CANADIAN CHEMICAL JOURNAL

A Monthly Review of Chemical Science and Industry

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The Great Adventure

THE great war which is demolishing many long established institutions and accepted theories is as surely clearing the ground for new conditions, and in no spehere are those new conditions more amazingly manifested than in the science and industry of chemistry. Many a branch, which had been monopolized by Germany in the world's markets, was suddenly dammed up by the shock of war and had to be re-created in Great Britain, France, the United States, Canada, Russia and other countries. In these countries secret processes have been disclosed or rediscovered and, under pressure of necessity, large factories and laboratories have been organized as by the stroke of the enchanter's wand.

The vast achievements of Great Britain in establishing new industries are as yet only partially known here; but the wonderful work of the United States and Canada in supplying their own markets, and to some extent foreign trade, is more familiar knowledge. That chemical industries of almost every class could have been built up to such an extent that the aggregate capital employed, at the beginning of this year in the United States alone was over $400,000,000, and that new chemical companies to the number of fifty to one hundred per month are reported, indicate the magnitude of the revolution.

Millions of new capital have also been invested in the chemical industries of Canada, and here as in the United States and Great Britain, the government has joined with the universities and scientific institutions in order that technical skill may be turned into a field of work in which we have long had the opportunity of putting to use the prodigal stores of our natural wealth.

The electrolytic production of chemicals is one of the modern marvels whose effects on the physical world grow with time and increasing knowledge, and no one who has reflected on the ramifications of the science of chemistry into every art and industry in civilized life can fail to see that Canada must ultimately be a leader in this field of human endeavor. This is so, not because of any assumption of superior intelligence in its people, but because nature has endowed the country with those resources on which ecletro-chemistry is based. Chief of these—apart from the mineral resources—are the enormous undeveloped water powers.

It is estimated by some authorities that Canada has forty per cent. of the water powers of the world—which if proved will ensure pre-eminence in the chemical industries. Many of these have been developed since the war, and the attention of the world is now being directed to the natural advantages of Canada by means which call for further progress when the new and increasing demands of peace come.

This movement explains the advent of The Canadian Chemical Journal which, in aiming to advance the science and the industries based upon chemistry, appeals confidently to the sympathy and co-operation of all interested.

Having founded the Canadian Engineer, the Canadian Textile Journal, the Pulp and Paper Magazine, the Canadian Woodworker and other technical publications, the management can refer to the success of these journals as ground for hoping that The Canadian Chemical Journal will be destined for a yet greater career of service to the country.

The New Era in Chemistry

THE world-shaking events of the last three years have revolutionized our political and economic methods, and it is becoming a truism among thinkers and writers that the world after the war will be different to anything we have known. If our industrial methods have been revolutionized, our conditions as affected by chemistry have been literally turned inside out. The chemical organizations and industries built up in Germany by patient work through many years had become one of the scientific wonders of the world, until it had become accepted that all nations must depend upon that country for their most essential chemical supplies. Where hundreds of products had become monopolized by German chemists, who could have predicted that the foundations of the laborious scientific structure would be shaken and that within three years great chemical industries should be created on new foundations in Great Britain, the United States, France, Canada and other countries?

When the proposal was first made that these countries should strike for independence in the more essential branches of production there were many experts in the United States and Great Britain who declared that the thing was impossible within ten years, but the impossible has been achieved. It seems a modern marvel that within three years the United States has built up chemical industries employing an aggregate capital of $400,000,000, and the chemical works created in Britain probably employ an equal amount of money, while in Canada a good many millions of dollars have already been invested and more are to come.

Of course the present abnormally high prices of almost all kinds of chemicals make this an attractive field of investment, but it may fairly be assumed that the natural resources of Canada are such that the Canadian chemical industries will stand the readjustment of peace conditions and that in many of the more important branches they will become permanent. This assumption is based mainly on three factors. First, the enormous water powers of Canada, as yet undeveloped, which are becoming more and more the deciding element in the cheap production of many chemicals—such for example as atmospheric nitrogen; second, the mineral deposits of Canada whose extent and variety are as yet scarcely comprehended by our own people; and third, the intelligence and energy of the younger generation of Canadian students, who will naturally turn their talents to the possibilities opened up under the new conditions.

The electrolytic production of chemicals based on the water powers of Canada, referred to elsewhere and upon the new methods of treating ores and nonmetallic minerals will of itself open up a vast field of development in Canada; while the wood products of the country now so thoughtlessly wasted, will provide a round of industries of great magnitude. This can be appreciated by a study of the admirable review of the prospects of wood chemicals given in this issue by Dr. John S. Bates, of the Farest Products Laboratories, established in Montreal by the Dominion Government.

The work of the Dominion Government in promoting what is known as the Advisory Council for Industrial and Scientific Research, which will help to make practical application of scientific facts and discoveries, should do much to forward the new chemical industries on safe lines.

Worthy of the highest praise is the voluntary work of the Joint Committee of Technical Organizations, presided over by Mr. Alfred Burton, one of the pioneers of the Canadian section of the Society of Chemical Industry. A further account of this movement will be given in another issue.

The founding of the chemical industries of Canada—as of the United States with which the progress of Canada is so closely associated—has come upon us as one of the necessities of the war. It must be our resolve to undertake the development with thankfulness and humility, and above all to determine that the immense native resources of which a good Providence has made the Canadian people, the custodians shall never be used by us for the defacement of nature, or the destruction of art, much less for the slaughter or degradation of human beings. The process should be synthetic not destructive.

Water Powers of Canada

THE creation of a "water-power branch" of the Department of the Interior was a statesmanlike move of Hon. Dr. Roche, the Minister of that department, and the work already accomplished by Mr. J. B. Challes, C.E., the superintendent and his staff has been appreciated by all concerned with the country's industrial development.

In a volume recently issued, known as "Water Resources, Paper No. 16" some striking figures concerning the unutilized water powers are given. In various provinces of Canada there has been roughly measured water power amounting to 17,746,000 horse power, but this does not include a large portion of the Yukon, the northern regions of the Northwest Territories, or the large unexplored northern districts of Ontario and Quebec—comprising among other powers the wonderful falls at Hamilton

KAKABEKA FALLS, KAMINISTIQUIA RIVER
One of the many water powers of Canada now beginning to be developed.

inlet in the Labrador. While the country comprising the slopes between the height of land of central Canada and the shores of James Bay and Hudson Bay is largely unexplored it is known from its configuration to have water powers of great volume.

Making allowance for these unknown quantities, and bearing in mind that the water powers now developed in Canada, including those of Niagara, the "Soo" and Fort Francis, aggregate 1,712,193 horse power we get some idea of what is in store for power production in Canada. Of this developed power, 789,466 horse power are assigned to Ontario; 520,000 horse power to Quebec, 265,345 to British Columbia, 56,730 to Manitoba and the balance to the other provinces.

Practically all of this developed horse power has been the creation of the past twenty years; and the fact that about two-thirds of this total has been brought into service in the last ten years is an instructive indication of the ratio of the increase.

For the equitable use and administration of this colossal natural resource it is fortunate that the title to nearly all these powers remains in the control of either the Federal Government or the various provincial governments. In the case of Ontario, Quebec, British Columbia, New Brunswick and Nova Scotia, the powers are under provincial control, while in the other provinces they are under Dominion authority.

In later issues we hope to give further information on the prospective administration of these water powers in relation to the evolution of the chemical and metallurgical industries of Canada.

Canadian Potash and Nitrate Industries

THE application of chemistry to the manufacture of potassium and nitrogen is of incalculable importance to Canada, not merely because of the relation of these elements to the numerous chemical compounds, but because the basic industry of agriculture, without which all other industries would languish, cannot develop without the systematic supply of potash and nitrates as fertilizers. The world had accustomed itself to look to Germany for both nitrates and potash, but the war having cut off these supplies the industrial nations like Great Britain, the United States and others, have determined that these supplies must be had elsewhere for the future. The United States government has devoted the sum of $100,000 this year to experiments in the commercial production of potash alone, and Great Britain is looking for new sources of fertilizing chemicals. Canada is the most promising source of these substances—of potash, because of the enormous areas of feldspar rock, and of nitrates because of the vast water powers which can be used for the cheap production of nitrogen from the air.

The distribution of feldspar on the continent of America is interesting to Canadians from the fact that the rock of the northern half of the continent carries a larger average percentage of potash and the silica which enters into the manufacture of porcelain and pottery is whiter and purer and contains less iron than that found in most of the feldspar rock south of the Canadian boundary. For this reason the porcelain and allied manufacturers of New Jersey and Ohio import increasing quantities of feldspar from Ontario; and this suggests new industries in Canada in which the potash, porcelain and related industries may be dovetailed into one another as in other manufacturing countries. There are millions of tons of feldspar rock in Ontario alone containing potash in percentages varying from 10 to 14 per cent., and the problem will be to extract the potash so that by-products—such for example, as alumina—may be used to make one product help the other. When we remember that hundreds of thousands of dollars were sunk by the Canadian Copper Company and others before the nickel ores of the Sudbury region yielded commercial results, we need not expect that the secrets of turning Canadian feldspar into profitable industrial products will be surrendered without the patient search of the chemist. But that these secrets will be uncovered is as certain as that chemistry has solved other problems equally difficult.

An account is given in this issue of an attempt now being made in Ontario to produce potash on a commercial scale as a by-product of the portland cement industry. It will be realized that this line of development is limited by two factors: first, that the product in potash is restricted to the limits of the cement market; and, second, that the profits obtainable while the war is on are not to be counted on afterwards. While giving every encouragement to bona fide endeavors to establish a Canadian potash industry based on our immense stores of feldspar rock, it will be well that every new process should be first subjected to tests by competent authorities in chemistry, lest the capital sunk in these experiments should discourage other investigators.

THERE is no doubt that it is very desirable for Canada, as well as for the Empire and the United States that an adequate supply of such a necessity as potash be assured, independent of what may be obtained from German sources. Aside from any obvious arguments, the Strassfurt deposits, even if they have been producing for a long time, are not inexhaustible. Borings in these deposits have at many times been flooded, with the consequent abandonment of the mine and the loss of the potash. In this connection, the Jessenitz disaster may be remembered, when one per cent. of the world's visible supply disappeared. Because the management in each particular case was able to drill new holes and resume operations, the market was not disturbed and less attention was paid to the event at the time than its importance deserved.

Of almost a score of processes for extracting potash from feldspar that have come to the front in recent times one is brought out by a Canadian and concerning which particulars are given for the first time in another part of this journal. A company has been formed which will commence operations shortly at Gravenhurst, where feldspar having a high potash content is said to exist. With the price of potash salts at its present high level there is no doubt that the process should prove worthy of careful examination.

Wood Alcohol and the Tariff

THE industrial development in Canada during the and for a year before, has led to the introduction of the motor truck and the automobile as commercial necessities, and in addition has provided a purchasing power which has trebled the number of passenger cars in three years.

Naturally this enormous development in the number of gasoline motors, and the increase in their horse power, has led to an enormous consumption of gasoline. The estimated consumption of gasoline in Canada for 1917 is placed at thirty-five million gallons.

In 1911 gasoline was selling at fourteen cents per Imperial gallon, while at the present time it is selling at thirty-six cents per Imperial gallon. Increased demand and limited output, both due in part to the great war has had an undoubted effect upon these prices, but while this is true of this commodity there seems no valid reason for maintaining hindrances to the development of a suitable substitute.

It has long been known that denatured alcohol has a greater efficiency as a power generator than gasoline. The reason that it has not replaced gasoline is not therefore engineering or chemical difficulties, but simply the matter of costs.

Denatured alcohol which may be the product of what is now waste materials, whether of the saw mill, the factory or the farm, can be manufactured and sold even at to-day's prices for twenty-five cents per Imperial gallon. The wood wastes in Canada alone would produce enough alcohol to operate our fleets of motor cars.

