN—I shall be obliged to omit altogether apparatus operated by battery or magneto currents, such as bells for signalling, telephones, and blasting apparatus, the operation of which is now pretty well understood, and confine myself to electric lighting and the electrical transmission of power, paying more particular attention to such apparatus as is most likely to prove useful to members of this Association.

I wish to take up and explain first of all, several fundamental principles in electric transmission, either for lighting or power, a knowledge of which is necessary to a clear understanding of the subject. The first and most important of these is that for transmitting a certain amount of power at a certain voltage or pressure, with a certain loss in the wire, the cost of copper increases as the square in the distance.

A recent paper by Mr. Irving Hale gives the following example: If for transmitting 100 horse-power one mile at 500 volts, with 10 per cent. loss in line, the wire costs $2,000, it will cost for transmitting the same power two miles, under the same conditions, the square of two or four times $2,000, or $8,000, and for ten miles, one hundred times $2,000, or $200,000 The reverse of this law is that for a certain power distance and loss in line, the cost of wire is inversely proportional to the square of the voltage. For instance, if it costs as explained, above $200,000 for wire to transmit 100 horse-power ten miles with 10 per cent. loss at 500 volts, it will cost at double that voltage or 1,000 volts, one quarter as much or $50,000 and at 5,000 volts (ten times the voltage) one-hundredth as much, or $2,000. Thus the same power can be transmitted with the same loss, ten miles at $5,000 volts, for the same cost of wire that is required for one mile at 500 volts.

When inventors first began to realize the commercial importance of incandescent lighting, one of the most difficult problems was to produce a lamp of sufficiently high voltage to bring down the cost of conductors to a reasonable figure. Edison's discovery of the high resistance filiment solved the problem and made it possible to use a voltage of about 110 for distributing purposes. Even this was found inadequate for large areas and he afterwards devised the three wire system, in which two dynamos are connected in such a manner that while the total voltage of the system is 220, the lamps being connected to a third or neutral wire receive only 110. By this means the voltage is doubled and the cost of copper accordingly reduced to one-fourth, or, practically, taking the central wire into consideration, to not more than three-eighths. This system is in use in nearly all large cities, both on this continent and in Europe. Later, attention was directed to the alternating system, which has been rapidly adopted in cases where the lighting is scattered or where long distances have to be covered. A brief consideration of the properties of alternating currents will show why it is better adapted for this work. If the electro-magnetic impulses that form an electric current are propagated continuously in one direction, the current is said to be continuous, but when they alternate in direction at a more or less rapid rate, then the current is said to be alternating. The alternating current enables us to take advantage of an effect called induction, which is only exerted when the current is suddenly broken or changed in direction. Thus if we wind two separate coils of wire on an iron bar, and pass a direct current through one coil, no effect is produced in the other coil except at the moment of turning on the current, but if an alternating current is used instead, a current is at once produced and maintained in the second coil. By a very simple law the pressure or voltage of the two coils are in proportion to the number of turns in each. Thus if the primary coil is supplied with current of 1,000 volts, and the secondary coil has one-tenth as many turns, the pressure in the secondary will be 100 volts. Such a device is called a transformer, and its use enables us to employ practically any voltage necessary for economy in transmission and reduce it to a low pressure at any desired point for use in lamps or motors.

The alternating current machine may be built to give directly a pressure up to 2,000 or 3,000 volts and in certain types as high as 5,000 volts. If this is insufficient for the purpose, the voltage may be still further increased by the use of transformers described above. By the proper proportion of the primary and secondary coils, the voltage may be raised to any pressure which can be safely transmitted over aerial lines.

Having thus described as briefly as possible the principles of electric transmission, and the different forms of current that may be employed, I will now take up in detail the different uses to which electrical apparatus may be applied:

Electric Lighting—Electric lighting for mines and auxiliary works offers the same advantages that are now so generally recognized as appertaining to this method

of illumination for other uses. Its steadiness, freedom from heat, and the ease with which it may be distributed, places it far in advance of any other artificial light. When once installed, the expense of operation is inconsiderable, especially when operated in connection with a complete electrical power system. The type of apparatus will be determined entirely by the conditions in each case. If the distance to which the lights are transmitted is small, a direct current dynamo of 110 volts will be the most satisfactory. In deep mines, however, and in cases where the source of power is at a considerable distance from the workings, the cost of conductors at this pressure becomes prohibitive, and it is necessary to use some method in which the voltage can be increased. By the use of two dynamos connected on the Edison three-wire system previously explained, the cost of conductors can be reduced to about three-eighths the amount required by the two wire-system, assuming that the third wire is made the same size as the outside wires. It is also possible to use a single dynamo of 220 volts, but this has its disadvantages, as it is necessary to use two lamps in series, and any accident to one of a pair puts the other out of use as well. For very long distances the alternating system at 1,000 volts pressure, or higher if necessary, may be used, the voltage being reduced by means of transformers to about 100 volts at the lamps.

Whatever type of dynamo is selected, should be placed in a dry position, free from dust, and if possible an independent foundation of brick or stone should be provided. An endless belt will always give the best results, as lacing produces a momentary flicker in the lights at each revolution. In all cases the steadiness and to some extent the life of the lamps is dependent on uniformity of speed.

The switchboard containing the necessary instruments and controlling devices, is preferable to slate or marble but as the expense of such a board is quite an item, a skeleton frame work of hardwood well shellacked may be made to answer every purpose. From the switchboard the wires are led to the distributing point which should be as nearly as possible in the centre of the district to be lighted. If the work is above ground, the method of installing the lines and lamps will not differ from the usual practice. If, however, the wires are to be carried underground, a much higher insulation must be maintained, and the work must be carried out in every respect with the greatest care.

For all mines where nitric acid does not occur, lead covered cables with rubber insulation are found to be the most suitable. The most satisfactory supports for lead cables are malleable iron brackets, but the method of securing them to the walls or roof must be determined entirely by the situation. On these brackets are placed glass insulators of the deep grove pattern and the cable is in turn secured to these. All cutouts and switches should be placed in malleable iron boxes and the cable should be led into these through hard rubber bushings. No attempt should be made to use key sockets for the lamps. Keyless sockets or porcelain or hard rubber should be used, or special fixtures similar to those designed for marine work. It will always be found to be economy in the long run to use only the highest class of insulation in underground work, and to have all fittings installed in such a manner that the chance of interruption to the service is reduced to a minimum.

Transmission of Power.—I do not know that it is necessary for me to point out the advantages of electrical transmission of power for mining. It is in many cases so self-evident that it requires no demonstration. It is seldom indeed that minerals are found in the most convenient place for their extraction from the earth. The necessary transportation of coal or other fuel makes the cost of operating any machinery excessive, and prevents the use of labor-saving devices which would be adopted if the problem of cheap power were solved. In fact the absolute necessity of obtaining power often forms one of the most serious problems to mining engineers.

Direct current apparatus has for a long time been used for this purpose, and for comparatively short distances has proved itself satisfactory in every way. Motors have been applied to hoists, pumps, diamond drills, air compressors, ore crushers, stamp mills, and almost every form of mining machinery. It was soon found however, that with the direct current, the voltage was limited to about 500 to 800 volts, and at this pressure it was impracticable to cover very long distances. Until a comparatively recent date, the alternating current could not be successfully used for motor work. The only motors available were of the synchronous type, so called because they run at the same speed or in a certain proportion to the speed of the generator. When operated on single phase circuits, they are not self-starting but must be brought up to their normal speed by an independent source of power. The load is then carefully applied by a friction clutch. If the work to be done is for a moment in excess of the capacity of the motor, they get out of step, as it is called, and stop. They also require a separate machine as an exciter to energize the field. It will thus be seen that their use for general power purposes is limited. By the introduction of what is known as the multi-phase systems all difficulties have been overcome and alternating current motors are now manufactured which are equal to the best direct current motors in efficiency and starting torque, and which have the additional advantage of having no commutator or moving contacts of any kind.

The three-phase system, which has so far been more generally adopted than its rival, the two-phase, may be best described as a combination of three separate alternating currents in which the reversal occurs at different times. The result is that the impulses which produce the rotation are at no time entirely interrupted. This system was first used at the Frankfort Electrical Exhibition held during the summer of 1891 in Germany, where the power was transmitted from Lauffen to Frankfort, a distance of 112 miles.

One of the first plants installed on this side of the Atlantic was at Hartford, Connecticut, which has been in operation since November, 1892. The machines in use here are of about 400 horse-power capacity, one being used as a generator and the other as a motor. The motor is used to drive street railway generators. Both are wound for low voltage, the pressure being raised at the generator end to 7,000 volts, and transmitted over the line, which is eleven miles in length, at this voltage. It is then reduced by means of transformers to the same potential as at the generator.

Following the Hartford plant, the plant at Redlands, California, was installed. This installation is a typical one for general central station work and supplies motors and arc and incandescent lamps. It was started on September 7th, 1893. After this practical start the adoption of the system was rapid both in the west and in east, some of the principal plants now in operation or under contract being at Taftville, near Norwich, Conn.; Concord, N.H.; Columbia, S.C.; Portland, Oregon; Santa Rosalie, Mexico; Sacramento, Cal.; Pelzer, S.C.; Park City, Utah; Pachuca, Mex.; Silverton, Col.; Troverse City, Mich.; Norway, Me.; Gouverneur, N.Y.; Rochester, N.H.; Bel Air, Maryland; Austin, Texas; St. Hyacinthe, P.Q.; Dowagiac, Mich.; Sparta, Wis., and East Poland, Me.

Of these the plants at Santa Rosalie and Pachuca, Mex.. Park City, Utah, and Silverton, Col., are exclusively for mining purposes. The Pachuca installation is the largest of these and offers a typical example of a three-phase transmission plant on a large scale. At the generating station are placed five three-phase alternators of 400 horse-power each, directly coupled to a Pelton water-wheel operating under a head of 700 feet. These machines generate current at a comparatively low potential of 700 volts. This current is led to transformers wound for a ratio of 1 to 15, thus raising the pressure to 10,500 volts. The line, which consists of three wires, No. O, B and S gauge, extends first to Real del Monte, a distance of 67,400 feet, or a little less than thirteen miles. Here is situated a transformer sub-station where the potential is reduced to 2,000 and 500 volts. The current at 500 volts is used to operate the machinery for two mines in the immediate neighborhood, while the 2,000 volt current is led to the Escobar and Barron mines, a distance of 4,400 and 11,000 feet respectively. The high potential line is then continued to Pachuca, a distance of 21,600 feet, where another sub-station is located supplying current through transformers to five mines in that vicinity. A third sub-station is located at San Rafael, 15,840 feet farther on, the total distance from the source of power being over twenty miles. It is expected that enormous economies will be effected by this plant over the old system of operating machinery by coal.

At Silverton, Col., we have definite data as to the saving affected by power transmission.

In Mr. Irving Hale's paper describing this plant, which has a total capacity of 400 horse-power, he states that the saving will not be less than $36,000 per year. The distance in this case is about three miles.

Aside from the direct saving effected by the use of electric power, which in many cases is sufficient to more than pay for the plant the first year, it is often found that the greater ease of operation and small repair account still further increase the balance in favor of electricity. Electric motors offer advantages over other forms of power for almost every description of mining work.

Electric Hoists.—To hoisting, for example, the motor is peculiarly applicable. A hoist does its heaviest work in starting its load A steam hoist having two engines with cranks at right angles can only be depended upon at this time for one-half of its rated capacity as one of the engines may be on a dead centre. An electric motor, on the other hand, has no dead centres, and a heavy current in excess of the normal, can be turned into the armature for a few moments without danger.

This important advantage is of great value, and gives electric hoists a greater capacity, other things being equal, than a steam hoist. The simplicity, too, is very apparent; instead of two link motions, we have a simple reversing switch, and the only parts subject to wear in the motor are the two bearings and the commutator. In the alternating motor the commutator is eliminated, giving an ideally simple motive power.

Electric Pumping.—The advantages of electrically operated pumps may be summed up briefly as follows. Saving of room as compared with Cornish pumps or other systems requiring a separate pump-shaft. The possibility of placing them in the most advantageous situation and connecting them to the sources of power, without heavy expense. Ease of control from a distance and independently of each other. The type of pump best adapted to electric driving is the triplex, which gives an even resistance to the rotary motion of the motor. They are built in almost every form required in mining operations. Centrifugal or rotary pumps are also well adapted to electric driving, and may be used where it is only required to raise the water to moderate heights.

Electric Haulage.—Remarkable successful results have been obtained in the application of electric haulage to mines, and it is now recognized as the ideal system for handling mine products. The first cost is somewhat more than a rope haulage plant, but the cost of maintenance and repairs is considerably less. Any locomotive system is more flexible than rope haulage, as the lines can be easily changed or extended. The construction of the electric locomotive admits of adapting it to the local peculiarities of the mine, and may be made for very low entries and for little or no overhang beyond the rails. Where the service required is simply the transportation of ore or materials on the surface, a standard street railway truck may be equipped with any particular type of car body required for the work. This may be used to tow a number of trail cars if necessary. Where it is desired to handle standard railway cars without a second handling of the material, locomotives of different capacities have been designed.

Electric Drills.—I am aware that electric percussion drills are not as a rule very well thought of by mining engineers in this country. They were originally placed upon the market without proper tests and before they had been perfected as a commercial piece of apparatus. Extravagant claims were made for them and the results were for this reason all the more disappointing. For the past two years the company with which I am connected has been engaged in perfecting the electric percussion drill, and their satisfactory working, wherever placed, is the best proof of our success. No change has been made in the principle of the drill. The iron plunger is given a reciprocating motion by two electro-magnets in the drill body, to which a pulsating current is supplied by a specially designed generator. The mountings are in every respect the same as the standard air or steam drill. The improvements made have been in reducing the heating of the coils and in devising an insulation which could not be injured by rough usage which a rock drill is called upon to withstand. While this may seem a small matter it pratically makes the difference between an experimental piece of apparatus and a commercial tool.

Electric drills offer peculiar advantages when the location of the work is often changed or where the source of power is at a considerable distance. They are more efficient and operate with less loss in transmission than steam or air drill. In place of expensive and troublesome pipe lines, a flexible cable easily changed in position is all that is required.

Miscellaneous Power Work.—In addition to the uses mentioned, electric motors may be applied to almost any form of mining machinery, the problem of their application being a mechanical rather than an electrical one. Special uses in connection with his own work will doubtless occur to any practical mining engineer. One object of this paper has been particularly to point out the great advance which has been made in transmitting power over long distances What can now be easily accomplished in this respect would have been difficult, if not impossible, even so recently as two or three years ago, and it is of the greatest importance that mine operators, using any considerable amount of power, should carefully investigate this matter. The saving of a large part of the expenditure for fuel would mean in many cases increased dividends, and in some cases would doubtless bring the balance of profit and loss account to the credit instead of the debit side.

MR. JOHN BLUE—The valuable paper which has just been read is one that ought to be discussed, but it is also one that few ordinary mining men are able to discuss on short notice. I think the best thing we can do is to study Mr. Dean's paper when it appears in THE MINING REVIEW, and be prepared to discuss it at our next meeting.

MR. R. H. BROWN—I have had no experience at all with electricity, but I may say that whenever we have asked for tenders for the construction of such things as hauling and dumping plants, we have always found electrical apparatus the most expensive. I was mentioning this fact to Mr. Dean, and he tells me that of late the cost has been lessened very much; but at least two years ago the price was prohibitive as compared with either steam or compressed air.

MR. DEAN—The advance has been particularly in the transmission of power through long distances by alternating currents. These can be produced as cheaply as continuous currents, and they have the advantage of being entirely sparkless, a point which I did not mention in my paper. With proper precautions they can be even utilized in a mine where explosive gases occur.

Phosphate's Future.

By Robert C. Adams, Montreal.

The apparent extinction of the Canadian phosphate industry has led many to regard it as dead and buried, beyond any hope of resurrection. A consideration of some facts and circumstances may warrant the hope that the mining of apatite will again revive, and that it will yet assume the prominent position in Canada's production that it was once expected to fill.

The principal causes of the decline of the industry were,

1. The fall in prices, due to increased production in other countries, notably in Florida, and also to the general depression of the agricultural interests.

2. The high cost of apatite mining owing to the uncertainty of its occurrence, and the expense of selecting or "cobbing" it.

3. The loss in weight and the frequent rejection of shipments that failed to analyze up to the guaranteed quality.

4. The lack of a home market.

As to the first cause, the fall of prices,—two remedies are already in sight. Phosphate producers the world over have been impoverished by the low prices, and are either lessening their output, or are combining to secure higher figures. The increasing value of agricultural products will bring prosperity to the farmer and naturally lead to a larger demand for fertilizers and better prices. It is quite reasonable to expect a considerable advance in the price of phosphates in the near future.

Secondly.—Although apatite cannot be expected to occur in more favorable modes than it has done in the past, it is better understood and there will not be the wild waste of money in fruitless search under improbable chances of success Mchanical and chemical means of separation may lessen the expense of cobbing and secure a more uniform quality. Methods have been patented by which the phosphoric acid s taken into solution from the pulverized rock and is then precipitated; a process which if successful would make a vast saving in the labor of selection and the cost of transportation, as only the pure product need be shipped. Mechanical separation by specific gravity has met with some success; and a combined chemical and mechanical process may be found to be available, as it is said that fluids can be compounded having a specific gravity of 3·5, which would float away all lighter substances. As the specific gravity of apatite is 3·2 jigging in two fluids, one under and one over its gravity, might secure an effective separation. These facts skilled experts must determine.

Thirdly.—By grinding all the phosphate and shipping it in bags and barrels there would be less loss in weight and more accuracy in sampling for the determination of quality.

Fourthly.—As to the home market, there is a certainty that it must arise. Agriculture is the basis of a country's prosperity and fertilizers are the basis of agriculture. It is estimated that every year a million and a half tons of phosphate are taken out of the soil of the United States by its food crops. Every net ton of wheat contains about 16 lbs. of phosphoric acid, and the average soil contains about 68·6 lbs. to the acre or just enough to supply the phosphate to 4·16 tons of wheat. In process of time the fertility of the soil is exhausted unless the ingredients that have been extracted by the crop are returned to it. A complete fertilizer is said to be composed of phosphate, potash, and ammonia, but the greatest of these is phosphate. Vast areas of land in eastern Canada that were formerly rich producers of grain are now barren, for lack of being supplied with plant food. A judicious use of fertilizers would restore vitality to the soil. The worn-out cotton lands of Georgia, by the use of artificial manures, were raised in twenty years from a value of $3 per acre to $30 per acre. The same transformation might take place in Quebec could knowledge and enterprize be combined to apply the remedy. Every ton of phosphate that can be produced in Canada is needed on her own soil, and should be sold for use here instead of being transported thousands of miles and often sacrificed in competition with inferior foreign products, or through losses by those tricks of trade that are so notable a feature of modern commerce.

A few years ago, after Col. North and others had made immense fortunes in nitrate, a writer in the London Times, in an article upon phosphate as a fertilizer, said: "To adopt a homely simile, the nitrate is like a glass of spirits, while the phosphate may be compared to a plate of beef." This caught the British fancy and did a good deal to stimulate investment in Canadian phosphate lands on the part of some who thought that, to follow out the simile, phosphate kings might become as much richer than nitrate kings as beef was superior to spirits. Under this stimulus extravagant prices were paid for lands, and rash and unwise methods of operation were attempted, all of which contributed with the falling market to the ruin of the industry. But the fact remains that phosphate is the most valuable plant food that is known. The lands of the settled portion of eastern Canada are exhausted and phosphate is the principal tonic needed to restore their vitality. The use of phosphate constantly increases throughout the world. England and Germany are using ever-enlarging quantities, and in the United States every year more than a million tons of fertilizers are made, of which phosphate is the chief ingredient.

How shall this home market be created? The first means is the education of the farmers. The distribution of a knowledge of the results obtained by the careful tests made at the experimental farms would tend to give confidence in the use of such fertilizers as were recommended. The agricultural societies should be encouraged to spread information and help experiment. Missionaries should be sent to the waste places to preach the gospel of fertilization by which the wilderness may rejoice and blossom as the rose. The Government may rightfully engage in this work of enlightenment.

A difference of opinion exists as to whether it is a correct policy for the Government to give direct pecuniary encouragement to industries. The majority of the people have decided in favor of a national policy, which has enabled anyone who manufactured any article, be it pickles or pig-iron, to go to Ottawa and secure either a protective duty or a bonus, or both. If this is the policy of the country, surely it can in no case be so well applied as in the promotion of agriculture, the staple industry of the land, upon which its prosperity mainly rests. While there are about 300,000 people in the Dominion engaged in mechanical and manufacturing industries there are nearly 800,000 occupied in production from the soil The occupiers of land number 620,486 of whom 524,806 are owners and only 92,708 are tenants. So large a land-owning class implies the intelligence essential to successful cultivation of the soil, and there can be no more hopeful field for the inculcation of useful practical knowledge pertaining directly to the welfare of the people, than among the sturdy agriculturists of Canada. As long as the Government see fit to bonus or protect industries employing a few hundred workers, the 600,000 farmers of Canada have a right to ask for consideration, and in no way can they be aided to prosperity better than by assistance to the intelligent use of cheap and effective fertilizers. If the Government would devote a sum of money to the spread of knowledge about fertilizers, and to the encouragement of the mining and manufacturing of phosphates, it would be of greater benefit to the country than the same amount of money applied to any other industrial pursuit, be it what it may. There is no proper conception as yet in Canada as to the great value to be obtained from the judicious use of artificial fertilizers, and if the Government is to be in any sense paternal it should consider its primary duty to be to increase the productiveness of the soil.

By the establishment of fertilizer manufactories and the consequent creation of a home market for phosphate, a great stimulus would be given to the cheap production of apatite. Many farmers have deposits of phosphate upon their lands or in their neighborhood. They are often willing to put in their spare time in winter in mining, even if it only yielded them wages of 50 cents a day. In the early period of phosphate mining in Canada a large output was obtained from this source, but the difficulties of foreign shipment, or unsatisfactory dealings with middlemen, discouraged these efforts. With a ready market at hand for small quantities, a great many people would turn their attention to the mining of apatite, even at the present low prices, and this work in some cases would certainly lead to the discovery of large deposits that would pay handsome profits. Although the average cost of phosphate may be said to be $8 or $10 a ton, it has often been the case that a bunch of 100 tons has been taken out at a cost of not over $2 a ton. The fortunate farmer who should strike this bonanza would make more profit from it in one month than the other products of his farm would yield him in a year. This success would stimulate others to work and thus enlarge the output.

One favorable feature in the future prospects for Canadian phosphate mining and fertilizer manufacturing is the facility for cheap freights to the far west. It is a remarkable fact that nearly all the phosphate mines of Canada are so situated that their products can be water-borne to market with only a short land haulage. The Lievre, Gatineau, and Ottawa rivers, and the Rideau canal can float the mineral to the St. Lawrence at either Montreal or Kingston, from whence the returning grain barges and schooners would transport it to the west at almost ballast rates of freight. The phosphates of Carolina or Florida to reach the same points along the shores of the great lakes must pay freight rates to the railroads greatly in excess of the rates by the water route. This saving added to the superior value of Canadian apatite might overcome the competition due to cheapness of production at the south, and as the use of fertilizers extends in the west as it is bound to do, Canada may become the chief source of supply for that great region which for a thousand miles adjoins the Canadian waterways.

One of the greatest means of increasing the production of phosphate would be to prove that in its crude state, finely ground, it is effective as a fertilizer. At present the custom is to mix the phosphate with an equal weight of sulphuric acid, by which means it becomes soluble in water and is termed superphosphate. It is due to the acid that the objectionable odor exists. This process increases the cost of the fertilizer to the farmer two or three-fold. Many experiments go to show that the raw phosphate is effective, especially when mixed with stable manure, or when applied to crops that do not require a very quick stimulant. Mr. W. H. Bowker, the eminent fertilizer manufacturer, while arguing for the general superiority of superphosphates, says: "There may be places where insoluble phosphates can be advantageously applied, as upon land covered with fruit trees or devoted to grass. Perennial plants, like grasses and trees, no doubt extract phosphoric acid more readily than annual plants, owing to their numerous and well-developed roots. Winter grains, especially wheat, from the long time it occupies the ground, and its growth in the fall, may also be benefitted by an insoluble or partially insoluble phosphate." As this admission applies to four-fifths of the cultivated land, it indicates the possibility of an extended use of crude pulverized phosphate.

Another reason for expecting a revival of Canadian apatite mining is the fact that in a great many instances it is associated with phlogopite,—mica of amber or silver-grey color. This mica was formerly worthless, and many phosphate pits were abandoned on account of the prevalence of this mineral. Now that its use as an electrical insulator has become general, selected lots of mica can be sold for $100 a ton, and many properties which would not pay if worked for phosphate alone, or for mica alone, may be made profitable by the production of the allied apatite and mica.

Our reasons for hopefulness as to a revival of the Canadian phosphate industry are based, then, upon the expectation of a rise in prices; better systems of mining and selection; shipping in the pulverized condition; the opening of a home market; the availability of the great western market by means of cheap water freights; the increasing use of phosphate everywhere; the certainty that phosphate of lime is the best fertilizer known; the assurance that Canadian apatite is the richest known available source of phosphoric acid; the efforts already made by Government, through the experimental farms, and by agricultural societies to gain knowledge of plant food; the hope that more effort will be made to spread this knowledge; the hope that the Government may find effective means to encourage the industry; the use of pulverized phosphate as a fertilizer, thus securing a very cheap article, in which the buyer might feel more confidence than in a mysteriously manufactured article chiefly remarkable for its bad smell; and finally the possibility of mining, with the phosphate, mica as a by-product and getting two results for one effort. Added to all these is a sentiment that in these days of altruistic development may not be altogether unworthy of consideration by a body of men so noted for humane ideas, and for a devotion to ethical culture as are the mining men of Canada.

All men want to make money! Most men care not how they make money! Some men want to moke money in useful ways. The latter are not content to gain their profits by ministering to the luxury, folly, or vice of mankind, they have the philanthropic sentiment as well as the greed for gain. They do not wish to thrive by selling silks, wines, jewellery, rum, tobacco, patent medicines, or lottery tickets. They prefer to deal in coal, iron, grain, cattle, and the common necessaries of life, and they desire to have the sentiment of rendering real service to their fellow-men, while they are at the same time earning their livelihood or gaining a fortune. The production and manufacture of fertilizers gives a field for operation that for beneficence cannot be surpassed, and in other countries these industries have proved to be the source of large fortunes.

There is an oft quoted passage of Dean Swift's in Gulliver's Travels which is worth repeating in this connection: "And he gave it for his opinion that whoever could make two ears of corn or two blades of grass to grow upon a spot of ground where only one grew before, would deserve better of mankind and do more essential service to his country than the whole race of politicians put together." This idea should encourage capitalists with humane sentiments or corporations with souls, if any such exist contrary to proverbial slander, and they surely do, to engage in this useful occupation of the production of fertilizers. Whatever may be said as to the scent which they give to the air they are unsurpassed among manufactured products in the odor of morality and the flavor of beneficence.

In view of all these physicial facts and moral influences may we not encourage hope for the future of phosphate?

Mr. F. T. Shutt—You remarked, Mr. Chairman, that it was the duty of the government to protect our home industries. What I should like us as a people to realize is that in addition to our mines and our timber we have another resource that it is necessary we should protect—the native fertility of our soils. (Hear, hear.) It is with this view that I have prepared my own paper. In connection with the paper that has just been read, I should like to say that we must not view phosphoric acid, or any other fertilizer, as a tonic or stimulant. I would emphasize the fact that it is plant food. The opinion prevails among our farmers that artificial fertilizers act as stimulants; that after their use there comes a reaction, and that they have a tendency to exhaust the soil. The fact is quite the contrary. Fertilizers are essentially food

for vegetation, and add to, not detract from, the fertility of the soil. Capt. Adams, I think, referred to a chemical means of separating high-grade from low-grade phosphate. I can understand the mechanical method, but I know of no chemical one. I should like to have information on that point.

MR. J. BURLEY SMITH—That is the difficulty which has practically floored us. Chemists do not as yet know of any method of doing it. I have spent considerable time in inventing mechanical means of separation, and have been to a certain extent successful, but I am not aware of any chemical means.

MR. JOHN BLUE—Capt. Adams mentioned that on account of the difference between the specific gravity of the gangue and the phosphate it was possible to effect a separation by means of jigging. In that I think he is wrong, as the difference in specific gravity is altogether too slight.

Phosphoric Acid in Agriculture.

By FRANK T. SHUTT, M.A., F.I.C., F.C.S., Chief Chemist, Dominion Experimental Farms.

When the achievements of science during the present century come to be written up, I am firmly of the belief that, notwithstanding the useful and brilliant discoveries in electricity and physiology, and the marvellous engineering feats of the age, it will be found that chemistry has, during the past ninety years, contributed more towards the necessaries and luxuries of life, more towards the economy and comfort of living, the civilization and progress of the world, than any other science, natural or physical. Agriculture is the oldest of the arts, but it is only within the most recent time that she has been exalted to a science. The science of agriculture dates from the day when the art of farming became to be studied from a chemical standpoint, and chemists sought by analysis to learn the composition of plants and animals, to understand the nature and sources of plant food and animal requirements, and to comprehend the manifold changes that matter undergoes when those changes are brought about by plant and animal life. That day is in the recollection of some that are still living.

Deeply interesting as the history of the birth and development of agricultural science is, it is not my purpose to consider it to-day, even in outline. I shall rather content myself by stating one or two of the fundamental truths of agricultural science, for the knowledge of which we have to thank chemistry. Their realization may help us to understand more clearly the question we are to consider to-day—Phosphoric Acid in Agriculture.

First, then, chemistry has established the fact that plants require food for the maintenance of their life, development and reproduction. Their increase in weight is due to the assimilation of food materials. The assimilation being the result of the exercise of certain vital functions.

Secondly, it has been ascertained that this food is obtained by plants (which, of course, include all farm crops), partly from the atmosphere and partly from the soil. With respect to the former, nature always supplies an abundant quantity; but of the latter—the soil-derived food—the intelligent farmer must see to it that his crops are furnished with liberal amounts in available forms. Fertile virgin soils are storehouses or banks in which are laid up vast supplies of material to be converted by the agency of vegetable life into valuable food products for man and beast. Such stores, however, are not inexhaustible. Every crop harvested must necessarily lessen the amount of plant food in the soil. Science affirms, and practice corroborates the statement, that the continuous harvesting and selling of farm crops without any concomitant return of those elements extracted by the roots of the crops, invariably and inevitably lead to diminished yields, and finally to soil exhaustion of such an extreme character that farming is no longer profitable. Chemistry, then, in agriculture, forces home this truth, "Ex nihilo nihil fit."

Science and practice have shown that of the soil-derived elements of plant food it is generally necessary to replace only three in order that fertility may be maintained. The other constituents, though equally indispensible, are usually present in sufficient quantities in the soil for ordinary farm crop requirements. The three constituents here referred to are: Nitrogen, phosphoric acid and potash, and are known as the "essential elements of fertility." Manures and fertilizers are, therefore, plant food suppliers, and receive their value primarily, according to the amounts of these essential constituents that they contain. Their chief function is, therefore, to furnish available nitrogen, phosphoric acid and potash in the soil. These elements of plant food have been named in the order of their commercial value and agricultural importance.

To speak briefly of nitrogen, we have to chronicle most valuable assistance rendered by chemistry to agriculture in the recent discovery that the legumes have the power of appropriating and assimilating the free and uncombined nitrogen of the atmosphere. The leguminosæ include clover, pease, beans, vetches, &c., and as far as is at present known, are the only plants that have this important and valuable power. It would be foreign to our subject to discuss how this assimilation takes place; but I may be allowed to point out that the more extensive growing and feeding of leguminosæ upon Canadian farms will prove the cheapest and most permanent method of enriching impoverished soils in that very important element, nitrogen.

Concerning potash, it is only my purpose to mention that we have in Canadian wood ashes a valuable home source of this constituent. We, as an agricultural people, have not yet come to the realization of the fact that in selling our wood ashes across the line we are parting with a birthright for a mess of potage. Our supply of wood ashes is rapidly diminishing, and the day is not far distant when we shall have to replace the potash so lost to our soils by the salts from the Stassfort mines.

THE OCCURRENCE OF PHOSPHORIC ACID IN NATURE.

It might well be argued that since phosphoric acid is essential to the life of plants, and since vegetable life is so widespread, the presence of this constituent in the soil is wellnigh of universal occurrence. Phosphoric acid, chiefly as phosphate of lime, is found in many rocks, in feldspar, granite, gneiss, syenite, trachyte, dolerite, diorite, dolomite, &c., the percentage running from .09 to 1.7. The disintegration and decomposition of rock materials are among the chief factors in the formation of soils. It is thus that the mineral basis of soils are obtained; and hence, it is a very simple matter to account for the presence in them of phosphoric acid. The older rocks, it has been shown, are richer in this constituent than those of later origin. Knowing, therefore, the character of the originating rocks, we are able to form an estimate of the soil's richness in this element.

THE PERCENTAGE OF PHOSPHORIC ACID IN SOILS.

Most authors quote two-tenths of one per cent. as the average amount of phosphoric acid found in a good fertile soil. They further state that one-half that amount probably represents phosphoric acid in soils of ordinary fertility, while very rich and exceptional soils possess from .3 to .5 per cent.

The subjoined table gives the percentage of phosphoric acid in 40 surface soils and 16 sub-soils, obtained in the various provinces of Canada as indicated.

PHOSPHORIC ACID IN CANADIAN VIRGIN SOILS.

No.	Province.	Locality.	Surface or Subsoil	Character of Soil.	Per Cent. of Phos. Acid.
1	British Columbia	Ladner's Landing	Surface	Alluvial loam	.27
2	do	Chilliwack	Subsoil	Heavy clay	.13
3	do	Squamish Valley	Surface	Sandy loam	.20
4	do	Alberni	do	Clay loam	.08
5	do	1st Bench, Ex. Farm, Agassiz	do	Clay and sand	.23
6	do	2nd do do	do	do	.13
7	do	Orchard, do	do	do	.18
8	do	do do	do	do	.25
9	do	Pitt Meadows	do	Alluvial loam	.48
10	do	do	Subsoil	Yellow sandy	.13
11	N. W. T.	Walsh Flats	Surface	Clay loams	.17
12	do	do	do	do	.16
13	do	Tilley	do	Sandy	.13
14	do	do	do	Sandy	.17
15	do	Vermillion Hills	do	Undecomp'd rock mat.	.16
16	do	do	do	do do	.18
17	do	Yorkton	do	Black sandy loam	.20
18	do	do	Subsoil	do do	.09
19	do	Calgary	Surface		.17
20	do	Saskatoon	Subsoil	Clay	.10
21	do	Tp. 22, R. 26, W 2	do	Calcareous clay	.12
22	do	2 & 3, 34, 35, Tp. 29, R. 24, W. 2.	do	do	.11
23	Manitoba	Sec. 31, Tp. 4, R 1 W	Surface	Dp. blk l'm vir. pra. s'l	.27
24	Ontario	Muskoka	do	Loose sandy loam	.26
25	do	do	do	Sandy loam	.19
26	do	do	Subsoil	do	.17
27	do	do	Surface	Light grey sandy loam	.17
28	do	do	Subsoil		.08
29	do	Russell	Surface	Grey sandy loam	21
30	do	do	Subsoil	Light yellow sandy	.10
31	do	do	Surface	Grey sandy loam	.09
32	do	Walkerville	do		.12
33	do	Muskoka	do	Sandy and light	.17
34	do	do	Subsoil	do	.17
35	do	Port Arthur	Surface	Grey red sandy loam	.14
36	do	Lot 14, Con. 10, Brunel Tp., Muskoka	do	Clay loam	.16
37	do	Muskoka	Subsoil		.09
38	Quebec	Arthabaska	Surface	Sandy loam	.16
39	do	do	Subsoil		.17
40	do	do	Surface	Black muck	.22
41	do	do	Subsoil	Grey sandy	.31
42	do	St. Adelaide de Pabos	Surface	Red sandy	.04
43	do	do do	do	do	.07
44	do	St. Clet	do	Dark grey sandy loam	.32
45	do	do	Subsoil		.29
46	do	St. Ignace du Nominin[que	Surface	Heavy clay loam	.18
47	do	do do	Subsoil	do do	.18
48	do	St. Peter Joliet	Surface	Black clay loam	.27
49	do	do	Subsoil		.28
50	do	Maria, Bonaventure	Surface	Yellow soil	.18
51	New Brunswick	Restigouche	do	Pale yellow soil	.08
52	do	Sackville Marsh	do		.15
53	do	do	do		.17
54	Nova Scotia	Cumberland	do	Sandy	.06
55	do	S. W. Mabou	do	do	.09
56	P. E. I	Kings Co	do	Light sandy loam	.09

These results have been collated from the annual reports of the Chemical Division of the Experimental Farm, in which may be found the complete analyses of the soils, as made in our laboratory at Ottawa.

The samples examined by no means represent the "Provincial character" of the soils; that would be impossible with such a limited number of examples. They are, however, fairly representative of tolerably large areas of uncropped and unmanured lands in the various provinces.

The percentages above recorded may be regarded as those of "total" phosphoric acid; being determined after treatment of the soils with hydrochloric acid, according to the method as suggested by the Association of Official Agricultural Chemists of the United States. I shall not discuss these data in detail, but attention may be called to the high phosphoric acid content in the soils of alluvial origin from British Columbia, and in the virgin prairie soils of Manitoba. We obtain as an average of the above table, the following percentage of phosphoric acid:—

Surface soils (40) ..... .17
Subsoils (16) ..... .15

Assuming the weight of the surface soil to a depth of nine inches over one acre to be 2,600,000 pounds, we find an average amount in that area of 4,420 pounds of phosphoric acid. In the surface soils of alluvial and prairie origin, the amount of phosphoric acid would be still larger, more especially when we consider the greater depth of these soils.

CONDITION OF PHOSPHORIC ACID IN SOILS.

The natural phosphoric acid of the soil does not exist for the most part in a condition available for plant use. It is there present as the phosphates of lime, iron and alumina—compounds practically insoluble in water.