This undeveloped industry is still an infant not because of production costs, want of market or volume of business, but because of internal revenue tax. Gasoline is on the free list, while wood alcohol pays an import duty of $3.00 a gallon, or if produced in Canada, an excise duty equivalent to $1.50 a gallon. The removal of this impost on denatured alcohol would have a most beneficial effect upon the industrial development in Canada, and would give a great and needed stimulus to a variety of manufactures which cannot expand under the present handicap.

Moreover, now that temperance legislation is extinguishing the production of alcohol for spirituous liquors the conversion of these expensive plants into constructive commercial uses is bare justice to those who have invested large sums in distillation works.

THE chemist is the pilot who steers the manufacturer to new channels for the use of minerals, and this growing intimacy in the relation of chemistry to the mining industry is being appreciated by the Department of Mines at Ottawa. We are glad to note that for some months past an officer of the department, Dr. A. W. G. Wilson, has been investigating certain phases of the Canadian chemical industry, and it is likely that more attention will hereafter be paid officially to the development of those chemical manufactures whose products are based upon metals and minerals. It will be remembered that some years ago the Department of Mines undertook investigations in the explosives industry. One immediate purpose was the framing of an act to govern the inspection of explosive factories, and a bill was drawn up, but never put into effect. So far as government action is concerned there is now a great opportunity for connecting up the work of the geological survey and the Department of Mines with the growing chemical and metallurgical industries; for without this practical application the past labors of Canadian scientists like Logan, Dawson, Sterry, Hunt and others would be as the summer fallow without the crop.

NICKEL

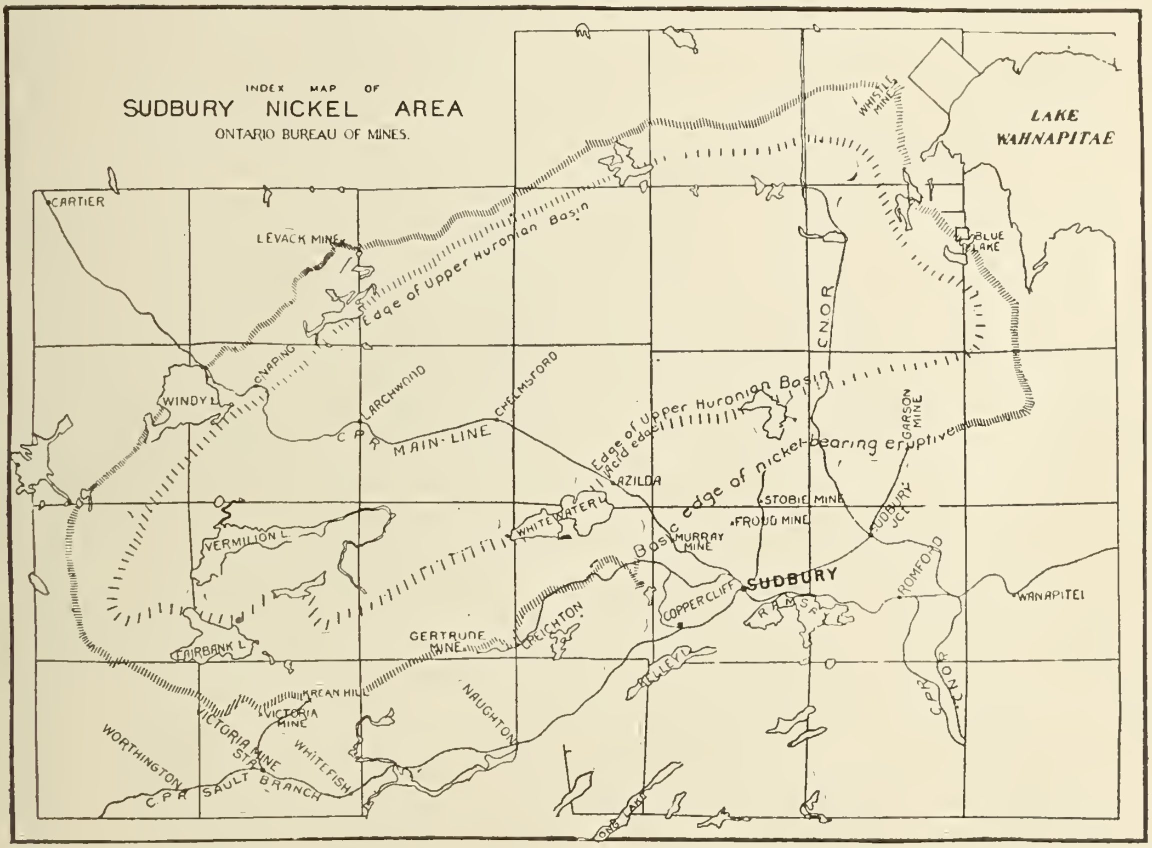
Its History and Geological Distribution

By E. B. Biggar

ARTICLE I

IT is a striking fact that the three materials that have had the most influence in the arts of war and peace in modern times have been rediscovered or re-adapted from Chinese industries established so far back in time that their introduction goes beyond even the tenacious traditions of that ancient people. Paper, gunpowder, and nickel were all used in China before the Christian era. Nickel, which we are accustomed to regard as the most modern of those metals that have had such momentous effect on the slaughter machinery of the great war, was in common use among the Chinese for peaceful utensils ages before the legions of Alexander or Caesar dominated the world, and perhaps antedated the Chaldean and Hittite civilizations. It was known among the Chinese as pack-fong; its modern name of nickel connects it with Germany (the word is German, meaning false copper), and for many years it was popularly known as German silver, although the term German silver is correctly applied to only one of the many alloys of nickel.

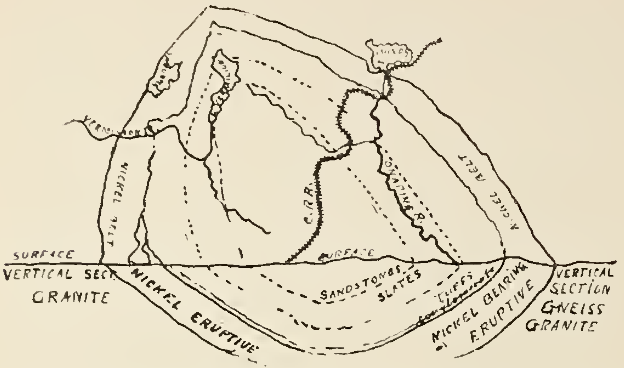
When chemical science took hold of this metal and brought out qualities which it was not at first known to possess—as, for example, its malleability—there began a search in various parts of the world for more. In the early years of its modern production it was relatively abundant in Saxony, Westphalia, and Hungary, so much so that the nickel industry was considered almost a monopoly of Germany. Sweden and Norway also came into prominence as a nickel mining region, and later there were various deposits discovered in the United States, chiefly in Pennsylvania, Virginia, North Carolina, Missouri and Oregon. Some deposits have been found in Cuba, and larger ones in South Africa and Australia, and just before the war nickel ores were found in the Greek Island of Lokris. The last named were thought by the discoverers to be rich, but the disturbances of the third Balkan conflict and the great war that followed have prevented mining work that would test the ore.



The Present Sources

There are two other sources of the world's supply of nickel—New Caledonia and Canada—and these have in very recent years eclipsed the older mines of Europe and the United States. New Caledonia is one of the islands of the Melanesian group of the western Pacific Ocean, and is a penal colony belonging to France and containing about 60,000 inhabitants, of whom less than 15,000 are free whites. The introduction of fresh convicts has ceased, however, and the 10,000 convicts will in time become free men, by death or discharge. This island came within an ace of being British territory, a British naval captain having, in 1853, hoisted the Union Jack on one part of the island, while a French expedition was in another part punishing the natives for a previous massacre of a French landing party. The treaty made by the British commander was afterwards repudiated by the native chief, and the British claims were given up to France. New Caledonia, which lies about nine hundred miles from the coast of Australia, now produces more nickel probably than the whole of Europe, but the nickel mines of Canada surpass the production of New Caledonia by a far greater quantity than that island does the other mines of the world.

The "changes and chances" by which Canada has thus become the primary source of the world's nickel output are very interesting, both from a geological and economic standpoint, while the political power involved in the possession of these mines may be measured by the statement that if the Canadian Government and people had chosen to use that power to its limit in 1912 the military arm of Europe would



The above diagram represents the bow of the boat or the stem end of the "melon" of the Sudbury nickel region. The vertical section shows the different strata of outcropping rock, and represents about quarter of the melon cut through. The boat point south-east.

have been struck with paralysis before it was fairly lifted to strike.

Discovered by Accident

It is a curious fact that neither the Cobalt silver ores nor nickel ores, which together form the most remarkable feature of the mineral output of Canada, were indicated or predicted by geological experts till the fifties of last century, and that both these minerals were brought to light by the picks and shovels of railway construction gangs, nickel being disclosed in the Sudbury region during the building of the Canadian Pacific Railway in 1883, and Cobalt during the building of Ontario's state-owned railway, the Temiskaming and Northern Ontario line. The first discovery of nickeliferous rock was about four miles from the town of Sudbury, and a number of other finds were made in the rough country thereabouts, but the nickel was combined with copper, and it was the copper contents of the ore which prospectors and capitalists thought to be of chief value. It was years, in fact, before the extent of the nickel ore was fully disclosed and even then there was no economical process known for separating the nickel from the copper and other mineral elements. Then the chemists and metallurgists went to work on the problem of treating it, and at last triumphed by three different methods of treatment. Their patient labor, their defeats, and final success have all the fascination of romance—to the student at least—but that is another story, and we can only note here the economic result that by their patience and determination Canada stands to-day as the producer of over four-fifths of the whole world's output of a metal which in the present highly organized industries of the world is more essential than any other substance taken from the earth. The noteworthy feature of the Canadian nickel mines is not merely that they outweigh in value the product of all the rest of the world, but that the ratio of their output continues to increase, while the output of nickel from other countries remains stationary.

Germany Running Short

In several cases, such as Sweden, Norway and the United States (the Swedish and Finnish mines were closed at the outbreak of war), the production has diminished because the mines cannot be economically worked in competition with Canadian ores. In no case has there been an increase in these other countries. Nothing can be positively said of the nickel mines of Germany, however, because for some years no statistics have been allowed to be issued; but a deduction unfavorable to German progress in nickel mining may be made from that fact and the further fact of the strenuous efforts made by German financial interests to obtain control of the refining end of the Canadian industry before the war, and the desperate attempts made since the war, to supply the shortage by the merchant-submarine invented for that specific purpose. The latest report of the "mineral industry of the United States" does not show that any of the States mentioned are now producing nickel.

These conditions in other countries have been generally due to (1) a lower grade of ore and irregular yield; (2) to limited areas, many countries having nickeliferous rock, only in pockets, and (3) the cost of reaching the chief markets of the world. Now all three of these causes have operated to keep the output of the New Caledonia mines practically stationary for the past twenty years. The output of the island has in fact declined seriously in the past few years.

Though the Cobalt-silver ores of the Cobalt region produce nickel as a by-product, the nickel content of these ores making a respectable total averaging several hundred tons of metal per year, the chief nickel-bearing rocks are in the Sudbury district. Here there is a section 36 miles long by 16 miles wide, compared by one geologist to a boat in shape, but—in view of the enormous wealth that has been diverted into private hands at the cost of the peace and safety of the nation—it will be more significantly typified by the figure of a huge mater-melon. The extent of the melon may be imagined from the statement of Prof. A. P. Coleman, that in the southern range alone of this nickel eruptive the three-mile-wide rind would contain 4,400,000,000 tons of rock per mile, which might yield an average of 2,500,000 tons of metal per mile. On the Creighton mine over 35,000,000 tons of ore have been proved. Outside of the main rind referred to other rich deposits have been found. Another geologist says of this region: "The probability is that after a hundred years years the supply (of nickel and copper) will appear to be inexhaustible as it is to the miners and explorers of to-day. It is likely, too, that other parts of the Province, besides the Sudbury district, will be found to yield both nickel and copper." This is to be inferred from the circumstances that the belt of Huronian rocks which contain the deposits already found, extends across the Province to the Quebec boundary, a distance of 300 miles, with an average breadth of 75 miles.