While, therefore, we have in ordinary soil analyses data regarding what may be termed the "total richness" in phosphoric acid, such analytical data, as usually obtained, do not furnish us with information respecting the availability of that phosphoric acid for plant use. Plants require their food in a soluble condition or in one that they can render such by the acid exudation of their roots. Hence the fertility of a soil cannot be measured entirely by the totals of its constituents. Thus, as has been

pointed out, many farm soils containing an amount of total phosphoric acid equivalent to two tons or more per acre, have had their yields vastly increased by the application of 2 or 3 hundredweights of superphosphates containing, say, from 30 to 50 pounds of soluble phosphoric acid.

The following table gives the weight of phosphoric acid taken from the soil by farm crops per acre. The amounts stated have been calculated from reliable chemical data and computed average provincial yields. With good farming the yields here quoted would be from one-third to two-thirds greater :—

WEIGHT OF PHOSPHORIC ACID TAKEN FROM THE SOIL BY FARM CROPS PER ACRE—AVERAGE.

	Pounds.
Wheat, 20 bushels, grain—Grain and straw	15.7
Barley, 25 bushels, grain—Grain and straw	14.0
Oats, 35 bushels grain—Grain and straw	15.6
Corn fodder, glazing—11 tons	32.5
Timothy and clover—One and a-half tons dry	15.0
Turnips (10½ tons of roots)—Roots and tops	27.3
Mangels (10 tons roots)—Roots and tops	28.0
Carrots (8½ tons roots)—Roots and tops	21.8
Potatoes (3 tons tubers)—Tubers and haulm	14.5

We thus see that the average annual phosphoric acid requirements for farm crops is somewhere in the neighborhood of 20 pounds per acre. We might, therefore, infer —providing the natural phosphoric acid of the soil were even in a fair degree available —that an addition of superphosphate would be unnecessary and unprofitable. Such, however, as already stated, is not the case. The explanation is, that the phosphoric acid of the soil, although frequently present, as regards amount, in ample quantity for crop use, becomes but very slowly available. This latter process is brought about by the solvent action of the soil water containing carbonic acid and the solvent action of the acid sap in the plant rootlets. I repeat, therefore, that soil fertility is dependent rather upon the percentage of available plant food than upon its total percentage. Soil exhaustion is principally the loss, by rapid succession of crops, of the store of immediately available elements in the soil. Our purpose in manuring is to replace them there in such conditions that they may at once be made use of by plants.

SOLUBILITY OF PHOSPHATES.

With respect to the solubility of mineral phosphate in soil water, Warrington says: "One part of pure tricalcic phosphate dissolves in 6,788 parts of water, saturated with carbonic acid." Some experiments made in our laboratory at Ottawa, on the solubility of the finely ground phosphates, resulted in showing that phosphoric acid equivalent to .05% of tricalcic phosphate had been rendered soluble when 5 grammes were treated for 3 hours with 150 c. c. of water through which carbonic acid was kept bubbling. Previous calcination of the ground phosphate increased its solubility when treated as in the foregoing experiment. In one trial, phosphoric acid equivalent to .45 per cent. of tricalcic phosphate had passed into solution. From these data it is evident that neither the particles of phosphate rock originally present in the soil nor as added in the form of ground apatite, can furnish, *per se*, at any one time, more than very small quantities of available phosphoric acid.

We may now inquire as to the solubility of the soil phosphoric acid in the sap exudation of rootlets, since it is by this means that plants are largely able to appropriate the mineral matter of the soil. Dr. Bernard Dyer, in a paper on the available mineral plant foods in soils, published in the journal of the Chemical Society, England, March, 1894, gives, among many other interesting data respecting the condition and amounts of plant food in soils, the results of his lengthy investigations to determine the degree of acidity of root sap. Dr. Dyer examined a large number of agricultural and garden crops, taken during the season of active growth. He made in all about 100 determinations, examining representatives of 20 natural orders of plants. His method of procedure I need not here explain, but his conclusion is of the greatest import. The average "sap acidity" for the roots of the 20 orders is .91 per cent., expressed as crystallized citric acid. Dr. Dyer concludes that these determinations "appear to be sufficient to indicate that the ratio of the soluble free acid in the roots of plants and the moisture contained in them—which is here called sap acidity—probably generally falls within, and not very far within, one per cent. crystallized citric acid." Citric acid was chosen by Dr. Dyer "partly on account of it being an organic acid, and in the sense contrary to other root sap acids, and partly because it is the acid generally used by those who have attempted to determine available phosphoric acid in manures by means of weak acids."

Dr. Dyer then proceeded to determine the amount of mineral plant food in the soil soluble in one per cent. citric acid solution, and by this means obtained a knowledge, more or less accurate, of the quantities of the phosphoric acid and potash—which quantities would represent the "immediate fertility" of the soil. The determinations were made on samples from the celebrated experimental farm of Sir John Lawes (at Rothamsted, England), with whom for over fifty years Sir Henry Gilbert has been associated in original agricultural research. For forty years in succession barley had been grown upon the plots from which the soils were taken. An exact account of its yields in straw and grain, as well as of the fertilizing constituents applied, has been kept. In all, 22 samples of soil were examined. The results are of such intense interest that I shall insert Dr. Dyer's table of results :—

PHOSPHORIC ACID DETERMINATIONS IN SAMPLES OF BARLEY SOILS FROM HOOSFIELD, ROTHAMSTED.

Manure Applied every Year since 1852 (for quantities see pages 143 and 144).	Percentage of Sulphuric Acid in Fine Soil, calculated on Dry State.			
	Total Phosphoric Acid.	Phosphoric Acid dissolved by 1 per cent. solution of Citric Acid.	Total Phosphoric Acid.	Phosphoric Acid soluble in 1 per cent. solution of Citric Acid.
			Lbs. per Acre.	Lbs. per Acre.
1. O. No manure	0.099	0.0055	2503	139
2. O. Superphosphate	0.182	0.0463	4601	1170
3. O. Potash, &c., (no phosphates)	0.121	0.0100	3059	253
4. O. Superphosphates, potash, &c.	0.189	0.0538	4778	1360
1. A. Ammonia salts	0.097	0.0060	2452	152
2. A. do and superphosphate	0.173	0.0425	4373	1073
3. A. do and potash, &c. (no phosphate)	0.102	0.0081	2579	205
4. A. do superphosphate and potash, &c	0.182	0.0500	4602	1264
1. AA. Nitrate of soda	0.104	0.0067	2629	170
2. AA. do and superphosphate	0 165	0.0350	4171	909
3. AA. do and potash, &c. (no phosphates)	0.104	0.0082	2629	207
4. AA. do superphosphate and potash, &c	0.179	0.0475	4525	1201
1. AAS. Nitrate of soda and silicate of soda	0.106	0.0071	2680	180
2. AAS. do do do and superphosphate	0.180	0.0475	4550	1201
3. AAS. do do do and potash, &c. (no phosphates)	0.105	0.0112	2654	283
4. AAS. do do do superphosphate and potash, &c	0.169	0.0479	4272	1211
1. C. Rape cake	0.158	0.0187	3731	442
2. C. do and superphosphate	0.229	0.0636	5408	1503
3. C. do and potash, &c. (no phosphates)	0.152	0.0214	3590	505
4. C. do superphosphate and potash, &c	0.203	0.0563	4794	1330
7¹. Farm yard manure for 20 years, unmanured for last 18 years	0.134	0.0206	3332	512
7⁸. Farm yard manure for 38 years	0.176	0.0447	3669	932

These figures are very significant as pointing out the comparatively small amount of available phosphoric acid to the total amount present. As remarked by Dr. Dyer, the ratio of the total phosphoric acid contained in the plots receiving no phosphates to the phosphoric acid in the plots receiving phosphates, is a small one, viz : 1 to 1.7 ; whereas, the ratio of the available phosphoric acid contained in the plots receiving no phosphates to that in the plots receiving phosphates, is a comparatively large one, viz : 1 to 6. Speaking of the phosphoric acid soluble in 1 per cent. solution of citric acid, he says :—

"We find that the average percentage thus found in the eight plots receiving no phosphates was 0.0078 ; in the eight soils that received phosphates it was 0.0463. These percentages are in the ratio of nearly 1 : 6. The difference in the percentages of phosphoric acid soluble in dilute citric acid is thus comparatively overwhelming."

A consideration of these data in conjunction with the yields obtained, affords an argument of the very strongest character in favor of judging of a soil's fertility by its available plant food rather than solely by the "total" percentages of its constituents, and further, we have in these results of Dr. Dyer, coupled with the yields of barley, of Sir Henry Gilbert, emphatic confirmatory evidence of the immense value of the application of soluble phosphates. Other factors (season, mechanical condition of soil, &c.), being satisfactory, experiments show that crop yields are directly dependent upon the amounts of available constituents in the soil, prominent among which is phosphoric acid.

We may, therefore, i quire as to the sources from which this phosphoric acid can be supplied. They may be classified as follows :—

1. Bones—and their products.
2. Guanos.
3. Mineral phosphates, including Canadian apatite, Spanish, Norwegian, South Carolina, Florida, French and Algerian phosphates and coprolites.
4. Superphosphates.
5. Thomas—phosphate or basic slag.

To discuss the relative merits of these from an agricultural standpoint is of course impossible in the present paper. Suffice it to say, that the one great Canadian source of phosphoric acid is in the vast deposits of apatite found chiefly in the Province of Quebec. We shall, therefore discuss, first, our mineral phosphate in its finely ground condition, and secondly, as converted into superphosphate. Some data have already been given as to the solubility of raw phospnate in soil water, that is, water that we may suppose contains carbonic acid. Further results are, that, according to Williams, one part of finely ground phosphate dissolves in 140,840 parts of carbonic acid water, and according to Bisshof, 1 in 393,000. It will be noticed that while these co-efficients of solubility are widely divergent—evidently due to difference in methods of determination and the fineness of the ground phosphates—they all show a very low degree of solubility in carbonic acid water. We may, therefore, conclude that neither the phosphate rock particles either added to or originally present in the soil can furnish, as the result of the solvent action of the soil water, at any one time, more than very small quantities of available phosphoric acid. We are evidently not yet in a position to assign definitely a place in the scale of agricultural values to finely ground phosphates. No doubt the experiments now going on here and elsewhere will before long throw light upon this subject. Finely ground phosphate undoubtedly adds to the store of the soil's phosphoric acid that will in time become available, but it is equally evident that in the majority of instances it will well repay to previously convert it into a soluble form. In this connection, it is well to remember that the profit in farming largely depends upon the rapid conversion of plant food into vegetable products, which can only be done when such plant food is present in the soil in tolerably large amounts, and in immediately available conditions. I have always advised, as being more economical and profitable, methods and fertilizers which tend to immediately increased yields, rather than those which may be looked upon as permanently improving the soil. At the same time, it is worthy to note that phosphoric acid, unlike its sister essential, nitrogen, does not easily leach or waste in the soil. It is an accumulative fertilizer, very little passing off in the drainage water.

SILVER-LEAD SMELTING IN BRITISH COLUMBIA.

New Works of the Kootenay Mining and Smelting Co., at Pilot Bay, B.C.

[Opened 16th March last. Shipped in 30 days 600 tons silver-lead bullion, and from 25th May to 25th June 700 tons, or a total of 1,300 tons. This is a customs lead and silver smelter, having a capacity of 200 tons per day. It has been operated to date mainly on ores from the Blue Bell mine, one of the largest deposits of low-grade galena on the continent. 20,000 tons have already been shipped from this mine to smelting works. The mine and smelter employ at date about 200 persons.]

It has already been stated that the acid sap of rootlets is an important factor in soil food assimilation. We have also seen that Dr. Dyer has shown that the acidity of this root sap is equivalent in solvent power, on the average, to a one per cent. solution of citric acid. Following up the work already quoted, Dr. Dyer ascertained the solubility of various phosphates in this solvent. He found that 15.81 per cent. of the total phosphoric acid of finely ground Canadian apatite was rendered soluble by treatment in the cold with a one per cent. citric acid solution, when the proportion was one part of phosphate to 200 parts of solvent. His tabulated results are of interest, and I therefore take the further liberty of quoting them :—

CITRIC ACID EXPERIMENTS.

Strength of citric acid in solution....1.0 per cent. solvent material = $\frac{200}{1}$

	Per cent. of Total Phosphoric Acid.
Canadian apatite	15.81
Spanish phosphate	10.73
Aruba "	29.99
Belgian "	3.08
Somme "	30.36
" "	30.51
South Carolina phosphate	38.06
Another deposit of same	34.46
Cambridge coprolites	33.31
Raw Redonda phosphate	9.21
Calcined Redonda phosphate	16.06
Bone meal	100.00
Steamed bone flour	89.66
Basic slag or cinder	72.84
Peruvian guano—	
Pabellon de Pica	97.50
Punta de Lobos	76.67
Lobos de Afuera	87.23
Huanillos	74.16
Fish guano	91.46

My own results obtained in the laboratory at Ottawa, using one per cent. citric acid solution in the proportion of 1 part of phosphate to 100 of the solution, showed that when treating a finely ground phosphate containing, approximately, 25 per cent. of carbonate of lime, 6.2 per cent. of the total phosphoric acid was rendered soluble.

Dr. Dyer concludes, "As a matter of fact we know that finely ground mineral phosphates do afford an available, if not an economical, source of plant food, their value being determined mainly by fineness of grinding and specific hardness."

The experimental fertilizer plots at the Central Experimental Farm, Ottawa, are under the charge of Mr. Saunders, the director. In his report for 1893 he gives the data of the previous six years' trials with various fertilizers on the yield of different farm crops. He concludes regarding raw phosphate as follows :—"The crops given by plot 4 in all the series seem to show that mineral phosphate untreated no matter how finely ground has little or no effect as a fertilizer, and that the effects observable where nitrate of soda and wood ashes are used in conjunction with the untreated mineral are probably due entirely to the action of these added fertilizers. There is, however, no doubt that the mineral phosphate when treated with sulphuric acid and rendered soluble by being changed to the superphosphate is a most valuable addition to the fertilizing constituents of the soil.

"It would appear that, when the finely ground mineral phosphate is intimately mixed with barn-yard manure in an active state of fermentation and composted for several days, better results are obtained than would be expected from the proportion of manure used and it is probable that under these circumstances some portion of the mineral phosphate is rendered soluble by the action of the ferments in the decaying manure."

Various experiments have been made in our laboratory at Ottawa since 1893 towards a means of cheaply and effectively converting the phosphoric acid of ground phosphate into soluble and available forms, by means of sulphate and bisulphate, and carbonate of the alkali metals. The first report on these experiments, already referred to, is contained in the report of the Minister of Agriculture for 1893. It is there shown that the fusion of one part finely ground phosphate with the bisulphate of soda renders soluble a large proportion of phosphoric acid. Thus in one instance, phosphoric acid equivalent to 38.49 per cent. of apatite had been so converted. I may be allowed to quote from that report my conclusions as to the solubility of the phosphoric acid after ignition with the sulphates and bisulphates of soda and potash :—"I infer from these results (1) that any soluble phosphoric acid that may be formed during the ignition of the mineral phosphates with the sulphates of soda and potash immediately recombines in the presence of water to form tricalcic phosphate, and (2) that the ignition of the mineral phosphates with the bisulphates of soda and potash produces, according to circumstance, more or less soluble phosphoric acid.

"This latter conclusion is a very important one, since it is possible that by using the by-product sodium bisulphate an economical method for the treatment of mineral phosphates may be devised. It is scarcely necessary to add that such a process would prove of great value to Canada and Canadian agriculturists. Before an affirmative statement can be made regarding the commercial success of this method for converting and utilizing our phosphate, the cost of the raw materials and of the treatment, as well as the price obtainable for the manufactured article, must be taken into careful consideration."

Since that date, further work has been done, but has not yet been published. These latter experiments comprise the following :—(a) Heating together finely ground phosphate with sulphate of soda and treating the residue with 2 per cent. citric acid solution. The results showed that phosphoric acid equivalent to 35% to 37% of the phosphate had been dissolved by this solvent,

(b) Ignition of the finely ground phosphate with sodium bisulphate and treatment of the mass with 2% citric solution. In this case 50% of the apatite was found to have been rendered soluble in the acid solution.

The bye-product that was used in these experiments contained only a small proportion of bisulphate—the large part being sulphate of soda. It did not yield, therefore, as large an amount of soluble phosphoric acid as when a pure bisulphate was used.

These experiments, the results of which I have condensed, were made before the appearance of Dr. Dyer's paper. Consequently I was not then aware that 1% citric acid represented the acidity in root sap. My solvent was undoubtedly too strong to give results which allow us to say that the percentages of phosphates above stated are such as are rendered immediately available for plant use. Nevertheless, we may safely draw the conclusion that ignition of the finely ground phosphates with sulphate of soda, as well as with the bye-product, bisulphate of soda, does convert a considerable amount of phosphate into a form *much more readily available* than the phosphoric acid in the untreated material.

I intend to repeat these experiments, using 1% citric acid solution for the treatment of the ignited mass.

(c) The third series of experiments in this investigation conducted by us, afford data regarding the effect of igniting finely ground phosphate with wood ashes and carbonate of potash. A mixture of wood ashes and finely ground phosphate was heated together and the mass subsequently treated with water. In the aqueous extract, phosphoric acid equivalent to 1.25% of the phosphate was found. The residue after treatment with water was left over night in a 1% solution of citric acid ; this brought into solution phosphoric acid equivalent to 3% of phosphate. As the duplicate experiment in this trial closely agreed, we must infer that simple heating with wood ashes does not appreciably improve the solubility of the phosphoric acid in the mineral phosphate.

In the next experiment sand was added to the wood ashes and ground phosphate before ignition. This method was not found to increase the percentage of available phosphoric acid over that found in the preceding experiment.

Trials were then made by fusing together carbonate of potash and finely ground phosphate. Treatment of the mass with water dissolved phosphoric acid equivalent to 6.5% of phosphate and the subjection of the residue to the action in the cold of 1% citric acid further dissolved phosphoric acid corresponding to 43.00% of phosphate.

From these experiments, I conclude that ignition with wood ashes does not materially increase the availability of the phosphoric acid in apatite, but that ignition with carbonate of potash does so very materially. If commercially any of the processes that comprise heating ground phosphate with the sulphates and bisulphates or carbonates of soda or potash are practicable, undoubtedly we should have a means of readily rendering more or less immediately available much phosphoric acid now locked up and well-nigh useless to agriculture.

I may point out that if the potash salt were used in the fusion, the resulting fertilizer would contain in addition to the available phosphoric acid, another element of almost equal importance to farm crops—viz.: potash.

SUPERPHOSPHATES.

It is scarcely necessary for me on the present occasion to do more than very briefly refer to the universally recognized importance of superphosphate as a supplier of available phosphoric acid. Its method of manufacture need not now concern us. Briefly, by means of sulphuric acid the apatite is decomposed, a phosphate of lime soluble in water and sulphate of lime being formed. It is important, however, to remember that from various causes, superphosphate is apt to revert in the soil or simply by keeping the percentage of reverted phosphoric acid reducing that of the water soluble phosphoric acid. Reverted phosphate of lime is due to the formation of a compound intermediate between insoluble tricalcic phosphate and the water soluble, monocalcic phosphate, and is produced by the action of undecomposed phosphate or by the presence of iron and alumina in the raw material or to these constituents or lime in the soil. When reversion is caused in the soil by excess of lime, the deterioration in value, from an agricultural standpoint, is not nearly as serious as when caused by iron or alumina. The value of reverted phosphoric acid is a question of great dispute. Reverted phosphate is of vastly greater value than the insoluble tricalcic, but does not appear to be quite equal to that of the water soluble (monocalcic phosphate).

Superphosphate has been found the very best source of phosphoric acid for crops whose early growth must be hastened and for those whose season of growth is not an extended one. Thus, in the case of turnips, its application may advance the growth of the crop to such an extent that the plants are able to successfully resist the ravages of the turnip fly. For cereals, and especially barley, in conjunction with nitrogenous manures, it is specially valuable. In a fertilizer for pastures, potatoes mangels and other root crops it is also a most useful ingredient.

Available phosphoric acid in the soil has the tendency to bring about early maturity of the crop. As the season of growth advances the phosphoric acid migrates, accumulating in the seed. It is thus that the soil is particularly impoverished in this constituent when the custom of growing large areas of grain and selling their products off the farm is persisted in.

With regard to the rate of application of superphosphate, no definite amount can be stated as being the most economical for all crops and all soils. As a special fertilizer for fruit trees and orchards, it must be supplemented more particularly by some form of potash in addition to nitrogen. Roots also require liberal quantities of phosphoric acid, but for cereals superphosphate gives the best return when applied with available nitrogenous manures.

With barn yard manure, 100-300 pounds of superphosphate per acre will be probably the quantity most profitable to use. For special and intense farming, 300-500 pounds per acre may be applied together with a nitrogenous or potash fertilizer, as the case may require. As plant food in different soils varies so much in amount, and as plant requirements also vary greatly, it is impossible to lay down any hard and fast lines for universal guidance. Let us remember that any excess of phosphoric acid applied, is not likely to be lost, for it is not, like nitrogen, easily leached from the soil. Further, all farm crops require phosphoric acid and there are few of our cultivated soils in the older provinces of Canada that would not have their crop yields increased by an application of phosphoric acid in an easily available form.

LOSS OF PHOSPHORIC ACID TO THE DOMINION IN EXPORTS OF AGRICULTURAL PRODUCTS.

Very briefly, and in conclusion, I purpose stating the approximate annual outgo of phosphoric acid in our agricultural exports, a loss which should be made good if the original fertility of our virgin soils is to be maintained.

By means of the statistics given in the returns of trade and navigation for the Dominion, for 1894, and knowing the percentage of phosphoric acid in the products, I have compiled the following instructive table :—

ESTIMATED TONS OF PHOSPHORIC ACID IN PRINCIPAL AGRICULTURAL EXPORTS IN 1894.

	Tons
Cattle	800
Sheep	170
Bacon and meat	230
Wheat	2,200
Barley	120
Oats	360
Peas	870
Cheese	770
Hay	1,050
Bones	1,200
	7,770

This amount to be replaced would require 51,800 tons of superphosphate containing 15% phosphoric acid.

We manufactured last year fertilizers to the value of. .	$244,469 00
And imported to the value of.....	16,978 00
Total	$261,447 00
And we exported fertilizer to the value of	31,413 00
	$230,034 00

This at a valuation of $30.00 per ton represents 7,667 tons, and if we suppose such fertilizers to contain, on an average, 10% phosphoric acid, these 7,667 tons will contain 766.7 tons of phosphoric acid. Deducting this amount from the total outgo for 1894:

7,760
767
6,993

Practeally 7,000 tons of phosphoric acid is the amount our soil was impoverished by in 1894. Truly a very significant amount. In these calculations I have not taken into account the phosphoric acid exported in our wood ashes and lumber, no small amount.

It is, therefore, evident that our Government through its officers does well to call the attention of its farmers for their own profit as well as for the welfare of the country at large to the necessity of applying more phosphate to the land. The development of the phosphate mining industry and superphosphate manufacture must therefore undoubtedly prove beneficial to our Dominion and is worthy of all encouragement.

Canada—A Natural Manufacturing Centre for Fertilizers.

By Mr. Henry Wigglesworth, New York.

Fertilizers, in the empirical sense of the term, have been used by agriculturalists as far back as any records go. The earliest writers speak of the beneficial results derived from certain substances when put on the soil, at a period when the scientific knowledge of the cause was unknown; and that improved fertility resulted from the application of certain soils or marls, was at least known in the earliest days we can read of. Manure is spoken of in the Old Testament, and was unquestionably used commonly in the earliest days.

But the true knowledge of these strange properties, the underlying principle that marks the opening of the new era of scientific agriculture was left unexplained until 1862, when Baron von Liebig in Germany, and Sir John Lawes in England, explained the laws of nourishment that govern the growth of plants.

The light thrown in 1862 is the whole basis of our modern methods in agriculture. The laws formulated at that time, stand now more clearly than ever, to guide the agriculturists in farming, and the fertilizer manufacturer in compounding the necessary nourishment to sustain fertility in the soil.

Liebig explains so well the foundation of the theory that it may be well to quote this summary of his laws:

1. "A soil can be termed fertile only when it contains all the materials requisite for the nutrition of plants in the required quantity and in the proper form.

2. "With every crop a portion of these ingredients is removed. One part of this portion is again added from the inexhaustible store of the atmosphere; another part, however, is lost forever, if not replaced by man.

3. "The fertility of the soil remains unchanged if all the ingredients of a crop are given back to the land for fertilizing.

4. "The manure produced in the course of husbandry is not sufficient to permanently maintain the fertility of a farm. It lacks the constituents which are annually exported in the shape of grain, hay, milk, and livestock."

The rapidity with which the world at large made use of this knowledge shows how fully it was appreciated, and how much it was required. It was clear, fertilizers must have a different value from manure. The one must be a mixture of a number of chemical or organic compounds which, when complete, would form a perfect plant food. The other, while possessing in a small degree fertilizing qualities, is more of a mechanical assistant which by lightening and making porous, warming and protecting the soil, would do much that a fertilizer could not do.

Manure is a bulky and heavy material at the best, more than half water, and being only a residue, does not feed the soil with those elements which the crop extracted.

A fertilizer is a complete concentrated plant food, and its only equivalent would be to return to the soil in the form of ash, all those sheep and cattle and stock that feed on the land, and all the grain which is reaped from it.

The manufacture of fertilizers dates from this period. Even now it is an industry hardly thirty years of age. In England the product is still known as artificial manure. In the Southern States the term guano is very commonly used.

Guano had been known and used largely to augment farm-yard manure before Liebig's day; but its importation became so stimulated by the more advanced knowledge of its use, that by 1872 the beds were practically exhausted.

Chemical fertilizers had been making their appearance in Great Britain and the Continent of Europe in every agricultural centre; and as guano became scarce the production of superphosphate increased. Accurate statistics cannot be quoted to show how rapidly fertilizers were made use of, but the development of our phosphate mines is a good guide.

Canada has always had some dominant spirit, pointing the way and telling of its great natural stores of wealth, and as far back as 1848 Dr. T. Sterry Hunt described the great extent of our apatite deposits; but it was 1871 before mining operations of any importance commenced in the phosphate districts.

Statistics of the output of the Canadian mines hardly come within the scope of this paper. The history of apatite mining only concerns us at present where the manufacture of fertilizers influences or throws light on the subject.

Until 1889, almost if not the whole output of Canadian apatite mines went either to Europe or the States; a plain truth painfully realized by all interested in the Buckingham mines. To the influence and exertions of the Hon. Judge Hall, of Montreal, but at that time Member of Parliament at Ottawa, representing Sherbrooke, belongs the chief credit for a new regime in the industry. He had been for years working to get some suitable and enterprising company interested in Quebec as a centre for manufacturing fertilizers. He was sure of the field, and worked as Mr. Hall, and a man of strong convictions can. It was necessary to have the aid of some chemical manufacturer. Had it been sufficient to grind the rock and mix it with other fertilizing ingredients, the task would have been more easy, but sulphuric acid to render soluble the phosphate of lime, of which apatite is composed, was required in large quantities, and that demanded a very large outlay. Some strongly capitalized concern must be found. G. H. Nichols & Co., of New York—now known as the Nichols Chemical Company—had since 1887 been supplying the entire Canadian trade with sulphuric acid from the works they had erected at Capelton, in conjunction with their mining interest there. In 1889 the Hon. Mr. Hall was successful in persuading Mr. W. H. Nichols, the president of the company, to erect and start works for dissolving the apatite, and manufacturing fertilizers generally. They agreed, at the same time, to undertake the introduction and sale of the fertilizer throughout the Dominion, a task that they were very loath to enter, and which had largely deterred them from making a start earlier.

In the spring of that year the first and only manufactory of fertilizers was inaugurated at Capelton by G. H. Nichols & Co. Fertilizers were but little known in Canada; they had been purchased in small quantities from the United States by a few farmers in the Eastern Townships. The Government of Quebec had also imported, some years previously, a car-load of guano for general distribution at cost price, but it proved almost impossible to give it away, for among the French-speaking portion of the population fertilizers were absolutely unheard of.

The difficulty of introducing anything so new can therefore be imagined. The Government in the face of their guano experience and losses sustained at that time, felt indisposed to do anything and did nothing. Only the natural centre and the rich endowments of nature for establishing such a business made it possible. "The means that Heaven yields must be embraced and not neglected." The Hon. Mr. Hall felt this, and rendered great personal aid at all times.

The lower grades of apatite lay around the mine useless and unsaleable. The possibility of marketing this 60 per cent. phosphate induced the mining company to offer it at a very low figure. The railroads also saw a great future in transporting this material, and made low freight rates. Sulphuric acid was manufactured on a large scale from the pyrites ore mined at Capelton, and was produced at a low cost. With cheap apatite, cheap sulphuric acid, cheap labor, and low transportation rates, superphosphates could be manufactured and sold at low cost to the farmer, and they were. From the very outset in 1889 superphosphate analyzing from 8 to 10 per cent. of available phosphoric acid, which is equal to twenty to twenty-five per cent. of soluble phosphate of lime, was turned out and sold from the Capelton works at almost half the price 15 to 20 years of American competition had forced it to in the States. There the price was, and is now, little less than $20 a ton. The "Capelton" grade was offered at $10 per ton.

Agents were established in every centre of importance; pamphlets, circulars and letters were distributed in French and English to suit the districts as required. Salesmen familiar with the country and good linguists traversed every likely centre, from Windsor, Ontario, to Halifax, N. S. The subject was made interesting to everyone, and there was no excuse for not hearing of the great benefits derived from the use of a reasonable quantity of fertilizers. The most stubborn opposition could not have forced down the production and growth of fertilizers in Canada. The natural centre made itself felt. Farmers knew they were benefited by it. Metaphorically speaking the cheap raw material for their manufacturing was a boon to be quickly invested in.

The first year's sales were sufficiently encouraging so that in 1890 there was built and established a large factory sufficient, as was supposed, to satisfy the demand for some years. In the following year, however, it became necessary to double one department of the works.

From this time the home consumption of apatite entered into the statistics of the output of the Canadian mines. A desirable condition of things, for you can hardly expect to satisfy foreign buyers with what there is no faith in at home. In five years, from 1889 to 1894, the sale of fertilizers has increased ten fold. The larger part of this tonnage distributed itself over Quebec where the lands were more exhausted than in Ontario, but a large amount was shipped to Ontario, New Brunswick, Nova Scotia and Prince Edward's Island. The Nichols Chemical Co. now have a capacity at Capelton of about 30,000 tons complete fertilizers per annum, but if the demand warranted, it could dissolve 150 tons of ground rock per day.

Dissolving apatite is important and bears largely upon the question of the future of this rock's position in the markets of the world. At one time it was hoped grinding would be sufficient to render available its nourishing elements; but years of experiments have made certain, that results are too slow to satisfy immediate wants in infertile soils.

A ground phosphate rock is to all practical purposes useless as a fertilizer. The tricalcic phosphate which represents from 60% in low grades to 80% in high grades, must be decomposed by sulphuric acid into the soluble or mono-calcic phosphate of lime. Then the phosphoric acid which Mr. Shutt has spoken of in such a convincing way will become available. Rendering soluble the phosphate of lime is the most expensive as well as the most troublesome part in manufacturing. It helps none that Charleston and other nodular phosphates can easily be dissolved, apatite is of entirely different origin. It belongs to the oldest geological period, it is altogether harder to crush, more troublesome to grind more difficult to dissolve, than any nodular phosphate known or used. It is this that has given apatite the name it has, among consumers; for it is only too widely known among manufacturers.

At first each factory supposed in their case with superior knowledge and more modern plant, better success would be met with; but the best that can be done leaves it a more expensive raw material to work with than other competitive phosphates.

This is really a very serious obstacle confronting the miner of apatite, but on the other hand, he has a very much higher grade of phosphate rock to work upon. It is necessary for him, however, to use every modern contrivance and device to mine and cobb, and prepare the rock for the market in the most economical way possible. The expensive transportation between Buckingham and Montreal must also be reduced to a minimum.

Apatite can be used by the manufacturer, and used economically; indeed, did we not understand the nature of apatite, and had it defied our attempts to dissolve it, the method must soon be learned, but the South Carolina beds which are at present furnishing the larger portion of the world's supply are estimated to last only about 20 years.

The Nichols Chemical Co. have never yet, in their Canadian works, used one ton of anything but apatite mined in the Buckingham district. They would use it in their works in the States, if it could be purchased at a relatively low figure. They have analysis to show that apatite can be dissolved with a residue of one per cent. of insoluble phosphoric acid, a result quite equal to any work done in Charleston or any American phosphate rocks. Their regular work averages between one and two per cent. insoluble phosphoric acid, and such a low per centage left undissolved is considered satisfactory work by those who use the softer and more tractable Carolina phosphates. No one will find fault with apatite who obtains these results. It can be done, without doubt, but as stated, costs more in every stage. For this reason, those interested in the apatite mined must devise means to sell at a lower figure per unit than softer rocks fetch. It is reasonable to expect this with the knowledge that the manufacturer entails more expense by using it. At a lower price per unit apatite would be a more attractive phosphate than the softer rocks, for its high grade would attract, and be an incentive to attain economical results.

Last year the Buckinghan mines produced less than any year since operations were thoroughly established there. The output was less than half the tonnage of 1884—ten years previously. It is a serious state of affairs and requires us to look it

in the face. In South Carolina, with a lower grade, but softer rock, the output keeps increasing steadily. There has not been time to ascertain the total tonnage, but 750,000 tons would be a fair estimate for 1894. This would be sufficient to make two millions of tons of complete fertilizer. A million tons, at any rate, are sold in the States. Canada's consumption of fertilizers bears no comparison whatever with this. When it does we shall turn out from the Buckingham district from 300,000 to 400,000 tons per annum. Do the parliaments of Quebec and Ontario, as well as Nova Scotia, New Brunswick and Prince Edward Island realize what this means? The western Provinces are hardly concerned yet.

The progress of the world depends upon the food supply of the world. The food supply must be proportional to the fertility of the soil. While we come into the world with nothing, and can take nothing out from it, we live on our grand-fathers. Every one of us consume and expend the stores nature has taken ages to accumulate, and in Canada we look on, doing nothing, while nature's stores are being steadily drained, our farming land fast becoming barren, and the average crop of all produce generally decreasing.

Throughout Ontario, there is an intelligent and level-headed class of farmers. The well tilled soil and clean farms bear evidence of the higher standard sought after, and yet Ontario (Canada's garden) produces an average yield of wheat less than half what it is possible to raise with the intelligent application of fertilizers. Sir John Lawes, on his experimental farm at Rothamstead, Eng., has grown wheat for thirty-eight years running without rotation, but with the use of fertilizers, and the average yield over the entire period of thirty-eight years is 36½ bushels of wheat weighing 59½ pounds to the bushel. Ontario's average yield is 17½ bushels per acre. Sir John Lawes, in the 46th year of his experiments, continuing this cropping without rotation and using fertilizers without barn manure of any sort, reports a yield of 35½ bushels of wheat, weighing 59¼ pounds per bushel. In other crops it proves the same way. The average yield in Canada where we have statistics to make comparison, makes a very bad showing alongside the average crops produced in Great Britain generally, and in Germany where high class farming has now become general.

"It is a condition, and not a theory that confronts us," and well deserves the consideration of this association. Are not we competing with Russia, India, Australia and the United States to supply the old world with grain, cattle, horses, butter, cheese, and farming produce of every sort? How can we hold our own unless the fertility of the soil is sustained. Progress, not retrogression, must be our watch-word. It is not only that the crops are decreasing, but the standard of quality cannot be kept up. The weight per bushel, and the nourishing qualities in the grain can easily be detected by any farmer where the grain has been grown on a barren or in unfertile soil. Sunshine is not enough; nourishment is absolutely essential to a growing crop. Our ability to supply the world must be made known by increased average yield and improved quality. There is every natural condition to assist. Railroad and shipping facilities can certainly not be complained of. We have also got the most marvellously rich deposits of phosphate that have ever been discovered, to manufacture fertilizers, and improve the quality of our farm lands. These phosphates are practically unlimited. Those who have studied their occurrence most carefully see no possibility of exhausting them. If all the population of Canada were employed there, mining for years, the extent of the deposits would not be laid bare.

Nitrogen of Ammonia, another of the essential ingredients is also at hand in abundance. The destructive distillation of the coal mine in Nova Scotia for the production of gas will yield enough ammonia for an indefinite time. Sulphate of ammonia is now manufactured from the waste liquors of the Montreal Works, but some of the liquors are exported to the States where they are more willing to pay for them than we are.

Tankage azotine, dried blood and other nitrogenous materials that are excellant basis for assisting the fertilizer manufacturer—all products of the abbatoirs—are made quite extensively in Canada, but are exported to the States, as there is no home market.

Salts of potash alone, of all the necessary ingredients for sustaining plant life remain undiscovered in Canada. It happens that our soils are still rich in this element because there has been so much timber burned while clearing the land. Kainit, or some of the other salts of potash may be discovered before the supply is exhausted. Meanwhile, we are no worse off than our neighbors who have to import it in large quantities from Germany.

It must be evident that Canada has singular natural endowments to carry on the fertilizer business. That there has been great progress in the last few years is plain but we are still far from the high standard European farming has long ago attained. We ought to consume one thousand times the quantity of fertilizers at present sold throughout the Eastern provinces; and then the phosphate industry of Buckingham will be in the thriving and progressive state it ought to be in now.

The Government of Japan found it necessary to come to the front in assisting the introduction of fertilizers. Mr. Earle C. Bacon, one of the members of the Association, and a familiar face to the most of us, designed for the Japan Government an extensive fertilizer factory, which is now said to be in operation. Every nation has probably, in one way or another, subsidized agricultural investigation, and what would tend to advance scientific methods of farming. There is great need of assistance in Canada if we are to continue furnishing food supplies to the old world.

Canadian Phosphate and Fertilizers—Home Manufacture and Home Market.

By Mr. J. Burley Smith, M.E., Glen Almond, Que.