Such is the present relation of Canada to this mineral, whose development is so big with the fate of nations.

The Romance of Science

By Thos. Bengough*

EVEN the "movies" are losing their power to thrill, with their rehash of stale plots and counter-plots involving distorted love, revenge, runaway and murder. The "legitimate drama" is begging for a hearing, with its mimic courts, its "stage money," and its blood-and-thunder—the latter being produced from various metallic substances behind the scenes.

It is truly refreshing at this time of jaded nerves to read the diary of such a boy as Humphrey Davy, burning the midnight candle poring over the only available books telling of the mysteries of light and heat so far as then known; sitting up till the early morning working out problems.

After being thrilled with the story of horrors connected with the explosion of "fire damp" in which hundreds of miners were burned and buried alive, young Davy got a second thrill from the thought that he might be able to prevent such tragedies by the invention of a new sort of lamp for miners. When this high purpose was once formed, writes his biographer, "Humphrey was so full of the project that all the day long he could think of little else, and at night he lay awake in his bed for many hours, planning an infinity of rude schemes for accomplishing the object he had in view."

And when at last the experimental stage was over, and the now famous "safety lamp" was a literal fact which had been tested and found true and positive, what a thrill for the young inventor! Of this wonderful lamp it has been well said that it is "a present from Philosophy to the Arts, and to the class of men farthest removed from the interests of science. We know of no discovery in which the admirer of science and the lover of mankind, have greater reason to congratulate one another. "The discovery," said Professor Playfair, "is in no degree the effect of accident; it is altogether the result of patient and enlightened research. The great use of an immediate and constant appeal to experiment cannot be better evinced than in this example. The result is as wonderful as it is important. An invisible and impossible barrier, made effectual against a force the most violent and irresistible in its operations, and a power that in its tremendous effects, seemed to emulate the lightning and the earthquake, confined within a narrow space, and shut up in a net of the most slender texture; these are facts which must excite a degree of wonder and astonishment from which neither ignorance nor wisdom can defend the beholder. When to this we add the beneficial consequences, and the saving of the lives of men, and consider that the effects are to remain as long as coal continues to be dug from the bowels of the earth, it may fairly be said that there is hardly a single invention in the whole compass of art or science of which one would rather wish to be the author."

What a real thrill there would be for the boys—yes, and the girls too,—in the upper form of our public schools, if the mysteries of science could be investigated, experimented upon, revealed, and interpreted by able and enthusiastic teachers! School days would not be long enough when real objects, quests, researches, experiments and inventions were on hand, and the young hunters were chasing their quarry to its lair! What a different world such a school would be from the dry-as-dust word-grind of to-day, when real things are left in the background, and words, words, words are demanded—words to be memorized; words to be classified, labeled, and "parsed." And all the while the terror of the fateful examination hanging over the young head—that examination on which a year's progress depends, and which is usually attended with such nervous breakdown that even at its best it does not represent the pupil's real progress, ability or standing.

Surely this war time, when Canada's national debt, mounting by millions, and soon to be twelve hundred millions, calls for changes in our training methods with a view to development of our unsurpassed natural resources—resources which can easily wipe out Canada's national debt if properly conserved and utilized.

Our schools are many years behind the times, and what we need, and need with a rush, is a new order of things that will bloom and boost the study of the sciences in all our public schools, from the lowest to highest, by the shortest, quickest, most graphic and striking method that is known or can be devised.

We have an ideal starting-point in the kindergarten, where the elements of science and art are taught in a most attractive form to children right on the threshold of their school life; but we have foolishly allowed the work to drop between the very lowest phase of our public school work and the very highest (the high school). This awful gap in the life of the mass of school children—for only ten per cent. pass on to high school—must be bridged at once, so that every boy and girl attending any public school will obtain a progressive course in elementary science. With simple apparatus and contrivances every child could get an intelligent, interesting and helpful grasp of the laws of nature—of air, breathing, exercise, digestion and the laws by which their bodies can be made and kept healthy and strong; of the atmosphere, with the laws of protection and prevention of disease; of the laws of growth of flowers, fruits and vegetables; of the mechanical powers by which human strength can be utilized to the best advantage; of substances which promote the health and progress of the race, and increase comfort and wealth; in short they can get the key that will unlock the mysteries of the universe, and enable them to feel at home in the world around them, and thus become useful citizens in the best sense.

The action of the Dominion Advisory Council on Industrial Research in offering twenty scholarships (worth $600 each) and half a dozen fellowships (worth $1,200 to $1,500 each) to bring to the front that number of young men who have shown special aptitude for research, is good as far as it goes, but it does not go far enough to make more than a ripple

*Mr. Bengough was secretary of the Commission on Technical Education appointed by the Dominion Government to investigate the scientific and technical systems of other countries and the reports he compiled are probably the most exhaustive published by any government.

on the too placid surface of our national life. We ought to have something spectacular—we ought to have at least a thousand such studentships—in order to make a stir in every locality in Canada. The offer should also extend downwards, so as to secure immediately as students of science, a host of young men and women who have not had any opportunity in this direction, but who show by their aptitudes, likings and experiments in science, that they would profit by the study and would likely make response in actual achievement.

Potash from Canadian Felspar

Process of National Potash Corporation Described.

D. J. Benham*

"Necessity is the mother of invention." This is an old adage that time and the entire history of the human race have proven true; for no matter how impossible, how complex or how difficult a national, commercial or industrial problem may appear, there has always arisen some fertile and ingenious brain equal to the occasion and capable of producing a solution in the hour of urgent need. And success has frequently been built on the failures of others by the inventive, self-reliant and tenacious men who have courage to defy failure and to break new ground without regard to well-established rules and precedents.

A noteworthy instance of this has just been rewarded by success in the manufacture of potash, that indispensable natural salt, which prior to the great European war was derived almost exlusively from the vast deposits at Strassfurt, giving to that country a virtual monopoly in a substance absolutely essential to the entire world. Potash in one of its many forms is the basis of many necessary drugs in every-day use; likewise the basis of numerous explosives but particularly of shrapnel powder; a requisite of the meat and soap trades; and indispensable as an agricultural fertilizer. In fact, its uses are as varied as they are numerous and necessary, and no effective substitute for it has been discovered.

The outbreak of the war, with its consequent blockade of Germany, the almost incalculable and insatiable demands for explosives, as well as drug necessities, created momentarily, a famine in potash throughout the world, excepting possibly within the German Empire and Austria. Only then did people fully realize the importance and the necessity of potash. The situation was dangerously acute; for the Allies must have explosives and drugs. The best chemists and engineers available concentrated their energies towards providing or developing a new source of supply, a new "war bride" as it were, which would render us independent of Germany in potash. No material in which potash was known to exist was overlooked in the laboratories of the world; for success meant merited fame and fortune to the discoverer, as well as a lasting benefit to mankind.

Some tangible idea of the acute situation so suddenly developed may be obtained from the fact that firms and dealers who had sold potash to the farmers for fertilizing purposes at prices ranging around $35 per ton, gladly repurchased it from their former customers at an advance approximating 1,000 per cent. And it is to be regretted that the farmers naturally took the cash profits thus afforded, for their lands upon which the armies of the world are so dependent, reflected starvation promptly in the declining crops of cotton, wheat and corn.

Of course, the temporary supply thus obtained was but the merest begatelle, for the daily consumption of potash in America in normal times was in excess of 1,400 tons per day, of which all had been imported from Germany, with the exception of approximately 65 tons per day, which had been produced in the United States by various means or processes, of a limited possibility for development or expansion. What the continent and the world was crying for was an unlimited supply.

Our forefathers had obtained their limited supplies of potash by the tedious and laborious process of leaching the lye from hardwood ashes, something the settlers of Ontario and their descendants are familiar with; but all the hardwood available would not have sufficed for even immediate requirements even had it been possible to get it promptly. Other sources had to be found and exploited, and attention centered on the deposits of feldspar which are distributed over North America in almost inexhaustible quantities; and kelp or seaweed, both of which were known to have a high potash content, though no process had been discovered heretofore which permitted its extraction on a commercial basis. The same was true of the great deposits of cement marl and clays, which were known to contain potash in lesser amounts than either kelp or feldspar. Necessity had never provided the incentive for the inventive and ingenious. The world had failed to realize its utter dependence on Germany and had slept in a false security.

True, very many engineers and chemists had realized that an important field for an industry was presented in the potash manufacturing; and a multitude of patents had been filed in Canada and the United States in past years, covering processes and machinery for extracting potash from feldspar; but none had been successful when put in commercial use. In fact, it had come to be regarded as a chemical and engineering impossibility; and was even so declared within the past few months at the last convention of the Canadian Association of Civil Engineers. A long record of failures was pointed t as conclusive proof of this, although as a matter of fact the new process was then a proven reality, though the announcement had not been made to the public at that time.

The results attained previously even when backed by several powerful corporations of the United States, including the fertiliser trust, and also another large concern which expended over half a million dollars in ineffectual experiments, all seemed to indicate the hopelessness of the situation. Moreover, the United States Government, as a stimulus calculated to attract the best experts in chemistry and science to the efforts to develop a permanent and adequate supply of potash within its own territory, from native materials, is understood to have made a standing offer of a cash prize of $1,000,000 as a reward for the discovery. This sum was so large that it was thought it would effect a solution of the problem, if such were possible, but it failed to achieve the desired result though naturally it did arouse protracted and genuine efforts, particularly in the experiments with feldspar. And so one of our great, potential natural resources remained undeveloped.

However, there were still many who confidently believed that when Mother Nature did instill the heavy percentages of potash content into the vast orthoclase deposits in North America, she also provided an effectual way of extracting it which would ultimately be revealed through the ingenuity of someone. This has run true, and the present great crisis in the history of our civilization was the time ordained evidently. The correct method has been finally discovered, and will be gratifying to Canadians to learn that the honor of discovery belongs to Canada. This country has already made many great contributions to the cause of the Empire and of the Allies in blood and treasure; but it may be that this discovery of a method of providing a ready and inexhaustible supply of potash may yet rank among not the least of them.

The discovery and the conditions leading up thereto through long months of tedious experimentation and often discouraging development, afford an interesting story. It is a story especially interesting to the chemical, scientific and engineering professions, wherein it has long been only an unrealized and unattainable hope.

* Secretary, National Potash Corporation, Toronto

Over three years ago the necessity of procuring a potash supply in Canada impressed itself upon Mr. Allan Grauel, C.E., of Kitchener, Ont., a gentleman of an inventive and original turn of mind. He was financially interested in a powder plant at the outbreak of the war, and the impossibility of securing the necessary potash for their operations induced him to devote his attention to the problem. Mr. Grauel had been a "hard rock" operator all his life, and he naturally turned to feldspar as the logical and proper source of supply.

Undeterred by the failures of others, and undeterred also by the discouraging results of his and with the aid of several chemists and authorities whose services he had enlisted, Mr. Grauel set resolutely to work to perfect a process for treating feldspar. For many weary months he persevered under conditions which would have caused the majority of men to abandon the project in disgust; but fortunately he had confidence in his own ability and believed he could see the way out of it as he profited by the information gained as he progressed. The experiments were very costly, requiring many thousands of dollars. Mr. Grauel speedily exhausted his own financial resources, and to his other difficulties was added the handicap of lack of necessary funds. However, a few loyal friends who had confidence in him stood behind him at critical times until finally he and they had the eminent satisfaction of seeing his dreams come true and his efforts crowned with success—a success achieved beyond question.

This fact, as we have already said, is a matter of more than ordinary importance from either a scientific, industrial or mechanical viewpoint, inasmuch as it affects vitally the interests of our citizens as individuals, and the nation and the Empire. The discovery has given to Canada at once a great and permanent industry, capable of almost immeasurable expansion in the time of peace, and to the Empire an asset of almost incalculable value in time of war. It is really a "war bride," but one which will develop and expand its beneficial effects on the country in a score of ways long after the grim shadows of the scourge of war have been forgotten, contributing to the wealth of the nation, the fertility of our vast agricultural regions and to the health of our citizens. An abundant supply of potash, at reasonable prices, to an agricultural country such as Canada may be of inestimable value if wisely and properly utilized.

The process, which is protected, consists in heating to a high temperature in a blast furance, 110 tons of a mixture of feldspar, coal, calcium chloride and limestone. The limestone is used to render the slag fluid, while the chlorine of the calcium chloride combines with the potash, forming potassium chloride which distills over at the temperature of the blast furnace into a condenser where it meets a current of steam, in which it dissolves. By a process of evaporation and crystallization of the solution thus obtained, the salt is obtained in a high state of purity.

It has been exhaustively tested and proven out in the plant of the National Portland Cement Company, Limited, at Durham, Ont., and elsewhere; indeed, the success of the process is in a large measure due to the earnest co-operation and assistance rendered by Mr. William Calder, formerly president and general manager of the plant at Durham, who unsparingly placed his extensive, modern equipment as well as his personal resources at the disposal of Mr. Grauel for the concluding experiments under commercial conditions. It is problematical if anything tangible would have resulted at this time without the liberal, mechanical assistance rendered by Mr. Calder. It was of the greatest benefit to the experiments to be able to conduct them under precise commercial conditions in a great modern plant representing a capital investment of $1,000,000. Without it much of the work would have been little better than supposition, and would have lacked the accuracy essential to the successful outcome. The trouble which has confronted many others who have experimented with feldspar lay in the fact that they had done their preparatory work in a laboratory or with small working models of a plant; but when they began a practical test in a commercial plant numerous unforeseen and insurmountable difficulties were encountered. Mr. Grauel was therefore fortunate in having a huge million dollar plant absolutely at his service, with full permission to alter and adjust wherever found necessary.

The first cause for anxiety was the question of releasing the full amount of the potash content in the feldspar and marl; but it was one which soon proven to be one of the least of the things to worry about. Progress in this matter was speedily made and it was finally found to be possible with improved and adapted equipment, combined with a scientific preparation of the "raw mix" to release and drive off under the most favorable conditions considerably over 90 per cent. of the total potash content in the feldspar, which ranges from eight to fourteen per cent. K_2O.

The next and the really genuine problem confronting Mr. Grauel was encountered in the collection of the potash vapors. Herein lay the difficulty which had wrecked so many carefully thought-out plans and aspirations. Progress was slow, but effective, until finally after numerous changes a systematic process and gas treating equipment were built up a secure basis of knowledge gained by a careful tabulation of results in each test furnished by the chemists who were constantly in attendance. As a result it is now possible to calculate with entire confidence on an average collection of at least 87 per cent. of all the potassium chloride vapors released. This is something which had hitherto been possible only in a laboratory test, consequently the scientific and industrial value of Mr. Grauel's discovery and inventions at once became apparent. The present percentage of collection, however, is not entirely satisfactory to the company, and improvements are now in course of preparation which will enable them to trap virtually 99 per cent. of the vapors.

A satisfactory process for disposition of the soda vapors from the potash, which has been a grave difficulty for many, has also been developed.

The mother liquor containing the potassium salts after being drawn off from the gas condensing and filtrating equipment is subjected to centrifugal treatment and evaporation. An evaporating pan, 12 x 60 feet by 1 foot deep being utilized.

The gas treating equipment consists of a coil through which the votailization products are collected and precipitated with steam.

For the present only muriate of potash will be produced but satisfactory experiments have been conducted in the manufacture of caustic potash. It is of course also comparatively easy to produce chlorate from the chloride, but the process requires extensive and costly electrical installations which are difficult to obtain at present, and, therefore while both caustic and chlorate are worth the fabulous prices of $1,800 to $2,000 a ton, the entire manufacturing attention of the National Potash Corporation, Limited, the company which has been organized to operate under Mr. Grauel's patents will be concentrated on the production of muriate, which is so urgently required in the manufacture of explosives and for fertilizers for the great wheat, corn and cotton belts upon which we are dependent for three agricultural commodities almost essential to the success of the Allies as explosives. Within a short time, however, the equipment for manufacturing caustic will be installed. The company expects to have its first unit with a capacity of 20 tons a day in active operation by the first of June.

Under this process it is possible not only to produce great quantities of potash, but to obtain muriate which is almost chemically pure, a standard, heretofore unobtainable without special refining. Samples have been shown, averaging, according to statistics 98 per cent. pure. When it is considered that the German muriate usually averaged 80 per cent. pure, it will readily be conceded that the new Canadian process is a scientific achievement of great interest to the chemical trade. It might even foreshadow a radical change in trade conditions, if the company can produce 20 tons per day per manufacturing unit. As the raw materials abound in all the laurentian formations throughout Ontario and Quebec in inexhaustible quantities, the producing capacity would only be limited by the requirements of the trade.

It is possible to so adapt the process and the equipment as to utilize cement marl as a raw material instead of feldspar, where the latter is not readily obtainable, and it is also possible to utilize either rotary kilns or blast furnaces of a certain type for releasing the potassium fumes. This is of a very material benefit to manufacturers, as there are numerous idle cement plants throughout this country. In the operation of a cement plant, the potash is virtually a bye-product, as the residue or clinker from the feldspar mix makes a portland cement of an exceptionally high quality and there is no curtailment of the capacity of the plant in the matter of cement. Thus a plant which is producing, say 1,500 barrels of cement a day as an average, will simultaneously produce upwards of 20 tons of muriate of potash in the same time.

In addition, the vast amount of dust, which has hitherto passed up the smokestacks and has been dissipated over the countryside, can be trapped within the plant and coverted into a valuable bye-product as fertilizer. It has been shown by analysis that it contains from 3.09 to 10.7 per cent. of alkaline chlorides, mixed with lime and other substances, constituting a high grade agricultural fertilizer. Upwards of 60 tons a day of this important commodity, which formerly went absolutely to waste in a plant operating eight rotary kilns is thus converted into a useful article worth from fifteen to twenty-five dollars a ton.

In operating the blast furnaces, the slag is converted into sewer pipe, tile and paving brick, being poured direct from the furnace into the moulds. It has a peculiar porcelain-like surface like all feldspar products. The establishment of a large allied industry along these modern lines can thus be foreshadowed. In this age of cement, there is thus opened an inviting field for auxiliary industries, capable of great expansion by the potash producers. It also assures the development of the great Canadian feldspar fields, which heretofore have only been operated in the most meagre way to provide the materials for the big merican pottery plants. These associated industries will also play an important part in the future of the Canadian potash industry, as they figure largely in the cost of production. By their aid, the Canadian company will assuredly be able, not only to break effectively the world-wide monopoly of Germany in potash production, but it should be able to capture and hold securely the whole American market, if it treats the consumer fairly. It is safe to predict that Germany's great trans-Atlantic trade in potash, amounting to many millions of dollars is forever lost to her, for notwithstanding the fact that prior to the war, muriate from Stassfurt was worth from $37.50 to $50.00 per ton, f.o.b. New York, whereas to-day muriate is worth from $250 to $450 a ton. The Canadian company considers that it can contemplate with complacency, competition, even on the former basis, though America will not likely see potash retailing below $100 a ton for several years to come. In this connection, officers of the company state that they will produce muriate of a quality heretofore unequalled at a price that will be less than the ocean freight on the German product.

The results to be attained are not left to speculation or mere supposition. Every step in the work has been carefully recorded; and in the matter of what may be done comparison might be made with the plant of the Riverside Portland Cement Company, at Riverside, Cal., which has been operating a dust plant with the Cottrell system of electrical precipitation for some time. They have few of the natural advantages of the Canadian company, but they have demonstrated definitely the operation of potash volatilisation in portland cement burning kilns. They have shown in their plant that potash is volatilised in the "burning zone of the kiln, the amount thus volatilized depending entirely upon the factors of time and temperature. The emission of the potash apparently follows ordinary vapor pressure laws, being quite independent of complex chemical considerations. Potash, in this plant, is volatilized in the form of K_2O which immediately reacts to form other salts with various constituent gases. Owing to presence of sulphur in their fuel, the potash combines with the SO_2 and is oxidized immediately to form potassium sulphate. The resulting fumes are carried by the kiln gases into the electrical precipitators, in which a fractionation of the material is accomplished. The commercial result has been that a 10 per cent. K_2O material is collected.

From this description of the Riversike operations, however, it is easy to form a mental comparison with the equipment of the National Potash Corporation, Limited, the latter using moisture instead of the electrical process of precipitation.

In the Riverside plant the percentage of potash content in the "raw mix" is about 0.5%, and the volatilization of even this very small amount of potash content is only about 60%. Yet in normal times, with no inflation of war values, they were able to pay a net profit of $64,430.00 per annum on a total investment of $180,000 in plant.

Compared with their "raw mix," however, the National Potash Corporation, with feldspar as a material, and using the blast furnace equipment, has a "mix" containing not less than 9½% to 12½%, potash content, according to the quality of the feldspar used, it being assumed that nothing with less than 10% is put through the crushers. In their cement "mix" the average of potash content is between 2½% and 3%; and they volatilise over 90% thereof, as compared with 60% in Riverside. The net result indicates that the Canadian company, in its cement plant operations, is able to volatilise from 2¼% to 2¾% of their entire mix, compared with 0.30% secured by the California company.

There is, however, a peculiar feature connected with the burning of feldspar, for which no reason is yet revealed. This is the fact that all of the potash content does not volatise at the same degree of temperature. A certain percentage is released at say 900 degrees centigrade, more at 1000°, and so on until the last of it is finally driven off in the neighborhood of 1600°. This feature has presented grave difficulties.

In connection with the manufacture of potash, it is interesting to note that necessity also provided another source of supply in America besides feldspar, namely, kelp or seaweed, which has long been known from breach-combing operations to contain a small potash, iodine and acetone content. The story of its development, too, is interesting in the extreme; for while minor experiments with this material had been successfully made at Vancouver and Victoria, it remained for a great American powder company to really prove out and develop the process—a feat of manufacture and enterprise which has since become a theme for thrilling moving picture films.

However, it is contended that kelp affords no guarantee of a permanency of supply, such as is afforded by the great orthoclase deposit throughout America, and there are many difficult and expensive features about its conversion into potash. Not the least of these is the harvesting and drying it in all kinds of weather. It has to be burned and the potash is leached from the residue; and it is considered by some authorities to be doubtful if, under even normal conditions, potash can be produced from kelp for less than $100 per ton. It may be, and it is to be hoped that it can, for there is room in the market for all that can be produced from available sources. At any rate, the present operations must stand as a monument to American ingenuity and enterprise, which quickly solved a desperate situation.

But as a commercial proposition in competition with the latest Canadian "War Bride," the process of the National Potash Corporation, Limited, with its raw material of feldspar, rich as it is in potash content, it would almost be like putting the archaic hardwood ash leach of our forefathers against the modern methods of Stassfurt.