Canada, possessing inexhaustible deposits of the richest known phosphate of lime, with all the necessary materials for manufacturing superphosphate at home, has, for many years, merely exported this invaluable mineral, to the deprivation of her own agriculture, and to aid in glutting the overstocked markets of the world. And to-day all the phosphate mines of Canada are shut down, and an industry, which, under proper conditions, might have been not only a flourishing mining but also an enormous manufacturing business, employing thousands of men in its various branches, has been allowed to die a natural death; and the phosphate mining districts, where, for many years, thirty to forty thousand dollars of foreign capital were spent every month in hard cash, have now to reproach, not the foreign manufacturers, who can buy their raw material cheaper nearer home, but Canada herself and her capitalists, who have not only not invested capital in the working of her phosphate mines, but have failed to see that the possession of such a mineral was the nucleus of a mighty manufacturing industry, not only for home consumption and the benefit of home agriculture, but for export to foreign countries as a manufactured fertilizer.

Without doubt Canada could at the present time with her wonderful resources, manufacture superphosphate so cheaply as to compete with any manufacturing centre abroad, but the beginning should be for home consumption, and in this direction a demand is certain to spring up.

Once show our farmers that by spending a small sum in artificial fertilizers they can increase the yield of their farm produce many times in excess of the sum so spent, and they will not fail to avail themselves of this knowledge, and the home demand will follow as a natural result.

The province of Quebec could alone, with advantage, use the superphosphate manufactured from all the phosphate of lime raised in Canada, taking the best figures of annual production, viz: 27,000 to 30,000 tons per annum.

In travelling through many of the older settled parts of Ontario and Quebec, more especially the latter, one is struck with the great irregularity of crops, one half a plot often being rich and the other half poor, and only too frequently no crop worth speaking of at all. There is no denying the fact that the Canadian farmer, generally, has either not yet felt the want of, or has not yet been educated into the use of artificial fertilizers; and the general neglect to use even the farm-yard manure which appears to be considered more often as an impediment on his farm than a recuperative agent, shows that he is not familiar with the principles of reproductive economy in agriculture, a fact which is further emphasized by the small proportion of produce raised compared to the enormous area of land occupied.

The system of farming has been, and is now, to take out all that can be got, sell everything for cash and move away.

Mr. G. H. Turner, of Burgess, Miss., says in one of the numbers of the *American Fertiliser*:—

"The soils of America have been wantonly despoiled of their virgin freshness, and robbed of their exuberant fertility, by the old 'three-shift' or chop-down, wear-out and move-away system; the soil tillers selling everything available off the land and putting nothing back; moving westward (as fast as they had got what they considered the 'cream' of the soil) until there was no longer a 'west' to go to; and in their migrations westward, they oftentimes left behind them all that made life worth the living—friends, society, good and convenient markets, good roads, and oftentimes wood and water—for what? For the sake of cultivating for a few more short years, virgin soil; and to postpone the evil moment as long as possible of paying the altogether too long deferred debt that they owed to Dame Nature, in the way of returning to the soil a modicum of that fertility (in the shape of manure and chemical fertilizers) that had so ruthlessly been removed from the soil by the various crops grown thereon, but sold as cash crops off the farm. The era of chemical fertilizers is here; there is no dodging the question nor disputing the facts in the case; it is here, and it is here to stay."

The same may be said of much of Canadian North America. The constant exodus of her sons shows that the old homesteads are not prolific enough, under present conditions, to do more than support the old folks, and that though the acreage is large enough to employ the additional labour, the elements of fertility are wanting. The phosphoric acid has been taken out from the land and none returned to it.

The avidity with which Canadian farmers are learning all that can be taught them in the making of cream, cheese, and butter, shows that both eyes and ears are open; and that their world-famed reputation in this direction has not been without its encouraging effect; and they are ready for fresh knowledge.

"The era of chemical fertilizers is here" and let us hope "it is here to stay." The splendid Government Experimental Farm at Ottawa is an open book for all to read, but that is not enough. The knowledge obtained by intelligent chemical experts there must be proclaimed from the house tops and from the street corners.

The good work of Prof. Robertson in lecturing on milk, cream, butter and cheese, etc., must be followed up by lectures on fertilizers, How, and in what quantity they should be used, their cost, and the kind best adapted to the different natures of soils and crops, with full information as to how they can be purchased.

Thus demonstrating how the land can be induced economically to yield more and still continue fertile.

Lectures must be given at the frequent meetings of the various local agricultural societies. Practical instruction in simple style must be sown broadcast, and an intelligent and appreciative people will quickly mark, learn, and inwardly digest the facts laid before them. The result will be a demand for fertilizers, improved and more regular crops, and the consequent well-being of our farmers.

A new home manufacture will be developed, a dormant mining industry will again flourish with increased vigour, great numbers of miners and laborers will find regular employment, and this time the industry will come to stay.

Situated on or near the banks of river du Lievre, which runs through Buckingham and the neighbouring townships, are the well known phosphate mines, now unfortunately idle, The Emerald, The British Phosphate Co., The Little Rapids, The North Star, The High Rock, Glasgow, The French Phosphate Co., Union, etc., to say nothing of the enormous areas of unworked phosphate lands on both sides of the river. And the river itself, formerly alive with steamboat, tug and scow, freighted with rich cargoes of mineral, is now silent and deserted save for a daily passenger steamer.

Three miles from the mouth of the river du Lievre stands the picturesque town of Buckingham notable for its magnificent water power, a portion only of which is utilized to drive the great lumber mills of Messrs. J. MacLaren and Ross Brothers, leaving a splendid surplus for other manufacturing trades, which must, sooner or later, make this promising town hum with the busy whirr of machinery.

The Buckingham branch of the Canadian Pacific Railway passes through the town and has its depot on the wharves of the river du Lievre, a little above the falls, where, a year or two ago, the phosphate mined up river was brought down by boat, loaded into cars, and conveyed to Montreal by rail, and thence shipped for use in the fertilizer manufactories of Great Britain, Germany and elsewhere, whose manufactured product in the shape of superphosphate found its way back occasionally even to Canada and the United States.

By a happy combination of circumstances and the ability to recognize and use them many a man has amassed an enormous fortune.

Observe the happy combination of circumstances here.

Buckingham town possesses abundant water-power which is available for grinding, pulverizing, and separating the phosphate ore and working the machinery of a manufactory generally, and the town is situated at the junction of the Canadian Pacific Ry. with the river down which the mineral is brought from the mines.

The two most important elements in the manufacture of superphosphate are phosphate and sulphuric acid. It is known that we have abundance of phosphate and the sulphuric acid could either be made on the spot or purchased elsewhere very cheaply. For a long time brimstone was the raw material almost exclusively used for producing sulphuric acid and was imported chiefly from Sicily, but it is now known that pyrites, or the sulphide of iron, is equally good and much cheaper where chemically pure acid is not required.

It is also well known to those who have searched for and mined phosphate that pyrites is exceedingly abundant in a phosphate distrct and if sought after as a mineral to mine instead of, as hitherto, to avoid, except as an indiction of other minerals, no doubt it could be obtained in very large quantities indeed. Some time ago a boring test in a phosphate mine passed through a deposit of iron pyrites fifteen feet thick, which, being of no value then was simply left and avoided. But supposing this were not taken into consideration; sulphuric acid is manufactured already at Capelton and could be delivered at Buckingham as cheaply as at superphosphate works anywhere.

The cost alone in freight of shipping phosphate to the superphosphate manufacturers of Great Britain and Germany averages not less than five to six dollars per ton; the cost of freighting the phosphate down the river du Lievre to a factory at Buckingham would certainly not exceed all round seventy-five cents to a dollar a ton.

To lessen the heavy freight charges to Europe manufacturers stipulate for the highest grade of phosphate viz: 80 to 85% first grade, and not less than 70% for second grade, in order that all extraneous matter, such as pyroxene, feldspar, waste mica, pyrites, etc. should be eliminated before leaving the mine.

To achieve this involves a very expensive system of mining; in the first place great care must be observed in blasting the mineral so as to keep it separate from the associated rock, then the crude mineral has to be sorted, screened, picked, and again sorted by a great number of men and boys, and it is only by using the greatest care that the maximum of each grade can be reached; too often at a cost which has precluded any chance of profit to a mine owner.

Owing to the almost uniform specific gravity of the associated minerals, with the exception of pyrites, no perfect mechanical method has yet superseded hand separation, which has probably cost more than the actual mining or winning of the mineral.

But from various experiments made by the writer he is confident that this can be accomplished successfully when once the experience of specialist machine makers has been brought to bear on the subject, and providing that the cost of operating the machinery be minimised by the economical use of water power; the item of steam machinery being a very serious one at each mine.

Although the difference in specific gravity is so slight as to render sedimentary separation difficult, still there is a difference which makes the process, though slow, not impossible, and the various atoms have peculiarities in shape and moving tendency which taken advantage of by special machinists cannot fail to result eventually in a perfect automatic method of separation.

If a manufactory were established at Buckingham—than which no more suitable locality could be found—nearly all the required separation would be made at the manufactory there, as the cost of freight from the mines being so slight would not preclude the carrying of a certain amount of extraneous matter, thus affecting an important economy, both in mining and manufacturing, at the very beginning.

Not only could the Canadian raw material be delivered at the manufactory here at from five to six dollars per ton cheaper than it could to European manufacturers (because of the freight and handling charges which now exclude it from those markets) but a lower grade mineral would be sufficient, therefore the aggregate yield from each mine would be proportionately greater and cost less, as there would be little or no waste and a great economy would be effected in the winning and handling.

The works at Buckingham being situated close to the Canadian Pacific Railway, the finished fertilizers could be distributed to consumers at rates which must defy the competition of any imported article.

The town of Buckingham, alive to the advantages of having such an important manufactory established in her midst, and a revival of the great phosphate mining industry, which contributed so much to her rise and prosperity in the past, will doubtless come forward with the offer of an adequate bonus or help in some shape or other to accomplish such a desirable consummation.

It may be confidently expected also that the Government, ever ready to aid Canadian agriculture and foster her infant manufactures, will take measures to encourage and assist this two-fold industry, which is assuredly of national importance.

MR. R. W. PRITTIE—I feel repaid by Mr. Shutt's able paper for having come all the way from Toronto to attend this meeting. When I was in England some thirteen years ago. an old gentleman showed me a grape-vine from which he sold £200 worth of grapes every year. He told me he was feeding it with "something from Canada," and I have little doubt he was using Canadian superphosphate. A gentleman at Richmond Hill was telling me the other day that he uses Canadian superphosphate on his fruit-farm of sixteen acres, and he always has a good crop and can sell his berries and small fruits for a cent a box more than his neighbors. I think it is the duty of the government to do more effective work in the future in developing the phosphate industry than they have done in the past, and when I go home I shall write to the Minister of Agriculture and give him my view of what I have heard to-night.

HON. MR. FLYNN—In what shape is phosphate utilized in other countries? Have they ever tried it in the ground form?

MR. SHUTT—The finely ground phosphate has practically no market. What has come in of late years is Thomas slag, a by-product in the manufacture of Bessemer steel. Great heaps of this accumulated at iron-works, and it was found to contain phosphoric acid in a form which was partially available for plants, and so it has been largely made use of on the continent of Europe. It seems to stand intermediate between finely ground phosphate and superphosphate. It is to a certain extent available, but not so much so as phosphoric acid. England uses superphosphate more particularly, while Germany uses a great deal of Thomas slag and phosphate, which comes from Algiers and other countries.

So long as money is lying in the bank not gaining interest, it is of no value to anybody, and just so with plant food in the soil. It is only when it is bearing interest that it is of value, and we may look upon crops as the interest. The whole science of farming may be summed up as being the conversion of mineral constituents into vegetable products, which are afterwards food for man and beast. The more rapidly we can accomplish this the more quickly do we get returns upon our capital.

With regard to any action which may be taken by this convention as to urging any mode of action upon the government, I think it is well to begin at the beginning. In my opinion the first duty of the government is to do the teaching. Let them by means of pamphlets, lectures, etc., issue such instruction as to the uses and value of superphosphate as the people are in a position to intelligently put into practice. Let them show the farming community that it will be to their advantage to use superphosphate as a fertilizer, and the effect upon the phosphate industry would soon be very marked.

MR. J. BURLEY SMITH—Mr. Shutt has shown us that an enormous quantity of phosphoric acid is every year being exported from the country in the form of agricultural products, and it is therefore evident that the necessity of returning phosphoric acid to the ground here is far more imperative than in Europe, whence it is not exported to anything like the same extent. Where the products of the farm are fed upon it, and the phosphoric acid is returned to the land in the manure, the loss is not so great; but where the products are constantly exported the drain is very severe. With regard to the question of using raw phosphate, I think we may rely upon the agricultural chemists, who have practically settled the point for us. They have gone exhaustively into the matter, and have proved that treated phosphate is the best form of fertilizer. I quite agree with Mr. Shutt as to the educational aspect of the question. From several inquiries I have myself lately received from people in my own neighborhood, I am of the opinion that the farmers really want information. If this whole matter were put in some easily understood form and placed in the farmers' hands, I believe they would be found willing to apply the information thus received. This would create a home demand, which would establish the industry with but little assistance from the government. The facilities for manufacturing superphosphate here are very great, and it has always appeared very curious to me that we should send our raw material several thousands of miles away to be manufactured, and then import back some of the finished product by way of the United States.

With regard to some of the statements made in Mr. Wigglesworth's paper, I think the sulphuric acid should be brought to the phosphate, not the phosphate to the sulphuric acid. It appears to me that Buckingham is the place where the manufacture of superphosphate should be started, and if this were done the cost of production would be reduced. The mineral must be ground very fine and separated by mechanical means to remove everything that is not phosphate, so that freight may not be paid upon it. At Buckingham there is abundance of water-power, and a good deal of the separation that is done at the mines might be done more cheaply there. The cost of floating the mineral down the river to the place of treatment would be very small. In every case, except that of Capelton, the sulphuric acid is brought to the seat of manufacture of the superphosphate fertilizer. In London, England, the bulk of the sulphuric acid comes from Spain. The phosphate would certainly not bear the cost of taking it to Spain to be treated. It seems to me self-evident that the manufacture should be done where we obtain the mineral.

MR. A. W. STEVENSON—The commercial aspect of the question is in danger of being lost sight of. The poor farmer in Manitoba, for instance, who cannot get more than ten or fifteen bushels of wheat per acre, realizes a return of from $6 to $9 per acre; how much can he spare out of this amount to buy fertilizers? He is very badly handicapped besides, having to send his product to market in England, and having to pay freight on the fertilizer from Quebec.

MR. SHUTT—Canada cannot compete in wheat growing with some of the countries in South America. The salvation of Manitoba is the dairy industry. The unskilled labor of South America enables them to produce wheat cheaply, but our labor is expensive, and we must put it into a channel where it will yield us a profit. The people of Manitoba are beginning to see this, and they are going largely into the dairying industry now. Besides, their soil is not in the same condition as the soil in the older provinces of Ontario and Quebec. It contains a larger percentage of phosphoric acid, and it will be some years before there will be any great necessity for fertilizers there.

MR. JAS. KING, M.P.P., for Megantic—I profess to be more of a miner than a farmer, and join with the chairman in regretting that circumstances would not allow the Minister of Agriculture to be present, as I am sure that he would have taken a great interest in the papers that have been read. It is part of the policy of the Department of Agriculture to have gentlemen going about the country giving lectures on agriculture, and I think for the furtherance of the apatite industry it would be important to have among them men with personal experience in the use of superphosphate. it would have a great effect on their agricultural audiences. As a rule, an agricultural audience has a great horror of theory, but if you could bring forward a man who has made use of superphosphate or fertilizer of any kind, and who is able to say it has been of great use to him, you could carry conviction to the mind of agricultural hearers on that point. I said I was not a farmer, but we happen to have a home-farm on which we have had occasion to use superphosphate from Sherbrooke. Our farmer, who is a conservative man and does not like new notions, is willing to admit that he considered this superphosphate much cheaper than any manure he could get in the neighborhood, and he was in a position to get manure from farmers and others in the vicinity at a very low cost. He said he found a very marked improvement as a result of using the fertilizer, in comparison with the effect produced by ordinary barn-yard manure. Evidence of this sort I consider valuable. I am quite sure that if the government could make it clear to the farmer that he could put $10 or $20 a year into these fertilizers with advantage, the consumption of them would largely increase. Speaking generally, I may say that within the last four or five years, farmers have taken heart in this province. Their returns from creameries, etc., have enabled them to look much more favorably on a farmer's lot than they had been able previously to do. (Applause.) I think they are now encouraged to take up modern methods of increasing the yield of their farms.

I regret the unavoidable absence of our old friend, the Hon. Mr. Irvine. We all understand the reason, but we know that his heart is with us, and that the Association has always had his support. At the same time, with the Commissioner of Crown Lands in the chair, the Mining Association of Quebec is in its natural position with reference to the government. It is fitting that the gentleman charged with the administration of the mining resources of this Province should frequently meet and come into conference with the men who actually do the mining. Speaking for myself and the miners generally, I feel that the official head of the mining department has been most anxious to work with us in every way within his power. (Hear, hear). This fact has given great support to the feeling of security with which mining is carried on in this Province under the government regulations. (Applause).

MR. G. Y. CHOWN—I beg to suggest that the convention memorialize the governments of Ontario, Quebec and the Dominion to disseminate amongst the farmers information dealing with the nitrogenous, potash and phosphoric elements in manure.

MR THOMAS W. GIBSON—The papers which have been read have been very interesting and valuable, in particular that of Mr. Shutt, who has given us a comprehensive and lucid survey of the whole field. If I might add a word, it would be that, in applying fertilizers it is necessary to consider (1) the necessities of the soil and (2) the requirements of the crops to be grown. A fertilizer which would be of great use on one soil might not be suitable to another. For instance the application of superphosphate to a soil already containing an excess of lime might be of little benefit, while such a soil might be in great need of manure containing nitrogen or potash. Certain crops require generous supplies of phosphoric acid, and for these superphosphate is an ideal fertilizer; others must have more of nitrogen or potash, and hence arises the necessity for choosing the fertilizer with the view of furnishing as nearly as possible the element or elements of nutrition required. We in Canada are for several reasons much behind European countries in the use of artificial manures, and there can be little doubt that it would be of great benefit to the agricultural industry if their employment could be extended. No doubt the Provincial and Federal governments can do something to this end, and by means of researches at the Dominion and Ontario experimental farms, something has already been done. The most feasible method of governmental assistance would seem to be by supplying information to farmers on the proper use of fertilizers and the benefits to be derived from them. I am inclined to doubt the wisdom of giving anything by way of a bonus to manufacturers, and this would be unnecessary if a market could be created for their product. The way to create a market for superphosphate is to convince the farmers that it would pay them to use it. Let reports and papers such as that read by Prof. Shutt be printed in handy form, not buried in the obscurity of a blue book among other papers on entirely different subjects, and let these be generously distributed among the farmers. This seems to me the best possible way of extending the market for superphosphate.

MR. B. T. A. BELL moved that a vote of thanks be heartily accorded to Mr. Wigglesworth and Prof. Shutt, who were not members of the Association, for the excellent papers they had furnished.—Carried unanimously.

HON. MR. FLYNN—The thanks of the meeting are certainly due to the gentlemen who have read the papers here to-night. Mr. Dean has given us an admirable account of the development of electricity as applied to mining, a subject which I have no doubt is bound to come to the front in a very short time. The papers read on the phosphate question dealt with the subject from various standpoints. They were all excellent, but I think I only express the sentiments of all present when I congratulate

Prof. Shutt in particular upon the able and complete manner in which he has presented the question. (Hear, hear.) I agree that the best way to popularize the idea of using fertilizers is to educate the people up to the point of appreciating their value, and it occurred to me while listening to Prof. Shutt's paper that it would be of great advantage to the farming community if it were published in pamphlet form and distributed as widely as possible. Speaking as the Commissioner of Crown Lands and as a member of the Government of Quebec, I am convinced that the question of extending the phosphate industry is now ripe for government encouragement. It must be admitted that our lands are in need of fertilizing, and the moment you can show to the governments of the Provinces and the Dominion that superphosphates is an excellent fertilizer, that moment it becomes the duty of the several governments to encourage those who are prepared to work the phosphate mines and convert the output into fertilizers. To do this is only in harmony with the policy of these governments, and so far as the Government of Quebec is concerned, I feel that all that is required is to bring the matter to the notice of the Minister of Agriculture, and I believe a most favorable response will be experienced. (Applause.) The Dominion Government has larger means at its command, and with the Experimental Farm has a larger field to work in, and why should the Dominion and the Provinces not have one policy in this matter? Why should they not work together to establish the industry and to create a home market, which, when created, would cause the business to be self-sustaining, and do away with the necessity of any further encouragement? Mr. Gibson has said that he was not inclined to view with favor the proposal to grant a bonus to the manufacturer. Well, it is a question for consideration how the industry should be encouraged. Would it pay at the present time to manufacture superphosphate? Until you get the people of the different Provinces to accept this fertilizer and the industry becomes self-sustaining, should there not be some helping hand? We are acting on this principle every day. In Quebec lately we granted a bonus of one cent per pound on butter in order to place it on the English market, and we also give aid to the beet sugar industry. I admit that action of this kind belongs specially to the sphere of the Dominion Government, and I am expressing my own personal opinion, not necessarily that of the Quebec Government, when I say that I believe the moment is now opportune to move in the direction indicated with regard to the phosphate industry. (Applause.) The governments of the Dominion and the several Provinces cannot do better than apply a portion of their money in this useful manner. I feel that I would be doing a good thing if by such a policy I could cause the mines in the Ottawa region now lying dormant to be worked, and in such a case I can tell you I do not anticipate any trouble as regards the question of royalty. (Laughter.) I read the other day that in South Carolina, whence phosphate is exported in considerable quantity, they have had some trouble about royalty. Now, there is no royalty in the Province of Quebec, and I think I can promise you that there will be none in the future. (Cheers.) The development of the phosphate industry would enhance the value of the phosphate lands still belonging to the Crown, and in this way I would be enabled to add to the revenue derivable from this part of the public domain. I may without indiscretion tell you that in my next report I shall have the pleasure of showing an increased income from mines in spite of the general stagnation throughout the Province and country. Mr. Wigglesworth in his paper treated the subject from the manufacturer's point of view. It seems to me that what Mr. Smith has said commends itself to every unbiassed mind. Why should not the phosphate be converted into superphosphate at the place where it is extracted from the ground? Why should not the lighter article be carried to the heavier, rather than the heavier to the lighter? Gentlemen, I believe that with an enlightened public opinion on the one hand which would welcome superphosphates as a fertilizer, and proper governmental assistance on the other, there is a great industry to be established which would redound to the benefit of the country as a whole. We have met here to promote the welfare of our common country, and if this should be the outcome of our efforts we shall have achieved a worthy end. (Loud applause.)

The meeting then adjourned *sine die*.

Silver Mining in B. C.

The following is excerpted from the Gold Commissioner's annual report for the West Kootenay district B. C.

Blue Bell.—Situated on Carpenter Creek. On this claim development work consists of 1800 feet of tunnelling and 200 feet of drifts. Shipments have been made from this property amounting to 240 tons, and there are 70 tons of ore now on the dump. The average assay is 137 oz. silver and 75 per cent. lead.

Cumberland.—In the Idaho Basin, has 400 feet of tunnelling on it, and gives employment for six men. The ore is of a high grade, and there are about 55 tons on the dump awaiting shipment.

Mountain Chief.—This claim, situated on the Payne Mountain, has shipped 100 tons of ore, averaging 214 oz. silver and 71½ per cent. lead, and has 75 tons of the same quality on the dump. Eleven men are employed on this property. The development work consists of 300 feet of tunnelling.

Slocan Star.—This mine, which is one of the most promising in the sub-division, is situated on Sandon Creek. The shipments this year amount to 840 tons. On the dump awaiting shipment are 300 tons more, besides 5,000 tons of concentrating ore, which will be handled as soon as the Company erect their concentrator. The ore averages 160 oz. silver and 70 per cent lead. Seventeen men are steadily employed, and the development work consists of 1,180 feet of tunnels, and 180 feet of a shaft

Idaho. This claim, situated in the Idaho Basin, bids fair to be a very valuable property, not only on account of the rich value of the ore, but on account of the immense bodies found. On this claim 1,300 feet of tunnells have been run, and 100 feet of shafting. Thirty-five men are employed. Two hundred and seventy-five tons of ore have been shipped, and there are on the dump awaiting shipment 270 tons of high grade ore and 4,000 tons of concentrating, which will be shipped to the concentrator at Howsen Creek as soon as it is finished. The average of the ore is 185 oz. silver and 68 per cent. lead.

Alamo. This mine is situated in the Twin Lake Basin. On this claim the development work consists of 675 feet of tunnells and 160 feet of shafts. The average of the ore is 200 oz. silver and 60 per cent. lead. Forty tons have been shipped, and on the dump there are 40 tons of high grade ore and 800 tons of concentrates. Twenty-five men are employed on this property.

Deadman.—This claim adjoins the Noble Five Group, and gives employment to six men. The ore averages 150 oz. silver and 50 per cent. lead. No ore has been shipped from this claim. About 250 feet of tunnels have been run as development work.

Washington.—This claim is situated in McGuigan Basin, but has not been working for the last three or four months. Fifteen hundred tons of ore have been shipped from the claim, averaging 140 oz. silver and 60 per cent. lead. Over 1,000 feet of tunnelling and shaft work have been driven on this mine.

Rucau. This claim is situated near the Noble Five, and employs 12 men. The development work consists of 630 feet of tunnels and 125 feet of a shaft. Eighty tons of ore have been shipped, showing a return of 176 oz. silver and 76 per cent. lead.

Noonday.—On Cody Creek, has shipped 20 tons ore, but the grade is lower at present than those claims mentioned above, averaging 75 oz. silver and 70 per cent. lead.

Wonderful.—On this claim 680 feet of development work have been done, but no ore has been shipped. Twenty-two men are employed. About 1,400 tons are, however, on the dump, consisting of shipable and concentrating ore.

Omega.—This claim is situated on the Noble Five Hill, and employs 10 men. The development work consists of 300 feet of tunnels and shafts.

Noble Five Group.—On this group of claims 1,700 feet of development work have been run, and 600 tons have been shipped. Twenty-two men are employed. The value of the ore is 150 oz. silver and 70 per cent. lead.

Mountain Chief No. 2.—This mine is situated between New Denver and Three Forks, and employs 10 men. The value of the ore is 170 oz. silver and 75 per cent. lead. Six hundred and sixty tons have been shipped, and there are over 2,000 tons of concentrating ore on the dump.

Alpha.—This claim overlooks Silverton and Slocan Lake. The development work consists of 500 feet of tunnels. Eight hundred tons of ore have been shipped, averaging 120 oz. silver and 64 per cent. lead. The mine employs 24 men.

Fisher Maiden.—Situated near the head of Four-Mile Creek, has development work consisting of 400 feet of tunnels. Ten men are employed. Fifty tons of ore have been shipped, averaging 230 oz. silver and 10 per cent. lead.

Read and Robertson Group.—Situated six miles east of Slocan Lake, is not at present being worked. The development work consists of 600 feet of tunnels. The ore averages 120 oz. silver and 75 per cent. lead.

Thompson Group.—This set of claims is situated on the head-waters of Four-Mile Creek. Five men are developing the property, which has a strong ledge traceable for 1¼ miles. The character of the ore is the same as the Fisher Maiden, and as depth is gained the galena disappears, leaving a high grade dry ore.

On 8-Mile and 10-Mile Creeks numerous discoveries were made this summer. The Kalispell, on 10-Mile Creek, located in August, is the most promising. The locators are at work, and have 7 tons of ore, averaging between 400 and 500 oz per ton. This is a very large ledge, and is situated close to Slocan Lake.

The Enterprise, on 8-Mile Creek, has a large showing, the ore averaging 250 oz. to the ton The ledge has been stripped in twenty different places, and each shows no less than two feet of galena ore.

Vancouver Group.—Situated 4 miles up 4-Mile Creek, employs 4 men. Fifteen tons have been shipped, averaging 233 oz. silver and 60 per cent. lead. The development work consists of 600 feet of tunnels and shafts.

A concentrator, with a capacity of 100 tons per day, is being erected at the junction of Howsen and Carpenter Creeks, and the machinery for same is now on the way in *via* the Nakusp and Slocan Railway. This is the first machinery for the Slocan country.

NELSON SUB-DIVISION.

Hall Mines.—This Group of mines, owned by the Hall Mines, Limited, comprising the Silver King, Kootenai Bonanza, and American Flag, are situated on Toad Mountain, Nelson.

The principal workings are on the Silver King ground, and have been pushed forward with the sole idea of developing the Company's property. A small amount of stoping has been done since June, 1894, and since the commencement of operations in the summer of 1893 about 4,000 tons of ore have been extracted. Of this quantity (principally produced through development work) 640 tons have been shipped to various smelters, and the returns show an average value of 116 oz. in silver, 12½ per cent. copper, and $2 per ton in gold.

This Company has been the first in the district to employ diamond drills for prospecting, and has now in operation one hand drill and one power drill of 1,200 feet capacity. The Company has also a complete plant—boiler, engine, air compressor, etc.—to serve the power drill, at present 1,600 feet distant, with air and water.

Since the Hall Mines, Limited, purchased the property from the original holders, the development work has shown that the large body of ore which was known to exist at the time of the purchase has increased in area, carrying the same uniform grade of ore.

The expenditure by the Company on this group of mines will probably amount to $100,000.

The number of men employed regularly in this group is 50.

Dandy.—Situated on Toad Mountain. Very little development work has been done on this property, but it is the intention of the owners, with the prospect of the smelter on Kootenay Lake nearing completion, to commence operations and ship ore at no distant date.

Starlight.—This claim, situated on Toad Mountain, and parctically newly developed, shows great promise of being a rich gold property.

The vein is about five feet wide, and the ore has an average of $20 per ton in free gold A shaft twenty feet has been sunk, and the uniform grade of the ore has been maintained. On the surface the vein has been stripped for a distance of 700 feet.

Fern Group.—This group of claims situated on Hall Creek have been bonded for $35,000. The claims are free milling, and have a reputed value of $20 per ton in gold.

AINSWORTH SUB-DIVISION.

The completion of the Pilot Bay smelter, the property of the Kootenay Mining and Smelting Co., has given a stimulus to mining in this section.

This Company owns the famous Blue Belle group, and several others in the Ainsworth and Toad Mountain camps, from most of which they will extract ore as early as possible. About the works at Pilot Bay nearly 100 men are now employed. The buildings are of brick, with corrugated iron roofs, and are equipped with various machinery of the most modern type, a battery of boilers of 200 h. p., smelters stacks capable of handling 100 tons of ore daily, sampling works with a capacity of 150 tons per day, and concentrator of like capacity.

A large and substantial wharf has been erected, and warehouses and ore-bins. It is predicted that the opening of these works will prove of great benefit to the people of the district, and particularly to those who are unable, from various causes, to send their ore to distant smelters.

The Blue Belle mine, on the ore of which the Company relies for much of its fluxes, has over 3,000 feet of tunnels, shafts, uprises, etc., completed and is in a position to turn out 150 tons of ore per day.

No. 1 Mine, Ainsworth Camp.—This mine is working under a lease, and on it a 60-ton concentrator has been erected, through which 500 tons of ore has been passed, with a result of one ton to seven. Two thousand five hundred feet of flume has been built, introducing water for the concentrator.

Lady of the Lake.—This claim has a promising body of ore, to work which the owners have put in a syphon to drain Loon Lake, which is being lowered rapidly.

King Solomon.—A shipment of five tons of ore from this mine realized 160 oz. in silver and 40 per cent. lead.

Little Mamie.—Since the conveyance of this claim to Mr. W. McVicar, of Nova Scotia, it has been worked with a force of 15 men, and shows a 30-inch body of concentrating ore.

Little Phil and Black Diamond.—Two ore veins have been reached by a joint tunnel, run on the dividing line between the two claims, one showing high grade ore. On the other, ore is being extracted and prepared for shipment.

United.—The yield from this mine, it is intended, shall be treated at Pilot Bay, and if found to be satisfactory the mine will be worked permanently.

Highland.—One tunnel 230 feet; another, 100 feet above, 90 feet long. The face of this drift shows 3 feet of ore. Three hundred tons of ore are now on the dump.

On the Wakefield, Budweiser and Amason are 250 feet of tunnel, and ore averaging 30 oz. silver and 45 per cent. lead has been found.

Morning Star.—This claim has ore averaging 60 oz. silver per ton.

Skyline.—This claim is not at present being worked, but it has completed large workings, and has several hundred tons of ore, averaging 80 oz. silver on the dump.

KASLO CAMP.

Eureka.—Extensive development work has been done on this claim. A 190-foot tunnel has been run, cross-cutting the vein at a depth of 170 feet. The vein shows a 30-inch body of high grade ore. About $10,000 has been expended in improvements, etc. Ore shipments have been commenced, and it is expected that about 200 tons will be shipped.

Echo.—An 18-foot tunnel has been run on the ledge, exposing an 18-inch body of ore.

Iron Crown.—A tunnel, 110 feet, has been run to cross-cut the vein.

San Berdino.—A 70-foot tunnel has been run to intersect the ledge.

Solo.—A 50-foot tunnel has been run on the vein, and a large quantity of ore is on the dump.

Wellington.—About 350 feet of sinking and tunnelling work has been done, which has shown up a 2½-foot body of ore. A 50-ton shipment of this ore has been made, showing good returns, and shipments will continue during the coming winter.

Virginia.—About $6,000 worth of development work has been done on this claim.

Carbonate.—Two tunnels have been driven, in all about 250 feet, which show up a nice body of ore. A 3-mile trail has been built to the waggon road, and it is expected that two carloads will be shipped as soon as raw-hiding commences.

Charleston.—On this claim, about $2,000 has been expended in tunnels and drifts.

Lincoln.—A 60-foot tunnel has been run to catch the vein.

Utica.—About $2,500 has been expended in development work. This claim has been bonded for $20,000. Ten men have been continuously working, and a trail has been built to connect with the waggon road, and ore will be shipped during the coming winter.

London.—A 50-foot tunnel has been driven, which shows in the face a 6-inch body of exceptionally high grade ore.

Lucky Boy.—About $2,000 has been expended in tunnels, etc., and considerable ore is on the dump.

Beaver.—A 70-foot tunnel has been run on the ledge, and a large body of copper and dry ore has been exposed. A good trail has been also built from this claim to connect with the Kaslo waggon road.

Northern Belle.—About $9,000 has been expended on this claim, and shipments of ore amounting to about 100 tons were made early in the spring.

Surprise.—A shipment of 25 tons has been made from this claim, with good results, and a contract has been let to haul 200 tons of this ore to Kaslo, and shipments will be regularly made as long as the snow is on the summit.

Whitewater and Irene.—On this claim, 6 men have been employed for the past two months, and will continue to work during the winter.

SILVER-LEAD SMELTING.

Dominion Bonus of Fifty Cents per Ton to Canadian Smelters.

(Proceedings of the House of Commons.)

On Tuesday, 9th July, the Hon. Mr. Foster presented his bill to encourage silver-lead smelting in Canada. The provisions of the Bill are as follows:—

An Act to encourage silver-lead smelting.

"HER MAJESTY, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows:—

1. To encourage silver-lead smelting in Canada, the Governor in Council, may, subject to the following provisions, authorize the payment of a bounty not exceeding fifty cents per ton, and not exceeding in all one hundred and fifty thousand dollars, on Canadian silver-lead ore smelted in Canada between the first day of July, one thousand eight hundred and ninety-five, and the first day of July, one thousand nine hundred.

2. The said bounty shall not for any one year exceed the sum of thirty thousand dollars: Provided, that the said sum if unexpended, or any balance thereof unexpended, may be carried forward from year to year and may be paid for any year in addition to the sum of thirty thousand dollars authorized as above for such year.

3. If in any year the quantity of ore smelted is greater than will allow of the payment, out of the sum available for that year, of fifty cents per ton, then the bounty per ton for that year shall be reduced proportionately.

4. The said bounty shall not be paid on any ores smelted in smelting works which are not established and in operation before the first day of January, one thousand eight hundred and ninety-seven.

5. The payment of the said bounty shall be under the direction of the Minister of Trade and Commerce, subject to such regulations as are made by the Governor in Council.

6. The Governor in Council may make regulations in relation to the said bounty in order to prevent fraud and to insure the good effect of this Act.

7. The said regulations shall be laid before Parliament within the first fifteen days of each session, with a statement of the money expended in payment of the said bounty, and of the persons to whom they were paid, and the places where the ore with respect to which they were paid was smelted, and such other particulars as tend to show the effect of the said bounty.