The first plant of the Canadian Potash Corporation will be located at Gravenhurst, Ont., and will consist of a battery of blast furnaces with attendant equipment as quickly as the instalation can be made. The plant and site of the Gravenhurst Crushed Granite Company has been acquired, together with an immense deposit of high grade feldspar so located as to give a gravity dump from the blasting pit to the great crushers having a capacity of about 200 tons per hour.

As one furnace will require only about 110 tons of feldspar per day, and produce therefrom about 20 tons of potash (KCO) and 800 feet of 20-inch sewer pipe, an idea of the plans and scope for possible development may be gathered.

The furnaces to be installed are designed and patented by Mr. P. McCaffery, president of the company, and a mining engineer who first came into prominence some years ago in the Denver camp, when he perfected a system for the extraction of copper which, like the extraction of potash from feldspar, had been declared by many to be impossible.

Chemistry in Canadian Woods

Dr. John S. Bates, superintendent of the Forest Products Laboratories, established by the Department of the Interior in association with McGill University gave a most instructive paper to the Canadian Society of Civil Engineers a few days ago on the "Present and Possible Products from Canadian Woods."

After pointing out that the products of Canadian forests rank next in value to agricultural products ($175,000,000 exclusive of the pulp and paper and some other industries based on wood) and that the capital invested in wood industries is larger than any other group in Canada, (over $320,000,000), Dr. Bates took up the various wood industries created by purely mechanical means, such as lumbering and its subsidiary industries. He indicated the remarkable development of the pulp and paper industries in recent years, showing that by reason of the vast water powers and resources of pulp wood forests Canada was destined to become one of the leading pulp and paper manufacturing countries of the world.

It is in the pulp and paper industries that chemistry enters, beginning with the production of sulphite and sulphate pulps and extending into the various special kinds of paper and cellulose products. He mentioned the interesting fact that the sulphate process by which the Kraft papers are made and which were only introduced into the Canadian mills a few years ago, now account for over 13 per cent. of the output of pulp in this country. It is made by the combined action of caustic soda and sodium sulphide on soft wood chips and makes a flexible fibre which is is displacing the old wrapping papers by reason of its great strength and toughness. While the manufacture of Kraft papers is growing rapidly the sulphite pulp still forms about 35 per cent. of the pulp made in Canada and the total production of sulphite pulp here has reached 1,000 tons per day.

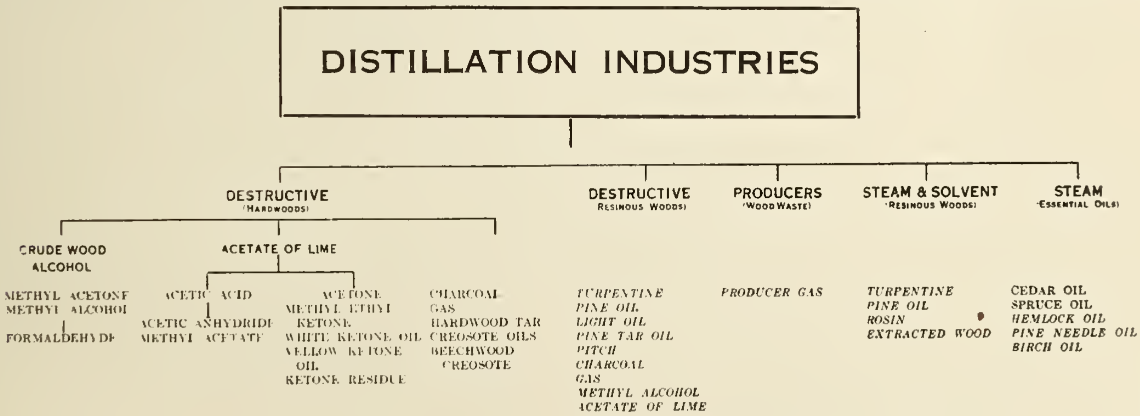
Distillation Industries

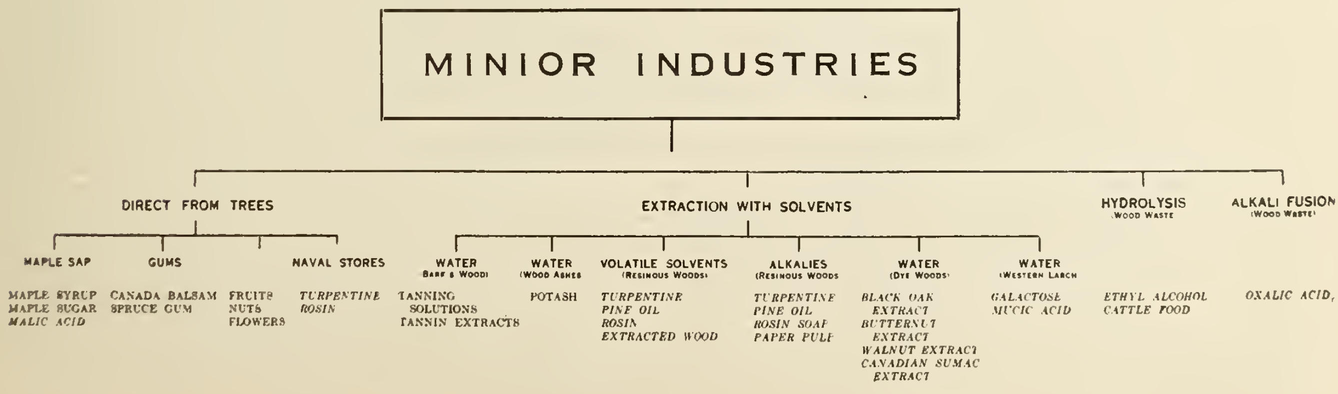
With regard to Canadian developments in distillation processes based on wood Dr. Bates said:

The destructive distillation of hardwoods is the only important distillation industry in Canada where wood is used as raw material. There are now eleven plants in Ontario and Quebec and the industry is well organized. It is gratifying to note that manufacture is carried beyond the stage of the crude products, where so many of Canada's industrial activities cease, and that the specially refined and derived products are produced in Canada for local and export trade. In the limited list of chemicals which are regularly exported from Canada there are

In a diagram showing the various products from Canadian trees, Dr. Bates enumerated about 70 items of manufacture from wood as wood or lumber; and 64 different products specifically based on the pulp and paper industry.

The following "trees" show the ramification of manufacturing in the chemical branches of the wood industries.





only three of much importance, namely calcium carbide, acetate of lime and methyl alcohol, the last two of which are entirely produced by hardwood distillation. It is important to remember that practically all the wood alcohol, and acetic acid which are so essential to modern civilization are produced by the destructive distillation of hardwood. The Canadian plants together consume over 500 cords of wood per day. Maple, beech and birch are the main species used, although oak, hickory and other hardwoods are suitable if they can be obtained. The primary distillation process is rather crude, the cordwood sticks being run into retorts on cars and the retorts being heated externally by fire which is controlled to some extent. The crude decomposition products which are driven off go through a series of refining operations for the separation and purification of the valuable products.

The crude wood alcohol is collected at a central refining plant where distillation products are separated in accordance with market demands at the time. The methyl acetone or acetone-alcohol solvent is a mixture of methyl alcohol and acetone with smaller quantities of methyl acetate, acetaldehyde and other compounds and is valuable solvent in the paint, varnish, leather and other industries. Methyl alcohol (wood alcohol) in the pure state (Columbian spirits) or containing more or less acetone is widely used as solvent, fuel, denaturant for industrial alcohol and in many chemical industries. Formaldehyde is produced by oxidation of methyl alcohol vapor with air in the presence of heated copper gauze and is in strong demand at the front for disinfecting purposes.

The acetic acid distilled from the wood is recovered in the form of gray acetate of lime and before the war America exported over half of the production to Europe for the benefit of foreign chemical industries. The main peace uses are for the production of acetic acid by distilling with sulphuric acid and in turn the manufacture of white lead, iron and aluminum acetates used as mordants in dyeing, and a variety of other acetates. Methyl acetate solvent is made from acetic acid and methyl alcohol. Acetic anhydride is another derivative of acetic acid and its production in Canada has been developed since the outbreak of war for the manufacture of aspirin in Montreal and elsewhere. It is also used for the manufacture of cellulose acetate which is becoming of more and more importance. The war has brought about a very radical change in the disposal of acetate of lime on account of the tremendous demand for acetone as a solvent for gun cotton in the manufacture of cordite, which is the most important British propellant explosive. Canada has played a large part in the furnishing of this solvent not only by hardwood distillation, but also by developing new chemical processes on a commercial basis. By decomposing acetate of lime in suitable retorts acetone is the main product and the higher ketones and ketone oils are refined for use as solvents in the artificial leather industry and elsewhere.

Hardwood charcoal is the other valuable product and is mainly used as household fuel and for manufacture of charcoal iron. The wood gas is of rather low heating value and is burned under the retorts. The hardwood tar is also used as fuel at the plant in most cases as the constituents have not the inherent value of the more widely-known coal tar; however, the recovery of certain by-products has important possibilities. The various creosote oils which are obtained in the course of separating the wood alcohol and acetic acid from the tar are at present of minor value, but recent investigations by the Forest Products Laboratories of Canada indicate that they are suitable for the flotation of Cobalt and other Canadian ores. So-called beechwood creosote is a standard article in the drug trade and is made by chemical treatment of hardwood creosote oils.

Destructive distillation of resinous woods is a much different proposition and aims mainly at the recovery of turpentine, pine oil and pine tar oil together with softwood charcoal. The industry has had a more or less checkered career in the Southern States where the very resinous "lightwood" of the longleaf pine is available. The wood is destructively distilled in retorts designed somewhat differently from hardwood retorts in order to give better temperature control. The uses of turpentine are well known and pine oil is valuable in the drug trade and for flotation of ores. The crude tarry fraction is large in quantity and as "pine tar oil" commands a fairly good price for impregnating ropes, staining shingles, etc. The yields of methyl alcohol and acetate of lime are much smaller than in the case of hardwoods and by present methods recovery has not been found profitable. Experiments have indicated that the resinous stumps of western yellow pine in British Columbia compare very favorably with southern pine in yields of distillation products and the old red pine stumps of Ontario contain a good deal of rosin and some turpentine. When the industry becomes more highly developed it will no doubt be established at certain points in Canada.

Wood waste of various kinds can be used in place of coal for the generation of producer gas and this method of utilization is practiced in Europe and to some extent in the United States. The increased efficiency of the producer and gas engine over the boiler and steam engine is a well-known advantage in the handling of fuels. In Canada wood waste occurs in such large quantities and is so easily used as fuel directly under steam boilers that there is not so much occasion for installing the more complicated large-scale gas producers. In line with the manufacture of producer gas it is important to mention the destructive distillation of wood waste modified to yield the maximum amoung of wood gas. A number of centres in America are now using wood gas for heating and illuminating purposes and as motor fuel.

The steam and solvent process applies to resinous longleaf pine in the Southern States. The selected wood waste is hogged or chipped, steamed to drive off most of the turpentine and pine oil and then extracted with gasoline or other volatile solvent for the recovery of rosin. The extracted wood is used in the manufacture of composition flooring blocks and is also suitable for manufacture of pulp. The resinous wood material in Canada is limited in quantity and not very high in quality, so that economic recovery of products is a more difficult problem.

By steam distillation of the leaves and twigs of certain trees which contain essential oils, products are obtained for the drug trade. Most of the cedar oil is produced by distilling the waste cedar wood in pencil manufacture and this particular species (Juniperus virginiana) does not grow commercially in Canada. Ordinary eastern cedar provides a small amount of cedar-leaf oil, and spruce oil is of some importance. A number of the essential oils which are well known in the drug trade are supplied from European tree species. Birch oil is mainly oil of wintergreen, which is now made synthetically.

Minor Industries

There is a variety of other processes for recovering products from trees, only a few of which are of importance in Canada at present.

Of products which are taken directly from the living trees maple sap takes quite a large place. The maple sugar industry in Canada furnishes products worth over two million dollars per year, over half of which comes from the province of Quebec. Calcium bi-malate has been recovered from the "sugar sand" in boiling down the syrup and is considered by the Macdonald College authorities to be superior to cream of tartar or other acid materials used in baking powder. Malic acid can also be produced from the malate of lime and is a high-priced chemical. Canada balsam and spruce gum are well known products which are obtained from balsam fir and spruce, respectively. Some of the fruits, nuts and flowers come from forest trees, although it is not intended to include the whole fruit industry, for example, under this head. The naval stores industry of the Southern States provides the bulk of the turpentine and rosin used throughout the world and involves the "chipping" of long-leaf pine trees. Experiments are now being carried out on western yellow pine in British Columbia with some prospect of commercial success.

Solvents are used in various ways to extract valuable products from certain kinds of wood material. In Canada hemlock bark is used directly in the tanneries and at one plant in New Brunswick for the manufacture of concentrated tannin extract. Oak bark and chestnut wood are of minor importance owing to the limited range of these species in the southern sections of Canada. The recovery of potash from wood ashes was at one time the main source of potash in Canada, but for many years the cheap potash salts from Germany have overshadowed all other sources. Since the outbreak of war there has been some revival of potash recovery in Canada owing to the great advance in prices. Hardwood ashes are the richer for treating, but in any case wood ashes should reach the land as fertilizer. The extraction of resinous woods with volatile solvents and the separation of the turpentine and pine oil from the rosin by distillation is not a promising industry for Canada on account of the limited supply of sufficiently resinous woods as already explained. This also holds true of extraction with weak alkali solutions whereby turpentine and pine oil are distilled with the steam, the rosin recovered from the solution in the form of soap by "salting out" with more alkali and the extracted wood cooked with the strengthened alkali to produce paper pulp. Dye woods are of but little importance in Canada. The extract of black oil is used partly as a tanning material and partly as a dye, while walnut and butternut extracts give a brown coloring material and the flowers of sumac a red dye which is at least used locally throughout the country. The laboratory of the United States Forest Service has made an interesting discovery that western larch contains from 6 to 8 per cent. of water-soluble material which is mainly galactose sugar. Various products including table syrup, ethyl alcohol and mucic acid which may be used, as a constituent of baking powder can be manufactured therefrom. It may be that a small industry can be established in Western Canada.

Hydrolysis of sawdust or hogged wood-waste is carried out by dampening with a certain proportion of dilute sulphuric acid and steaming under pressure for a short time. Part of the wood substance is thereby converted into sugars, most of which can be fermented by adding yeast to the neutralized water extract with recovery of ethyl alcohol (grain alcohol). The yield from softwoods is about 20 U.S. gallons (16.7 Imp. gallons) of 95 per cent. alcohol per ton of dry wood and it is estimated that the cost of production can be reduced to 15-20 cents per gallon. Two plants are operating in the United States, each consuming several hundred tons of wood waste per day. Undoubtedly the industry will be established in British Columbia or at other large saw-mill centres in Canada when the economics of the process are more definitely established and when Canada joins the other civilized countries of the world who have given their chemical industries the necessary factor of tax-free industrial alcohol. Cattle food as a substitute for hay can be recovered by removing the acidity from the hydrolyzed wood mass and in some cases mixing with waste molasses.

By heating a softwood sawdust at moderately high temperatures with a strong solution of caustic soda or caustic potash a large proportion of the wood is converted into sodium oxalate. The valuable product oxalic acid can be recovered by precipitation of the extract with lime and treatment of the calcium oxalate with sulphuric acid. One plant has been established in the United States, but it is doubtful if the industry will assume large proportions on account of cheap production of oxalic acid by other chemical methods, especially in Europe.

The Transformation at Trenton

A year ago the population of Trenton, Ont., was five thousand. It had no more inhabitants ten years before that; but a group of chemists and engineers came along last year and decided that Trenton was a suitable site for a high explosives industry, and between this and other combinations of events the town has to-day a resident and floating population of 10,000, and it is difficult to get house accommodation for newcomers.

The British Chemical Company, the largest of the new industries here, has a capital of several millions secured for its work by the Imperial Government, and this company is already turning out gun cotton and will make high explosive acids and T.N.T. (tri-nitro-toluol). Such a transformation have these works made in the old normal life of the town that there are Trentonian enthusiasts who look to a time soon at hand when T.N.T. will be recognized as the symbol for Trenton.

Having purchased several properties aggregating 233 acres on the east side of the river Trent, near the G.T. R. line and also near the dam above the town the British Chemical Company started to build a series of structures, some of them 600 feet long, for its high explosives and acid plants. In this locality the gradual rise of the land from the river shore forms an ideal situation for the acid plant, affording a ready flow of liquids from one stage of the process to another. The works are so laid out that the acid plant may be doubled in capacity on the present site. Power is derived from dam No. 2, but should more power be wanted it can be supplied from the several hydraulic installations acquired recently by the Hydro Electric Commission in the Trent Valley series, which are capable of furnishing ultimately nearly 70,000 horse power. The chemical equipment is being installed under the auspices of the Pratt Engineering & Machine Company, of New York, Atlanta and Chicago, and other structural works, including the trinitro-toluol plant, under the Church Ross Company, of Montreal. In the structural and preparatory work from 2,000 to 3,000 hands are temporarily employed, and when in running order several hundred skilled hands will be permanently employed. Sidings connect the works directly with the C.P.R. and C.N.R. as well as the Grand Trunk System of railways, while the harbor of Trenton, gives access to the Great Lakes and the Trent Canal with the inland waters of Ontario.

These works are so designed that when the war is over the output now taken up by the demands of the conflict may be readjusted to the requirements of the industries of peace.

The works are under the supervision of C. M. Barclay, representing the Imperial Munitions Board. The chief chemist is Dr. A. A. Swanson, Ph.D., of Princeton University, formerly chief chemist at the Aetna Chemical Company's works. The assistant chemist is H. N. Lyons, B.Sc., a graduate of the Pennsylvania State College, and lately with the Hercules Powder Company, who have fifteen plants working on explosives in the United States. Mr. Lyons was chemist at the Kennel, N.J., plant.

Among the other industries in Trenton the Canadian National Features, Limited, of which George Browning is manager, have started the manufacture of moving picture films. From forty to sixty hands are employed.

The Benedict Manufacturing Company, of Syracuse, N.Y., will start a Canadian branch for the manufacture of silver, brass and bronze goods.

There are reports that the Canadian Iron Mines Company, controlled by the Canadian Northern, will soon start up the iron ore concentrator at present idle here.

Joint Committee Activities

The Joint Committee of Technical Organizations of Ontario, which was created at the beginning of the year has been very successful in bringing together the men of science of the province to aid in the prosecution of the war, and also to devise ways and means by which the technical men of the province may, as a result of their special training and experience, render assistance in the development and government of the Dominion. The committee itself consists of a representative from each of the technical clubs and organizations in the province with as many as five other technical men able to be of service to the committee.

One of the activities of the joint committee, designed as a basis of future operations, was to take a man-power census of the twenty-five hundred members of all the technical organizations in the province. A blank card was prepared and sent out and practically all of these have been returned, properly filled in.

The committee is in close touch with the Imperial Munitions Board, the Honorary Advisory Council for Scientific and Industrial Research, the Militia Department and the Soldiers' Aid Commission, and have interested themselves as a body in the establishment of research laboratories at various points in the province.

Advisory Committee Meets

After being in session at Ottawa for a couple of days in April, the Advisory Council for Scientific and Industrial Research, of which Professor A. B. Macallum of the University of Toronto, is the chairman, has adjourned until the middle of May, when another meeting will be held at the capital. At the next meeting there will be formally constituted a number of committees, made up of distinguished representatives in the Dominion of several branches of technical work. These committees will be associated with the Council in the work of research and development in connection with their respective industries.

Progress of Committees

Reports of satisfactory progress were received from a number of the committees previously appointed. Among these committees were those that have been studying such subjects as the manufacture of iron and steel from the iron ore found in the Dominion, the manufacture of oil and other similar products from the oil shales of the Athabaska region, north of Edmonton. One important question that was considered at the meeting was how the manufacturing plants now making munitions may be utilized, after the war, for the manufacture of other products. The council is also considering, in a broad way, the more efficient use of the agricultural lands of the Dominion.

Studentships Established

In connection with the decision to establish a number of research studentships and fellowships it was announced that there will be twenty studentships and five fellowships. The studentships are of the value of $600 for the first year and $750 for the second year. The research fellowships are of the value of $1,000 for the first year and $1,200 for the second year. if the Advisory Council should decide to extend the fellowships over two years. The details of the plans have been communicated by the Cabinet to all Canadian universities.

Indigo

Advices from Midland, Michigan, tell us of the first production of indigo from coal tar in the United States. One thousand pounds of 20 per cent. paste are produced daily despite the fact that in the last tariff bill the ad valorem duty on dyestuffs was struck off for indigo and alizarine colors. The annual consumption of indigo in normal times is 10,000,000 pounds annually. By 1912 the German makers of the coal tar indigo, which is chemically the same as the product of the tropical indigo plants, had driven the natural product from the world's markets, including even China and Japan, where vast quantities of it are grown. The artificial is better and more reliable than the natural dye. Owing to the war, the natural product has come back upon the market again, but in normal times it can hardly be expected to hold its own.

The Canadian General Electric Company, Toronto, which has furnished equipment to a number of important electrochemical works during the past year, has held its annual meeting, at which the gross profits of the year were reported to be $2,225,912, the largest in the company's history. Nearly $800,000 was paid in dividends, and a sum of $631,603 was set aside for the amortization of the munitions plant. About 5,000 hands are now employed in the company's various plants.

Canadian Feldspar Notes

Kingston.—A few years ago only one company was operating a feldspar property in Ontario, but tod-ay there are six or more, and the demand from the United States exceeds the supply. It is stated that all feldspar prospects or virgin properties are being purchased by Americans. In former years feldspar was used only by potteries. It is now exported to the United States also by fertilizer companies, as it contains a large percentage of potash. The Feldspar Limited, Verona, Ont., is constructing a trolley four miles long from its mine to the C.P.R.

The percentage of potash in the Canadian feldspar varies from 10 to 14. Prior to the European war the feldspar from the Kingston district was only employed in the manufacture of pottery, but since the importance of potash from Europe has ceased, the Canadian feldspar has been substituted by soap manufacturers and fertilizer makers. The spar in this district is on the whole in a clear and pure state, requiring little cobbing or handpicking. Analysis of feldspar found in this district is as follows: Silica, 65.40 per cent.; alumina, 18.40; potash, 13.90; and soda, 1.95.

The best time for the exportation of this mineral is during navigation season from April 1st to November, when special freight rates can be had by boat from Kingston to points in northern New York. One of the mining properties in this district has a grinding plant near Rochester, N.Y., and the product is sold to the potteries.

Shawinigan Falls Development

The history of Shawinigan Falls, Que., from the time of its foundation in the water power of that place reads like a fairy tale, but it is a fairy tale based on accomplished facts, as any visitor at the present time may see.

It is not many years since the writer, in company with a party of members of the Canadian Society of Civil Engineers, beheld the beginnings of the first hydraulic works started in the spruce forest around Shawinigan Falls. Commencing with a power transmission line to Montreal and other places the village of Shawinigan Falls soon began to take on a distinct character in the industries created by its ample hydraulic power. The electrolytic refinement of minerals naturally came to this new industrial site and plants devoted to the manufacture of aluminum, calcium carbide, magnesium and other products were established one after another until now there are no less than twenty-two corporations carrying on work in this growing town. It has now reached a population of ten thousand, having doubled in a few years, and is, therefore, of the dimensions of a city. These companies are not all engaged in producing metals and chemicals, but include an electric railway company for the operation of the public utilities, hotels, etc.