MR. FOSTER—This resolution pretty well explains its object. The proposition is to encourage and extend the industry of silver-lead smelting in Canada, the principal region in which the industry bids fair to be developed being in British Columbia. The proposition is simply this, that the sum of $150,000 shall be appropriated, to extend over a period of five years; that for the first year, for instance, not more than one-fifth of the sum shall be paid out; that the payments shall be made upon each ton of ore which is smelted; that the maximum paid for each ton of ore which is smelted shall be 50 cents; that if more than sufficient is smelted at the rate of 50 cents per ton to make the $30,000, the maximum that can be paid out, then the rate per ton will be made by dividing the number of tons that are smelted into the $30,000, or the amount that can be made for the first year. If, during the first year, the $30,000 is not absorbed, any surplus which is left goes on to the second and succeeding year; but at no time can more than 50 cents per ton be paid for the smelting of these ores. The ores are found in more or less abundance through all parts of the mountain ranges of British Columbia. In the districts along the rivers from the southern boundary north of the line of railway, these ores have been prospected to a certain extent, and have been mined to a certain extent. But, up to the present time, they have all been exported for smelting, consequently, in the first place, the increase in the development of the industry must be retarded by the distance that these ores have to be transported in order to get them to the smelting furnaces which are in the United States. But a greater disadvantage than that is, that only a certain class of ores will bear the transportation and pay the expense, that is, the higher grade ores. As the higher grade ores form a small proportion, necessarily, of all the ores available, it leaves the low grade ores practically unused, although they are of considerable value, and pay largely for smelting, if the transportation to the smelting furnaces for separating the ores does not cost too much. In the smelting of these ores I am told that it is necessary to have two kinds; besides the common ores, they also need, in order to make up a composition for successful smelting, the dry silicious ores. These are not found in great abundance in British Columbia at the present time, although the prospectors have an idea that they exist, and any stimulus given to the smelting industry will, of course, provoke a search for, and it is hoped, a discovery of, those silicious ores in sufficient abundance to make what is so very requisite in the composition for successful smelting. The object the Government have in view is to give an impetus to the mining and smelting industry of that country, particularly, and wherever ores of that kind are found in Canada, for a limited period. It is not proposed, and it is not thought that it will be necessary, to give aid for any lengthy period. The main idea is to get the industry started, to set the prospectors at work, especially for these dry silicious ores, and so to stimulate the search for, and, consequently the development of, the mining of those ores. It is believed that a very great benefit will result. The labor employed, and the expenses of smelting are large. A certain amount of labor, of course, is employed in mining the ores, and taking away that high-grade portion of them which stands transportation, but that is not at all to be compared with the labor which is expended on all the adjuncts to the smelting which are necessary, and the expenditures that are made, if the ores, both high and low grade, are smelted in the country. For instance, in smelting 150 tons of ore, it is calculated that 500 tons of coal are used, that about 1,200 tons of coke are used, and about 500 tons of limestone. Now, all these industries will be stimulated by the smelting of the ore. The coke will be made, probably, at Nanaimo, and perhaps in the Rocky Mountains, and an industry will be developed there which does not, at the present time, exist, giving employment and making large expenditure as well. And so, with reference to the limestone and the coal. Then again, as is well known, the development of the mining industry has a particularly good effect on the consumption of agricultural products. A mining population is particularly a consuming population. It makes nothing for its own wear and for its own food, but it calls lavishly and constantly for the products of the manufacturer, and more especially for the products of the agriculturist. The effect has been seen in the history of this kind of mining in the western and north-western states, where lead smelting has been very greatly developed, and where the combined products of the smelting ores, and of agriculture, largely for the sustenance of the miners, have run up very largely, and now amounts to a very large sum. The amount that Parliament is asked to vote will be but small, the time will be limited, and it is not thought that a period longer than five years will be necessary in order to put the industry upon that basis of development upon which it can go on and extend itself. Certain conditions will be put about it. In the first place, the subsidy begins on the passing of the Act, and extends for five years, and a provision will be put in the Act by which any smelter, to have the advantage of this bounty, must commence these operations by the 1st July, 1896. The object is to give a stimulus to the development at once, to get capital to go in and set up establishments there, and commence operations, so as to give the benefits that are derived from a large industry. All this, of course, will be under regulations of the Governor in Council, as to conditions, supervision, and the like of that. I think these are the main features of the bill which it is proposed to found on the resolution. I may also state that the amount of 50 cents per ton, of course, is but a small percentage of the value. Probably the average value of product would be $50 or $60 per ton, and the aid would be somewhere in the region of 10 cents.

MR. LAURIER—Everybody, I think, including the Minister himself, may have some doubts as to the wisdom of the proposition he now introduces.

MR. FOSTER—I have none.

MR. LAURIER—I have. But for all that I am not disposed to criticise or oppose the motion submitted by the hon. gentleman. I take it that this is to be an experiment, and I should be glad to find that the results which the hon. gentleman anticipates materializes in the glowing figures which he has presented. I have my doubts as to that; the hon. gentleman has not. But he should have some, because he knows that at the present time silver all over the world is very much depressed, in fact, silver has ceased to become a commodity, and it is now an article to be avoided. The silver market of the United States was never so low as it is now, and I doubt if the aid which the hon. gentleman intends to give the mining and smelting industry of silver will have the results he looks for. However, for my part I would be very glad to know, whether in one year or in five years, that the market has improved, and therefore the results which the hon. gentleman predicts have been realized. If the amount asked from Parliament were a very large figure, in the present condition of the finances, I would, perhaps, be disposed to take a different view from that which I entertain at the present time; but as the amount is not large, as it is an experiment, and as mining in British Columbia is the principal industry of that province, and is one which we shall all be glad to see developed, I do not intend to offer any opposition to the proposition of the hon. gentleman. The Kootenay district, I suppose, will be that principally affected, and this industry is progressing and developing there, and from that consideration I will allow the motion to pass without offering any opposition.

MR. MARA—I am afraid that the words used here, "silver lead," will exclude some of the ores that it is desired to assist as well as silver-lead. For instance, in the Toad Mountain district, in Kootenay, the ores are silver and copper. Then, again, in the Trail Creek district, the ores are gold and iron. With the clause as it now reads, I am afraid that these ores would be excluded, whereas I think it is not the intention of the government to exclude any ores that are smelted within the Dominion.

MR. FOSTER—With reference to that, I have taken what information I could get from experts, and according to that information, the signification put on the word "smelting" would take in all the classes of ores that ought really to be included under the encouragement given to this industry. They will not take in any ores which are not fit for smelting, such as those which are produced by other processes outside of the real smelting process; but this will take in the very ores in that district of which the hon. gentleman has spoken.

MR. MARA—The leader of the House is correct, if these ores were all smelted together. The Slocan ores are argentiferous galena, the Toad Mountain ores carry

silver and copper, and the Trail Creek carry gold and iron. If all were smelted they would come within the clause under the head of silver-lead ores; but if treated separately at each different mining camp, I am afraid that the clause as it now stands will not cover them. That is the point I want to be distinctly understood. It will take a little time to frame an amendment to cover the point.

MR. FOSTER - This will take in the ores that we want to take in, those for which the bounty is to be given, namely, silver lead smelting ores. It includes all the lead ores, all that class of dry silicious ores of which I spoke the other day; it will also take in the sulphides which are found in the district referred to. The ores there I am told carry a small proportion of copper, but the copper in the smelting is recovered as a side product. What we particularly want to do is to encourage the industry of lead smelting, the production of lead bullion, and the information I have is that this term will include those ores.

MR. MILLS (Bothwell)—The usual galena ores?

MR. FOSTER -Yes. We can pass the Bill through Committee and defer the third reading.

MR. MASSON—Is this ton to be weighed as the ore goes in or comes out?

MR. FOSTER -It is a ton of ore.

MR. CHARLTON -Is it a long ton or two thousand pounds.

MR. FOSTER—Two thousand pounds.

Bill reported

CANADIAN COMPANIES

Horsefly Hydraulic Mining Co. Ltd.—Reports from Horse Fly, up to the 8th instant, say that hydraulic operations are going on satisfactorily, the gravel showing up well. The company is driving more drifts in order to put in blasts and loosen up the gravel. The ditch is in excellent condition, and altogether the enterprise is in a very satisfactory state. The extensive operations of this and the Cariboo company have put an entirely new life into the affairs of that section of the country.

Cariboo Hydraulic Mining Co.—Advices from Quesnelle to June 7th, state that the past week had been very dry, and the water supply had been reduced to 250 miners' inches, which made it possible only to run 3 hours daily, with the head necessary to operate the monitors. The company had 545 men at work on the ditch from Hazeltine to Polley's Lake, and good progress was being made. It will, however, possibly be well on in July before the work is finished and the full and continuous supply of water secured.

The Montreal Hydraulic Mining Co. of Cariboo, Ltd.—This company, which has large hydraulic claims on the Quesnelle river, is pushing on exploration work. By the close of this month it expects to complete these preliminary operations, except the work of driving the tunnel (which is about 150 feet below the top of the bank), about 300 feet farther. By that time it will have the shafts down to the level of the tunnel. The latter has effectually drained the shafts and the company has had no trouble with water this season. The gravel which has been gone through in the shafts and tunnel has proved to be even richer than that taken out at the commencement of the work, and the company is satisfied that the property will pay handsomely when it can begin hydraulic operations. Work is going on continuously on the three-shift plan.

The Columbian Hydraulic Gold Mining Co. at Hill's Bar is engaged in laying its line of pipes for a distance of half-a-mile from the point of its water supply to the head of the bar, which yielded so much gold in the days of '58 and '59. The company expects to be ready to commence washing dirt some time in July. It will follow the old plan of working, as it believes that using the large head of water from a powerful monitor is the reason why so much fine gold has been lost on some of the claims on the Fraser river, the working of which has caused so much disappointment during the last year or two.

Van Winkle Hydraulic Mining Co. Ltd.—There was a clean-up on the Van Winkle claim, above Lytton, about two weeks ago. As a result of about a ten days' run, the clean-up was a little more than $400. The clean up was made to test the efficiency of the sluices, and it was found that they were not in a proper condition to retain all the gold. The work is again going on, and it is now thought that the results will be satisfactory. There has been a large expenditure on this plant, and it is to be hoped that the results of operation will be remunerative to the company.

Horsefly Gold Mining Co. Ltd. In the Horsefly Gold Mining Co. (Foreign) vs. Whipple and others, application was made by Mr. Lindley Crease before Mr. Justice Drake yesterday for a writ of attachment against defendants Kelly, McCallum and Shaw, for disobeying the injunction granted to plaintiffs to restrain all defendants from gold mining on the property claimed by plaintiffs at Horsefly creek. Mr. A. L. Belyea contra. An order was made for writs to issue in one week unless cause was shown to the contrary before the expiration of that time.

Oxford Mining Co. Ltd.—This company is applying for incorporation under Nova Scotia statutes to carry on the business of mining in that province. Authorized capital, $50,000, in shares of $100. Chief place of business is to be at the Oxford gold mines, Lake Catcha district, Halifax county, Nova Scotia. The directors of the new company are to be: E. J. Partington, C. E. Willis and W. H. Covert.

The Cinnabar Mining Company of British Columbia, Ltd., has been incorporated under British Columbia laws, to acquire from F. C. Innes four mineral claims on the north shore of Kamloops lake, near Copper creek, in the Kamloops division of Yale district, known as the "Rose Bush," "Lake View," "Yellow Jacket" and "Blue Bird," and to carry on the business of miners. Authorized capital: $100,000, in shares of $1 Head office: Vancouver. Directors: R. G. Tatlow, A. Graham Ferguson and C. O. Wickenden.

Kamloops Mining and Development Co. Ltd., has been incorporated with an authorized capital of $30,000, in 300 shares of $100, and headquarters at Kamloops, B.C. Directors: Harold E. Forster, C. C. Woodhouse, F. M. Wells and Harry Symons.

Robert E. Lee Mining Co. Ltd.—Registered 28th June, 1895, under the Foreign Companies' Act, B.C., with an authorized capital of $500,000 and headquarters at Spokane, Wash.

Boundary Creek Mining Co., Ltd., has been registered at Victoria, B.C., 28th June, with an authorized capital of $1,000,000, to carry on mining in the Province of British Columbia. Head office: Spokane, Wash.

Idaho Gold Mining and Smelting Co., Ltd.—Registered at Victoria, B.C., with an authorized capital of $500,000, and headquarters in the city of Butte, Montana, U.S.A. Formed to carry on a general mining, smelting, milling and reduction business, and particularly to carry on and conduct such business in Trail Creek Division of West Kootenay Mining District, British Columbia and vicinity, and also more particularly to mine and develop that certain mineral claim in said Trail Creek division of West Kootenay Mining District, British Columbia, known and called the Idaho Mineral Claim, and to reduce the ores extracted therefrom by concentration, smelting, milling and other processes; also to hold, own, purchase, lease, bond or otherwise acquire mining property or other property necessary to carry on the business of the said Company; also to purchase, sell, or in anywise to acquire or dispose of ores for the purpose of carrying on and conducting a general custom business in the reduction of ores of all kinds.

Centre Star Mining and Smelting Co., Ltd.—Registered at Victoria, B.C. 16th July, with an authorized capital of $500,000, and headquarters at Butte City, Montana. Formed to carry on and conduct a general mining, smelting, milling and reduction business, and particularly to carry on and conduct such business in Trail Creek Division of West Kootenay Mining District, in British Columbia, and vicinity, and also more particularly to mine and develop that certain mineral claim in said Trail Creek Division of West Kootenay Mining District, British Columbia, known and called the Centre Star Mineral Claim, and to reduce the ores extracted therefrom by concentration, smelting, milling, and other processes; also to hold, own, purchase, lease, bond, or otherwise acquire mining property or other property necessary to carry on the business of the said Company; also to purchase, sell, or in anywise to acquire or dispose of ores for the purpose of carrying on and conducting a general custom business in the reduction of ores of all kinds.

Eureka Consolidated Mining Company, Ltd.—Registered under the Foreign Companies Act, B.C., at Victoria, 28th June, with an authorized capital of $500,000. Head office: Spokane, Wash.

Provincial Natural Gas and Fuel Co. of Ontario, Ltd.—Supplementary letters patent have been granted, reducing the capital stock of this company from $600,000 to the sum of $510,000; also reducing the amount of each share from $100 to $85.

War Eagle Mining Company.—This company has ordered a 20-drill Rand compressor for its mine at Trail Creek. The plant is said to cost $10,500 laid down, and consists of a compound Corliss condensing engine, with air cylinders 18 x 30. Its weight is 70,000 pounds and two 75-horse power boilers will be required to run it. The War Eagle is now taking compressed air from the Le Roi, but the latter company finds itself unable to continue the arrangement.

Horsefly Hydraulic Gold Mining Co.—Latest advices respecting this company's operations in the Cariboo district state: The clean-up has been continued, and was completed on the 13th inst. The period during which hydraulic operations were conducted was 23 days. The clean-up has produced 781 ounces of gold, of the value of $13,350. The manager writes that the result was fully as good as could be expected in proportion to what was recovered from the sluices, the limited area of ground worked, and the cemented character of the portion of the gravel overlying the powder drift. Although the effect of the blasts which were fired was to loosen up the cement very considerably, yet the extraordinarily tenacious character of this cemented cap (varying in thickness from one foot to seven feet) made the work very tedious and unsatisfactory, while the comparatively barren nature of that deposit made the results not as profitable as they would have been in fair average gravel. Under the circumstances an average result of nearly $600 a day cannot be considered discouraging. Mr. Hobson writes that he has as great confidence in the property as ever as to the ultimate returns and we have seen or heard of nothing so far that would cause us to change the opinion we expressed several months ago in respect to this and the Cariboo Company's property. It is unfortunate that ridiculously extravagant reports should have been circulated by outside parties without any authority or authentic knowledge. To develop a large property like that owned by either of these companies requires the expenditure of both time and money and the results of the early operations cannot be considered as a proof of the richness of the ground, especially when under such conditions as have prevailed on the Horsefly claim. The last advices from the Horsefly mine report that No. 2 pit was running steadily, and that operations would be resumed almost immediately in No. 1 pit with four giants. By this time, therefore, it may be assumed that work is again in full blast, with everything in shape for a steady run.

Cariboo Hydraulic Mining Co.—Advices from Cariboo district up to the 14th ultimo report that operations at the Cariboo Hydraulic Mining Company's claims are suspended owing to the scarcity of water. The season up there has been drier and hotter than for several years past, and California miners say it has been much drier than is often the case in that State. As a comparison between this and previous seasons, it may be stated that from observations taken, there was, in the season of 1892, water running sufficient to fill two such ditches as supply the monitors of the Cariboo Company; in 1893 there were about 1,500 inches, while in 1894, although a dry season, there was considerably more water than there has been this year. However, the work on the ditch from Polley's lake is now well advanced, and it is likely to be completed by the first week in August. Then there will be a constant supply of at least 2,000 inches, and operations will go on uninterruptedly, whatever the character of the season.

Nelson Hydraulic Mining Co., Ltd.—This company reports a partial clean-up with satisfactory results. The run is stated to have been for only 120 hours and

the gold secured is valued at from $4,000 to $5,000, although the exact sum is not known. A letter from Nelson says that there is "on view in the Bank of British Columbia there, a good-sized bowl half full of gold, a gold brick of the value of $2,000, a smaller brick, and a $50 nugget. This represents the gold picked off the bedrock in front of the boxes, and the contents of the first two or three boxes themselves."

The company has now got through most of the barren ground, large boulders, etc., and will now have much richer gravel upon which to work. As there is still abundance of water available another good clean-up may be expected before the close of the season. The expenditure on the property to date has not exceeded $20,000.

Hall Mines, Ltd.—It is reported that this company has accepted the bid of the California Wire Works for the erection of an aerial tramway from the Silver King mine to Nelson.

Danville Slate and Asbestos Co.—Mining is being vigorously proceeded with on this company's properties, more particularly at the Jeffrey Asbestos mine, where a strong force of miners are employed. A large new mill-building equipped with a first class plant, including a number of cyclone pulverizers, and 500 h.p. engine furnished by the Laurie Engine Co. of Montreal, is rapidly nearing completion. The management report the cyclone mill a great success.

War Eagle Mining Co—The remarkable results being obtained by this company's gold mine in the Trail Creek district is attracting attention. To date the claim has been opened by tunnels, winzes, and air shafts. Work, however, has been confined to two of these veins, while the principal workings from which the ore has been taken are on one vein only. The development work up to now consists of a tunnel over 650 feet long, and a second tunnel 350 feet long. There are also three shafts from the surface, one of them being sunk considerably in advance of the face of the 650 feet tunnel. This shaft is down now about 80 feet. The vein, before reaching the spot where this shaft is being sunk, appears to be split, although each of the parallel veins which have been exposed by open cuts are of about the same width and inclination as the single vein. At the surface the ore in this shaft is about eight feet wide while at the depth to which the shaft is now sunk the vein is nearly twelve feet wide. The ore in this shaft is the highest grade of any yet struck, while it gets better with depth. The lower tunnel was started at the east end of the mine and is now in about 350 feet. Above this tunnel, at a height of 120 feet, another has been run. This was started considerably west of the lower tunnel, and has been driven for about 650 feet. The uprise from this tunnel is 110 feet, and it is from here that the chief quantity of the ore has been taken. Some stoping is now being done there. There are now good reserves of ore and the dividends already commenced to be paid to the shareholders are, therefore, likely to be regularly maintained. The last paid was at the rate of 10 per cent., or $50,000. This barely represented the profits actually realized in three months. So far no expensive hoisting or pumping machinery has been required, and from all appearances this expenditure will not be necessary for some time. The location of the War Eagle was made in July, 1890, by Messrs. J. Morris and J. Bourgeois. After some vicissitudes the property was bonded in April, 1894, by Patrick Clark, of Spokane, for himself and others, for $20,000. Immediately after this bond was given the War Eagle Mining Company was organized with a capital stock of $500,000 and work was prosecuted with the vigor usually shown by such men as Clark, Finch and Kingsbury. James Clark, who has been identified with some of the best developed mines in the Cœur d'Alenes and elsewhere, was secured as superintendent, while his brother, Patrick Clark, was made manager with headquarters in Spokane, where the head office of the company is located. Since that time work has gone on steadily and the mine has produced enough ore, which has netted $30 and over per ton, to pay two handsome dividends, dividend No. 1 being for $32,000 and No. 2 for $50,000. Sixty-five men find employment in and about the mine and 20 teams are kept busy hauling the ore to the railroad, the output at this time being 65 tons daily. The ore reserves in the War Eagle are sufficient to promise another dividend soon, and from present indications it is probable others will follow at regular and frequent intervals.

Black Jack Mining Co.—It is reported that the property of this company, including the reduction works at Rat Portage, Ont., has been sold to a company of French and English capitalists.

LEGAL.

The Judgment in Capt. Adams' Suits,—Moses Ediams et al. and W. H. Brandon et al.

The following is a certified copy of the judgment in the celebrated "Bon Ton" suits, the mineral property owned by Captain Adams, of Montreal:—

"I certify that this action was tried before His Honor Judge Spinks, with a jury, of the county of Kootenay, on the 20th day of April, A.D. 1895.

"The jury found:

"1. Have the defendants *knowingly and falsely represented* that the recorder made a mistake in recording the claim in order to obtain a certificate of improvements to ground to which they had no right?—No.

"2. Did the defendants *wilfully* state that they had expended money on the claim that they knew they had no right to take credit for?—No.

"3. Did the defendants, *for the purpose of deceiving*, put in an advertisement not correct?—No.

"4. Whole question?—No.

"5. Was the certificate of improvements obtained by fraud?—No.

"The trial judge directed that judgment should be entered for the said defendants with costs.

"Dated this 22nd day of April, A.D. 1895.

"(Signed) T. H. GIFFIN,

"Registrar of the County Court of Kootenay, holden at Nelson.'

Verdict of Interest to British Columbia Miners.

At the sitting of the County Court, Nelson, B.C., Judge Spinks gave judgment in the "Early Bird" case as follows:—

"The facts of the case are undisputed and very shortly stated. The defendant located and recorded a mineral claim, he did the required assessment work, but did not record the assessment work until the anniversary of the date of the record.

"It is contended by the plaintiff that the recording of the assessment work was not done within the first year of the defendant's holding of the claim and that therefore he had forfeited all rights under his record.

"Sec. 24 of the Mineral Act, 1891, reads as follows: Any free miner having duly located and recorded a mineral claim, shall be entitled to hold the same for the period of one year from the recording of the same, and thence from year to year. Provided, however, that during each year and each succeeding year, such free miner shall do, or cause to be done, work on the claim itself to the value of one hundred dollars, and shall satisfy the Gold Commissioner or Mining Recorder that such work has been done by an affidavit of the free miner, or his agent, setting out a detailed statement of such work, and shall obtain from such Gold Commissioner or Mining Recorder, and shall record, a certificate of such work having been done.

"This section has been slightly altered, but not so as to affect the point at issue.

"Sec. 34 also sets out the interest a free miner has in his claim and reads as follows: The interest of a free miner in his mineral claim shall, save as to claims held as real estate, be deemed to be a chattel interest, equivalent to a lease, for one year, and thence from year to year, subject to the performance and observance of all the terms and conditions of this Act.

"The question therefore settles itself down to this: when does the first year of a tenancy expire? This seems to have been settled by the case of Ackland vs. Lutley, 9 A. & E. 879, in which Lord Denman says, 'The general understanding is that terms for years last during the whole anniversary of the day from which they are granted.' This case was followed in the Ontario case of McCallum vs. Snyder. 10 C. P. 191.

"My judgment therefore is, that the first year of the free miner's tenancy, which, we have seen, is declared by the Mineral Act to be equivalent to a tenancy from year to year, does not expire until the end of the anniversary of the date of the record, and therefore that the certificate of work being recorded on such anniversary was recorded in time to prevent a forfeiture."

MISCELLANEA

Winding Ropes in Deep Belgian Collieries—Messrs. A. Harmegnies Brothers, of Dour, Belgium, have manufactured flat drawing ropes for new deep winnings in the Mons and Charleroi districts. The largest of these, made for the Sainte Henriette, or No. 18 pit of the Societe des Produits at Flenu, are intended to lift a load of 6½ tons, made up of 3½ tons weight of cage and six tubs and three tons net load of coal, from a depth of 1,200 metres (3937 feet). They are made of Manilly aloe fibre of a flat section, with 10 strands tapering in breadth from 420 millimetres at the large end to 220 millimetres at the small end, and in thickness from 49 to 29 millimetres. The average weight per metre is 11 kilograms, giving for the length of 1,350 metres a weight of 14,85 tons for each rope. The working strain will be 90 kilograms per square centimetre at the thick and 110 kilograms at the thin end. These are the first 10-stranded ropes that have been made in aloe fibre. The winding engines constructed in the shops of the Societe des Produits have cylinders 1,100 millimeters in diameter and 2,000 millimeters stroke, and are intended to be worked with steam at four atmospheres boiler pressure, bringing the load from the bottom of the mine to the bank in 65.4 revolutions, the radius of effort on the rope reels varying from 1.62 metre empty to 4.22 metres when filled. The moment of the load varies from 17.166 kilograms at starting to 405 kilograms on the arrival of the cage at bank. The steam consumption will be 248.52 cubic metres, of 465 kilograms per journey. The working life of the ropes will be about 24 months. Flat steel ropes by the same makers are in use at the Providence pit at Marchiennes au Pont near Charleroi. These are made of eight parallel four-stranded ropes tapered by reducing the number of wires in the strand from 12 to 11 and 10, according to position, the diameter of the wire, which is of crucible cast steel, of a tensile strength of 89 tons per square inch, being kept constant at two millimetres throughout. The breadth of the rope varies from 200 millimetres at the thick to 170 at the thin end, and the average weight is 12.25 kilograms per metre. The winding engines of 2,000 horse power are similar in dimensions to those noticed above, and draw a gross load—12½ tons; 6½ tons for the cage and 12 tubs and 6 tons of coal—from a depth of 950 metres (3117 feet). Owing to the small diameter of the shaft only single tub decks can be used in these collieries so that 10 and 12 deck cages are required in order to be able to command a large output during the shift while running the engines at a proper working speed. The life of the ropes is about 12 months

The Supply and Consumption of Oil.—The *Engineering News* of April 25th remarks in an editorial that the recent sudden jump in prices of crude oil appears, from all statistics available, to be likely to mark a permanent change, and one of no small moment from an engineering point of view. The production of oil has kept in advance of consumption for so many years through the constant opening of new fields that people have grown oblivious to the fact that an end must come to the supply of this valuable product, and that this end could not long be postponed if the world went on using up the supply at such a prodigal rate as it has been doing in the past dozen years. The advance in price has greatly stimulated the prospecting for new territory, and has caused the reopening of many abandoned wells of small production; but the total increase in production thus far secured seems to be small. An advance in the price of refined illuminating oil is probably inevitable. Notwithstanding the increased price of crude oil, the use of oil for fuel does not seem likely to be materially interfered with for some time to come.

The Possibilities of Electrical Pumping Machinery.*

BY CHAS. A. HAGUE.

The pumping of water by means of the power derived from the electric current has, as many are aware, already been accomplished upon a limited scale.

The convenience and controllability of electrical power, together with its simplicity of application to the work of pumping, commends it very strongly for use in isolated places, such as high-service systems in public water supply, wherein a comparatively small percentage of the total water supplied by the initial plant is needed for dwellings situated upon levels too high to be accommodated by the general pres-

sure ; and the question, of course, arises whether we shall put the entire system of the city under the highest pressure required to force a supply to these higher levels, thereby placing a large portion of the mains and fixtures under an unnecessary strain, while operating under wasteful conditions of pumping power ; or whether we shall isolate the higher levels and handle the smaller percentage of water by itself.

The application of electrical energy to the pumping of the main supply of a city of considerable size, although presenting many attractive features as far as the actual operation of the pumps is concerned, is not yet within the possibilities on account of the absence of inexpensive methods for producing the necessary current ; so that apparently, in pumping large quantities for some time to come, the compound, the triple, and the quadruple steam pumping engine will hold their sway. To-day it is beginning to offset very forcibly the proposition that it does not pay, in the present state of perfection of the steam engine, to go very far out of the way of regular commerce, to get the cheap power afforded by a falling stream.

To bring the problem of high service pumping down to figures and familiar terms, supposing that a city's total supply is 10,000,000 gals. per day, and only 1,000,000 gals. are needed for a district which would make it necessary to deliver its supply under a pressure of 125 lb. per square inch if delivered from the main pumping station ; while the remaining 9,000,000 only needed a pressure of 75 lb. for distribution. Then the difference in power would be as follows : The entire 10,000,000 gals. under the 125 lb. pressure represents 500 horse power, while the 9,000,000 under 75 lb. pressure represents only 270 horse power; and the 1,000,000 under the high service pressure of 125 lb. represents only 20 horse power. The economy of power then would be $500-(270\times 20)=210$ horse power saved by dividing the service.

How convenient it would be to generate an electric current at the main pumping station, with the boiler plant used for pumping the main water supply, then run the wires up to a point adapted to the high service pumpage and operate an electrically driven pump. Of course a high service steam pumping plant could be installed at the proper point, but that would mean expensive attendance, hauling of coal, ashes, and supplies; and last, although by no means least, large quantities of smoke and dust dispensed broadcast over what is generally a residence district. There are cities wherein pumping plants are supplied with anthracite coal at double the cost of bituminous coal, to quiet the complaints of dwellers and the owners of lawns and trees.

Glance for a moment at the saving in fuel shown by dividing the service as set forth above. The case supposed is extreme, but extremes illustrate forcibly, and there probably cases in actual practice the full equal of the one supposed. Allowing that an economic duty of 1,000,000,000 is obtained at the pumping station, or say 2 lb. of coal per horse-power hour, then the 210-horse power saved represents $5,475 per annum, which would pay 5 per cent. interest upon $109,500.

Even if it should not be desirable to install an electric generating plant at the main pumping station, power could often be obtained from street railways, or lighting plants already in existence in many cities. When we consider the inconvenience and cost of sometimes providing mains for different districts, simply to convey the water supply from a central high-service pumping station, the possibility of a small electrical station for each district begins to hint at the economy in first cost and maintenance of such an electrical system.

The method of switching on and off the electric current by means of the water-level or pressure is one of the details that will occur to the hydro-electrical engineer. In using the term hydro-electrical engineer, I simply follow the tendency to specialize which has taken strong hold upon modern science and practice. At the start, the hydraulic engineer thought that there was nothing to do but harness up the electric dynamo and motor to a pump, and the task was accomplished of pumping by electricity. The electric engineers imagined there was nothing to do but harness up a pump to his motor, and behold the result was obtained. But after a few attempts it was discovered that the pump handling such a stubborn and inelastic element as water was subject to inertia, shock, and variable power within short limits, quite at variance with the steady uniform operation desirable for the best electrical results. The pump man turned his attention to securing a steadier flow of water, while the electrical man was, apparently, inclined to adopt the convenient but wasteful methods involved in the process of wasting power instead of controlling it. Hence the "hydro-electric" engineer, whose office is to reconcile the extremes of the case into the most benefit to all concerned, precisely in effect as the modern steam pumping-engine designer has evolved a machine which, operated by a highly-elastic fluid at one end, smoothly delivers an obstinate unyielding fluid at the other.

If the steam pumping-engine taking steam from the boiler at a pressure of 150 lb., and sending this steam to the condenser at a pressure 8 lb. below the atmosphere, can deliver without shock, and with a fairly close approach to theoretical economy, a steady stream of water, there is every reason to believe that the "hydro-electrical" engineer will eventually be able to bring the items of short-circuiting, resistances, amperes, and volts into a reasonably close approximation to the results demanded.

* Abstract of a paper read before the Atlanta meeting of the American Waterworks Association, May 28-30, 1895.

Cannel Coal as an Enricher.—The *Progressive Age* of April 15th has an article on this subject by Graham Macfarlane. In view of the strong competition of petroleum products, any cannel coal which does not yield a coke which is of some value to the gas-works is shut out from general use by gas companies, except such as are in the immediate neighborhood of the mines producing such cannel. As to how cannel coal was deposited there have been various ingenious theories proposed. Having professionally examined nearly all of our American cannel mines, the author was inclined to the belief that cannel coal was derived from a highly resinous vegetation, either distinct from that from which came ordinary bituminous coal, or more likely the lighter and more resinous part of the general forest of the carboniferous age, which in a gelatinous condition was finally deposited either in little separate seams, or as a part of the many bituminous seams. In almost every instance the cannel coal seams are extremely sporadic and treacherous, and now, with the lower prices forced by oil competition, the lot of the cannel coal operator is not a happy one. Most towns use cannel coal as an enricher.

Coal Washing Plant, Powell Duffryn Company's Elliot Pits.—The *Engineer* of May 3rd describes and illustrates the coal washing plant at the Powell Duffryn Steam Coal Company's Elliot Pit, Aberaman, near Aberdare, South Wales, and erected in the years 1891-92 by the makers, the Humboldt Engineering Works Company. This "washery" is intended to wash provisionally 350 tons, and later 500 tons of nuts and small coal, including dust, per day of nine hours, and to reduce the whole quantity, or only part of it, to the necessary size for making first-class coke. The above-mentioned quantity of coal consists of the screenings from ordinary bar screens with 1½ inch spaces, on which the pit coal is screened, in previousiy erected screening plant as found in most collieries. In reference to screening and sizing plant a machine, patented by the Humboldt Company, which is used either for breaking anthracite or other coal into nuts of any required size, or for breaking lumps of coal from the picking table, mixed with dirt or shale, to a suitabie size for subsequent treatment in the washers, is also illustrated and described. (6 Figs.)

Steel Castings—At a recent meeting of the Manchester Association of Engineers the question of steel castings was introduced by Alfred Saxon, who, after enumerating the infinite variety of purposes for which steel castings were now used, said that for repetition work they would, speaking generally, be better than cast iron or steel forgings. There were certainly difficulties in the machining of steel castings, and in connection with many of them special designing was no doubt necessary. A source of trouble not infrequently was their liability to burst during contraction in cooling, when they were being shrunk on to parts of engines ; in these cases he thought, however, the engineer had not carefully studied the nature of the material he had to deal with, and had simply allowed the same amount for shrinkage as he would in a forged iron or steel shaft. In some quarters it was stated that failures and disappointments in steel castings were vastly in excess of those in cast iron. He urged that engineers should insist upon their castings being sent in unpainted. In the use of cast iron they had failures and bad castings, but yet they would never think of discontinuing them ; in steel they had a stronger metal, from which almost any form of casting could be produced, and it was their duty to see how they could economically use it in the way of lightening their structures, or where strength was needed without increase of bulk.

Quebec Mining Association Excursions.—A notable feature of the proceedings of the summer meeting of this association at Quebec on 27th and 28th June, was the delightful series of excursions thoughtfully arranged for the entertainment of the members and their friends by the local committee. These included a thoroughly enjoyable calèche drive to the historic sites of the ancient city on the morning of Friday, 28th, at the conclusion of which cake and wine were served in the Union Club. In the afternoon the members and a number of prominent citizens of Quebec were the guests of Messrs. Carrière, Lainé & Company, in the steam yacht "Vega" visiting the Chaudiere Falls, Montmorenci Falls, and the large engineering works of the firm at Levis. Before returning to Quebec, the Hon. E. J. Flynn and his Worship Mayor Villeneuve gracefully acknowlcdged the courtesy of Messrs. Carrière, Lainé & Co., and congratulated them on the success of their engineering enterprise. Mr. C. H. Carrière, Mr. James King, M.L.A., and Mr. Lawrence Lynch, members of the local committee, were then duly "bounced" to the strains of "They are jolly good fellows." On Saturday many of the members took advantage of the special rates given to the association and visited the Saguenay *via* Lake St. John, while others who could not afford time for so long a journey ran out to Ste. Anne de Beaupré.

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Lecturer on Mining Engineering, The Economic Geology of Ontario, and The Discovery and Winning of Minerals.

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THE SCHOOL PROVIDES THE FOLLOWING COURSES OF STUDY:

1. *A Course of four years leading to the Degree of MINING ENGINEER, (M.E.)*
2. *A Course of three years, for which a Certificate in ANALYTICAL CHEMISTRY and ASSAYING is given.*
3. *A COURSE OF EIGHT WEEKS, (January and February), for Prospectors, Mine Foremen and others interested in Mines and Minerals.*

Lecturers are sent to any mining centre where a sufficient number of students is guaranteed, to conduct SHORT COURSES in Blowpipe Analysis, Chemistry, Mineralogy, Geology, Prospecting and Mining.

The different courses are made thoroughly practical by work in the well-equipped Chemical, Assay, Mineralogical and Petrographical Laboratories. A Mining Laboratory furnished with Mills, Separators, Concentrators, etc., is in course of construction. It will be open for work in Session 1894-5. Surveying is practised in the field during the warmer months of the Session.

FOR CALENDAR OF THE SCHOOL AND FURTHER INFORMATION APPLY TO

WM. MASON, Bursar,

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PROVINCE OF NOVA SCOTIA.

Leases for Mines of Gold, Silver, Coal, Iron, Copper, Lead, Tin

—AND—

PRECIOUS STONES.

TITLES GIVEN DIRECT FROM THE CROWN, ROYALTIES AND RENTALS MODERATE.

GOLD AND SILVER.

Under the provisions of chap. 1, Acts of 1892, of Mines and Minerals, Licenses are issued for prospecting Gold and Silver for a term of twelve months. Mines of Gold and Silver are laid off in areas of 150 by 250 feet, any number of which up to one hundred can be included in one License, provided that the length of the block does not exceed twice its width. The cost is 50 cents per area. Leases of any number of areas are granted for a term of 40 years at $2.00 per area. These leases are forfeitable if not worked, but advantage can be taken of a recent Act by which on payment of 50 cents annually for each area contained in the lease it becomes non-forfeitable if the labor be not performed.

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

Applications for Licenses or Leases are receivable at the office of the Commissioner of Public Works and Mines each week day from 10 a.m. to 4 p.m., except Saturday, when the hours are from 10 to 1. Licenses are issued in the order of application according to priority. If a person discovers Gold in any part of the Province, he may stake out the boundaries of the areas he desires to obtain, and this gives him one week and twenty-four hours for every 15 miles from Halifax in which to make application at the Department for his ground.

MINES OTHER THAN GOLD AND SILVER.

Licenses to search for eighteen months are issued, at a cost of thirty dollars, for minerals other than Gold and Silver, out of which areas can be selected for mining under lease. These leases are for four renewable terms of twenty years each. The cost for the first year is fifty dollars, and an annual rental of thirty dollars secures each lease from liability to forfeiture for non-working.

All rentals are refunded if afterwards the areas are worked and pay royalties. All titles, transfers, etc., of minerals are registered by the Mines Department for a nominal fee, and provision is made for lessees and licensees whereby they can acquire promptly either by arrangement with the owner or by arbitration all land required for their mining works.

The Government as a security for the payment of royalties, makes the royalties first lien on the plant and fixtures of the mine.

The unusually generous conditions under which the Government of Nova Scotia grants its minerals have introduced many outside capitalists, who have always stated that the Mining laws of the Province were the best they had had experience of.

The royalties on the remaining minerals are: Copper, four cents on every unit; Lead, two cents upon every unit; Iron, five cents on every ton; Tin and Precious Stones; five per cent.; Coal, 10 cents on every ton sold.

The Gold district of the Province extends along its entire Atlantic coast, and varies in width from 10 to 40 miles, and embraces an area of over three thousand miles, and is traversed by good roads and accessible at all points by water. Coal is known in the Counties of Cumberland, Colchester, Pictou and Antigonish, and at numerous points in the Island of Cape Breton. The ores of Iron, Copper, etc., are met at numerous points, and are being rapidly secured by miners and investors.

Copies of the Mining Law and any information can be had on application to

THE HON. C. E. CHURCH,

Commissioner Public Works and Mines,

HALIFAX, NOVA SCOTIA.