The Canadian Chemical Journal hopes to give at another time a more comprehensive sketch of the remarkable developments of Shawinigan Falls. In the meantime, readers will be interested in the fact that the Canada Carbide Company's works, producing the raw material for acetylene gas, is now turning out 125 tons of carbide per day. The company makes its own lime for the carbide and has recently added seven kilns, making eleven lime-kilns now in operation. It also makes its own packages for shipping carbide, runs its own saw-mills, for the package department, and is practically a self-contained industry.

Another important development since the war is that of the production of metallic magnesium by the Shawinigan Electro-Metals Company, Limited. As is well known, the production of metallic magnesium was practically monopolized by German producers, and when the war cut off supplies from that country the allied nations and the United States were at their wit's ends to obtain magnesium in any form. The Shawinigan Electro-Metals Company then started in and utilizing the deposits found in the Ottawa Valley and portions of Quebec have already achieved a success which has won the admiration of those who are large users of the metal and its various compounds. The company's latest achievement is in the manufacture of metallic magnesium in the form of both wire and ribbon. The metal ribbon is wound on spools or drums and is in demand by kodak and film manufacturers and makers of scientific apparatus. The company has not merely produced a magnesium which will pass in the market, but it has actually excelled the German product in point of quality and purity. We have this on no less an authority than that of Dr. W. M. Grosvenor, who in a paper read before the New York section of the American Electro Chemical Society, states that the German magnesium rarely exceeded 98 per cent. and frequently fell below that, whereas the Shawinigan Falls product has actually reached, and often exceeded 99 per cent. in purity.

We thus have in this new seat of industry a product which is based on Canadian raw material and which in times of peace can be extended in many ways for magnesium can be turned into many uses and is capable of many combinations. It is used largely now in the war, for magnesium is a material from which are made the star shells that light up the battlefields of Flanders. The Shawinigan Electro-Metals Company now produce magnesium in ingots and in the form of powder, as well as in the ribbon and wire already mentioned.

Canadian Antimony Production

In a paper read before the Canadian Society of Civil Engineers recently, Mr. J. A. DeCew, chemical engineer of Montreal, outlined his method of recovering antimony from its ores by a process of volatilization. Owing to the fact that antimony sulphide burns readily to the oxide in that both these compounds are volatile, a blast furnace is arranged to make use of this fact, air being passed in at the bottom and the gaseous oxide conducted into an apparatus similar to a condenser, where it is condensed and deposited. To covert the oxide into the metal, the oxide is mixed with finely divided carbon and sodium carbonate and heated in a reducing atmosphere on the floor of a reverberatory furnace to a temperature between 800 and 900 deg. C.

It is a matter of regret that shortly after Mr. DeCew had erected a large plant in New Brunswick for the production of metallic antimony, the visible supply in that province petered out and the plant and process had to be abandoned.

According to the annual report of the Department of Mines at Ottawa for 1915, 1,341 tons of antimony ore and metal were produced during that year, this being the first recorded production since 1910. The ore is found at Trail, Lake George, N.B., West Gore, N.S., and in smaller amounts at various places in British Columbia and the Yukon.

Toronto Chemists Pass

The results in the Faculty of Applied Science of the University of Toronto have been issued and it is noticed that, with the exception of three freshmen, all the undergraduates in the chemical departments, have passed their respective years. J. V. Dickson graduates with honors and three other students who have been employed on munition work are granted standing conditionally.

By a recent order-in-council the export from Canada of cyanide of sodium and compounds and mixtures combining cyanide of sodium is prohibited to all destinations except Great Britain and British possessions. British orders-in-council have also been promulgated recently restricting the importation into Great Britain of many articles, including various chemicals. To export such chemicals from Canada to Great Britain a license has to be procured. Information on these matters may be obtained by writing to the Department of Trade and Commerce, Ottawa.

Society of Chemical Industry

The last regular meeting for the season of the Toronto branch of the Society of Chemical Industry was held at the Engineer's Club on April 26th. The subject of the evening was the manufacture of phenol, Dr. M. C. Boswell introducing the subject by reviewing the work that was done in the laboratory after all the available references had been consulted and many months spent on finding the best process and altering it to suit such conditions as the replacement of potash salts by those of sodium. Typical reactions of phenol were also given, showing the great number of substances that are made by the action of various reagents.

Mr. H. Van der Linde, who was engaged in erecting the first successful phenol plant in the States, following Dr. Boswell's laboratory work, described the difficulties that were encountered in the process and, by means of lantern slides, illustrated some of the apparatus used in the industry. Difficulties were encountered in every operation, the yield was low at the beginning, but by patient research each operation was brought up to the high standard of efficiency now maintained at the plant.

Notes From Near Niagara

The electrolytic treatment of metals has made a new reputation for the group of towns and villages in the Niagara district centering around Welland and St. Catharines. For example the population of the town of Welland three or four years ago was under 5,000, while to-day it is estimated at 11,000 and Welland is therefore entitled to a charter as a city. This charter will be conferred on the next Dominion Day.

In 1906 the workers in industrial establishments in Welland numbered 100, in 1912 they were 3,000 and last year they were 4,890; while the annual value of the output of the factories increased from $50,000 in 1906 to $3,610,000 in 1916. There are now 22 establishments in Welland. A large share of the present output is due to the munitions work, but mnone the less the industrial advance of Welland, as of St. Catharines, Thorold, Merritton, Port Colborne and Niagara Falls, is founded on the cheap and plentiful supply of hydraulic power derived from the great Niagara. This power has naturally led to a specialization in metallurgy and hence are found such important works as the Coniagas Reduction Company, and the Canada Carbide Company, of St. Catharines and Merritton, the Volta Manufacturing Company, the Canadian Steel Foundry Company, the Electrical Steel and Metals Company, the Electro Metals, Limited, (Crocker Bros., New York), Metals-Chemical Limited, and the Union Carbide Company, at Welland, among the more recent establishments, and lastly the large nickel refining works of the International Nickel Company at Port Colborne, referred to elsewhere. From a few hundred horse power used eight or ten years ago the electro-metallurgical works of Welland now require about 80,000 horse power.

These are a few indications of the transformations brought about by the application of electricity to the smelting and refining of metals, and in view of the new hydraulic works decided on by the Hydro Electric Power Commission of Ontario, at Chippawa, adding 300,000 electric horse power to the power already in use in this vicinity, there seems every reason why, in a few years, all the land comprised in the district indicated by the towns and villages mentioned should become one great metropolitan area of population drawn together by the electrochemical magnet.

An interesting event of the month of May is the meeting of the American Electrochemical Society at Detroit, opening on the 2nd and closing on the 5th. As the meeting is along the Canadian frontier there will no doubt be a good contingent of Canadian visitors.

The Mineral Production of Canada in 1916

(Subject to Revision)

Metallic Products

	Quantity	Value
Antimony ore (exports), tons*	794	$48,158
Cobalt metallic and contained in oxide, etc., lbs.	841,859	926,045
Copper, value at 27.202c. per lb., lbs.	119,770,814	32,580,057
Gold, oz.	926,963	19,162,025
Iron, pig from Canadian ore, tons	115,691	1,328,595
Iron, ore sold for export, tons	140,608	393,689
Lead, value at 8.513c. per lb., lbs.	41,593,680	3,540,870
Molybdenite, contents at $1 per lb., lbs.	159,000	159,000
Nickel, value at 35c. per lb., lbs.	82,958,564	29,035,497
Platinum, oz.	15	600
Silver, value at 65.661c. per oz., oz.	25,669,172	16,854,635
Zinc, value at 12.804c. per lb., lbs.	23,515,030	3,010,864
Total		$107,040,035

Non-Metallic Products

	Quantity	Value
Actinolite, tons	250	2,750
Arsenic, white, tons	2,186	262,349
Asbestos, tons	136,016	5,133,332
Asbestics, tons	18,500	27,147
Chromite, crude ore,† tons	27,030	299,753
Coal, tons	14,461,678	38,857,557
Corundum, tons	67	10,307
Feldspar, tons	19,166	71,357
Fluorspar, tons	1,284	10,238
Graphite, tons	3,971	285,362
Grindstone, tons	3,328	50,982
Gypsum, tons	341,618	730,831
Magnesite, tons	55,413	563,829
Manganese, tons	979	90,791
Mica, tons	914	122,541
Mineral pigments—		
Barytes, tons	1,368	19,393
Oxides, tons	8,811	58,711
Mineral water	....	114,587
Natural gas, M. cu. ft.	25,238,568	3,924,632
Peat, tons	300	1,500
Petroleum, barrels	198,123	392,284
Phosphate, tons	203	2,514
Pyrites, tons	309,411	1,084,019
Quartz, tons	135,803	241,806
Salt, tons	124,033	668,627
Talc, tons	10,651	36,475
Tripolite, tons	620	12,139
Total		$53,075,813

Structural Materials and Clay Products

	Quantity	Value
Cement, Portland, barrels	5,359,050	6,529,861
Clay Products—		
Brick: common, pressed, paving	......	2,358,245
Sewer pipe	......	716,287
Tile, pottery, refractories	......	1,104,901
Kaolin, tons	1,750	17,500
Lime, bushels	5,482,876	1,089,505
Sand and gravel	......	1,734,183
Sand-lime brick	13,825,307	113,136
Slate, squares	1,262	6,223
Stone—		
Granite	......	1,277,019
Limestone	......	2,326,519
Marble	......	118,810
Sandstone	......	145,711
Total structural materials and clay products		$17,537,900
All other non-metallic		53,075,813
Total value, metallic		107,040,035
Grand total, 1916		$177,653,748

*Tons of 2,000 lbs.

†Ore and concentrates finally marketed estimated as 13,834 tons.

Scientific Farm on Long Island

C. W. Munson, former president of the Munson Steamship Company, is planning to turn his 500 acre estate on Long Island, into farm land and in an effort to prove that produce scientifically grown can be sold in the public market at lower prices than in any recent year.

Huge Increase in Canada's Mineral Production

The preliminary mineral report for the year 1916 has recently been issued and it shows the value of minerals produced to be $177,653,748, which is an increase of about thirty per cent. over the production of the previous year. The best previous production was $145,634,812 in 1913.

The figures show the stimulation produced by the demands of war on nickel, copper, zinc, molybdenum, iron and steel has been very great and that also magnesite and chromite are now being produced in Canada, instead of being imported.

New industries established during the year comprise the installation of electrolytic zinc and copper refineries at Trail; the beginning of construction of a nickel refinery at Port Colborne; production of metallic magnesium at Shawinigan Falls; the production of ferro-molybdenum at Orillia and Belleville; also metallic arsenic; stellite, a new cobalt alloy for high speed tool metal and increased production of steel, by the electric furnace method.

The accompanying table shows the detailed production figures for 1916.

Gold.—The total production in 1916 was $184,124 greater than in the previous year. Twenty-six per cent. was derived from placer and alluvial mining; 54% in bullion and refined gold and 20% in matte, blister copper, residues, etc. Practically all the gold produced was exported.

Silver.—The production of silver was 3.6% less in 1916 than in the previous year, but its value was 27% greater due to the fact that the average price in 1915 was 49.6 cents as against 65.66 cents in 1916.

Copper.—A large increase, both in production and price was registered in 1916; 119,770,814 pounds being produced, an increase of 18.8%. It was valued at $32,580,057, being worth 27.2 cents a pound. This is the highest price since 1873, when the average for the year was 28 cents. A further increase in production is expected this year, an electrolytic refinery having commenced operations in the winter at Trail with a daily capacity of 10 tons of refined metal.

Lead.—41,593,680 pounds were produced during the year, being a decrease of over 10% in quantity. The price, however, averaged nearly 3% greater, giving a total increase in value of 32%. A large portion of the production was refined electrolytically at Trail.

Nickel.—The total production was 82,958,564 pounds, which at 35 cents a pound would be valued at $29,035,497. This is an increase of 14,649,907 pounds or 21.5% over 1915.

Zinc.—Some 47,000,000 pounds were mined during the year of which half was refined and shipped, this being the first year in which any attempt was made to refine the metal in Canada. Two refineries are operating, one at Trail and the other at Shawinigan Falls.

Cobalt.—841,859 pounds were recovered at the smelters at Deloro, Thorold and Welland as the metal, oxide, sulphate, carbonate, etc., Stellite, a high speed tool metal of cobalt and chromium being also produced. The 1915 production was 504,212 pounds.

Molybdenum.—The demand for this metal resulted in considerable prospecting during the year. Seventeen different localities were shipping during 1916, that at Quyon, Que., being the most important. Concentrators are situated at Renfrew and Ottawa.

159,000 pounds was produced during the year. Some of the concentrates were used in making molybdic acid and ferro-manganese at Orillia.

Iron.—As usual, operations have been confined to the Michipicoten district, with a small production of ilmenite from Quebec. Two Canadian companies operating in Newfoundland shipped 1,012,060 short tons during the year. A large deposit of siderite, iron carbonate, is being mined this year in the Michipicoten district by the Algoma Steel Corporation.

Asbestos.—This industry has been very active during 1916, the value of the production being the highest on record although the quantity was not as great as in 1913. No new fields were developed during the year, although there is an indication that some activity may be looked for in some of the scattered deposits near Ottawa, this year.

Chromite.—27,030 tons, valued at $299,753 and having an average trioxide content of 24% were produced in 1916, being over twice the quantity produced in the preceding year.

Felspar.—Shipments of felspar were the highest in record during 1916, being 19,166 tons. Frontenac county, Ont., produced 14,878 tons, the rest coming from Quebec.

Fluorspar.—Practically the first commercial shipments were made in 1916 from Madoc, amounting to 1,284 tons valued at $10,238. There is an annual consumption in steel furnaces of from 10,000 to 15,000 tons.

Graphite.—Total shipments of refined graphite amounted to 3,971 tons valued at $285,362, mostly from Ontario. The production in 1915 was 2,635 tons, valued at $124,223.

Gypsum.—422,741 tons were quarried in 1916 of which 341,618 tons valued at $730,831 were shipped.

Magnesite.—Shipments during the year amounted to 55,413 tons at $10.17 per ton coming chiefly from Grenville Tp., Que., with a few hundred tons from the Atlin district, B.C.

Natural Gas.—The total production in 1916 was 25,238,568,000 cubic feet being 5,000,000,000 greater than 1915 and coming mostly from Ontario.

Petroleum.—About 200,000 barrels were produced in 1916 which is about the same as in the three previous years, the value, however, has risen considerably in that time.

Pyrites.—The production has increased from 286,038 tons in 1915 to 309,411 tons in 1916. Ontario supplied 177,552 tons and Quebec supplied 130,799.

Salt.—124,033 tons were produced during the year compared to 119,900 tons in 1915, the total production being obtained from deposits in southern Ontario. In addition to the above figures some brine is used at Sandwich, where caustic soda and bleaching powder are made.

Another Potash Plant at Searles Lake

The United States Department of the Interior has announced that a second plant for the production of potash at Searles Lake, Cal., is in operation by the Pacific Coast Borax and the Solvay Process companies. It is estimated that 1,000 tons of muriate of 80 per cent. or better will be produced by a new method of refinement by the two companies. The new field consists of 1,500 acres of patented land and railroad facilities are being extended to the plant.

The American Trona Corporation has been producing about 2,000 tons a month for over six months, the product being largely absorbed by the eastern chemical and fertilizer trade. A refinery is being completed at San Pedro, where it is expected that potash, borax and other chemicals of the highest grade will be available for the market in October.

Ontario Mineral Production, 1916

The following table has been recently issued by the Ontario Bureau of Mines and, subject to final revision, shows the mineral output for 1916:

Product	—1916— Quantity	Value
Metallic—		
Gold, oz	497,830	$10,339,259
Silver, oz	19,874,970	12,622,849
Copper ore, tons	858	24,638
Copper (in matte) (a), tons	22,430	8,299,051
Nickel (in matte) (b), tons	41,299	20,649,279
Iron ore (exported), tons	121,495	....
Pig iron (c), tons	118,165	1,646,010
Cobalt ore, tons	337	75,195
Cobalt (metallic), lbs	328,563	288,614
Cobalt oxide, lbs	691,681	473,713
Nickel oxide, lbs	100,013	16,915
Nickel (metallic), lbs	42,411	17,847
Other nickel and cobalt compounds, lbs	350,831	60,956
Molybdenite (concentrates), lbs	17,956	19,541
Lead, lbs	689,882	60,038
Metallic Totals		$54,936,605
Non-Metallic—		
Arsenic (white and other forms), lbs	4,320,890	$200,103
Asbestos, lbs	500	100
Brick (fancy, pressed and paving), M	31,742	318,942
Brick (common), M	58,541	498,896
Tile (drain), M	16,562	302,080
Tile (porous fireproofing) (d), M	4,451	176,953
Cement (Portland), bbls	2,143,949	2,242,433
Corundum, tons	67	8,763
Feldspar, tons	12,965	42,159
Fluorspar, tons	1,283	42,159
Graphite (refined), tons	3,446	249,586
Gypsum (crushed, ground and calcined), tons	36,668	116,206
Iron pyrites, tons	175,508	471,555
Lime, bushels	1,367,005	243,942
Mica, tons	266	55,407
Natural gas, M cu. ft	16,767,910	2,235,513
Petroleum (crude), Imp. gals	6,890,681	387,846
Pottery	......	42,025
Quartz, tons	94,267	158,583
Salt, tons	128,495	698,835
Sand and gravel, cu. yards	1,129,189	407,438
Sewer pipe	......	216,749
Stone (building, trap, granite, etc.)	......	711,243
Talc (crude and ground), tons	11,810	111,489
Non-Metallic. Total		$9,906,992
Add Metallic. Total		54,936,605
		$64,843,597

(a) Copper in the matte valued at 18c. per lb.
(b) Nickel in the matte valued at 25c. per lb.
(c) Production from Ontario iron ore only.
(d) Included in 1915 with fancy, pressed and paving brick.

Harry Akers Passes

Mr. Harry Akers, B.A.Sc., who had been engaged on research work at Yorkton, Va., died of heart failure on April 21st. He graduated from the Faculty of Applied Science, University of Toronto, in 1909 and immediately entered the partnership of Akers, Mason and Bonnington, Toronto. After some experience here he acted as demonstrator at the University of Toronto, in the department of electrochemistry. Some of his achievements include the development of a process for the manufacture of cyanide direct from coke, limestone and nitrogen which replaced the earlier process of first making carbide. He was also connected with the development of the process of making maltose from starch, the process being used now by the Malt Products Company, of Guelph. He superintended the installation and operation of a plant for the manufacture of metallic magnesium at Rumford, Maine, from a process developed in the Department of Electrochemistry of the University of Toronto.

Aspirin and Phenacetine in Canada

As many chemical manufacturers have found to their cost, the making of fine chemicals, such as were formerly made in Germany, is not as easy as would seem on the surface. German chemical firms before the war controlled both the manufacture and sale of a large number of fine chemicals and had both the trade name and the alleged process patented in all countries. Since the outbreak of war, a large number have tried to make these chemicals and drugs and found that following the patent specifications, made by a German chemist and a German lawyer they were led into all sorts of traps and pit-falls that German cunning could prepare for them. After a great deal of research, Canadian chemists have been successful in working out processes for many drugs and chemicals, in many cases even improving on the original article. One company that has met with a great deal of success is the Chemical Products of Canada, Limited, Toronto, which has issued the following statement of its activities at the request of this journal:

"The company was organized and commenced to manufacture Acetyl Salicylic Acid (Aspirin) in June, 1916. On commencement, like in all new enterprises we had difficulties to overcome in plant adjustments, but finally succeeded in turning out a product which now meets the B.P. specifications in every respect. We consider this quite a feat to be able to now make a product which compares most favorably with the German Aspirin before the war exclusively controlled in German hands and have been successful in sending a large quantity of our goods abroad to the English, French and Russian Governments, in addition to selling practically every wholesale drug house in Canada.

"Unfortunately at the present time we are unable to take advantage of the use of the word 'Aspirin,' due to the fact that the government have not seen fit to cancel the registration of the German trade mark here, although we understand that in London two months after the war broke out all registrations and trade marks in connection with this were cancelled and we see no reason why the Canadian Government should not do the same to benefit a Canadian concern in competition with the Germans.

"After meeting with good success in the manufacture of Aspirin we started in on research work on Phenacetine, a product which has been in big demand, and also exclusively before the war controlled in German hands. Due to the fact that there are so many failures with concerns in the United States making this product, the price has advanced to abnormal figures and on November 1st, 1916, we had completed satisfactory tests to enable us to turn out a product which was marketable and at the present time we are shipping large quantities abroad as well as supplying the Canadian trade with this article.

"The company intends to branch out in other lines, following the principle of making goods solely controlled in German hands. We have now two chemists under way on research work which we hope will enable us to put on the market products which are very scarce at the present time, and expect to have some available not later than the first of June."

-The Machinery Utilities Company, of New York, announce in another part of this paper a series of booklets relating to machinery and equipment which may interest Canadian buyers.

American Scientists Assisting Allies

Six prominent American scientists are now on their way to England and France to co-operate with scientists of those countries in studying problems arising out of the war, and more will go later it is learned. The six were sent jointly by the Advisory Commission of the Council of National Defence and the National Research Council.

Members of the party and the subjects in which they specialize, are: Dr. Joseph S. Ames, Johns Hopkins University, Aeronautics; Dr. Richard F. Strong, Harvard, Camp Sanitation; Dr. Linsley R. Williams, Assistant Health Commissioner of New York State; George A. Hulett, Princeton, Chemistry of Explosives; Dr. Harry Fielding Reid, Johns Hopkins, Scientific Map Making, and Photography from Airplanes, and Dr. George A. Burgess, of the Federal Bureau of Standards, Metals, Suitable for Guns and Rigid Dirigibles.

The scientists are accredited to the American Embassies in London and Paris, and will develop their activities in both England and France at their own discretion. All are expected to make early reports on special subjects which have been assigned them, so that their information may be used at once in the United States.

Glycerine from Seal Oil

A despatch from St. John's, Nfld., says: It is understood that the British Government will commandeer the entire output of seal oil in this colony this year. Glycerine extracted from the oil has been found valuable in the manufacture of explosives.

Take Ink from Newsprint Paper

Extensive experimental tests are now being made at the Riverside Paper Company, Number Two divisional mill, of the American Writing Paper Company, on the manufacture of de-inking news print paper. The experimental tests which have been going on for a number of weeks, are under the direct supervision of Thomas Jasperson, who has a process for de-inking news print, a product that is equal to the present news print paper. He is now offering the local paper trade samples of the new paper in any quantity desired, either on rolls or flat. This new paper appears to be of an exceptionally good quality, and if the final experiments develop to be successful, the manufacture of this paper will doubtless be continued, and on a broad scale.

C.P.R. Holds Hydro-Electric Exhibition

The Natural Resources Survey of the Canadian Pacific Railway, of which Arthur D. Little Limited, are directors, held an interesting electrical and electrochemical exhibition in the museum of the Survey at 137 McGill Street, Montreal, from March 12th to 31st. The object of the exhibition was to show the tremendous water-power still available for use in the manufacture of the various products exhibited, all of which were made at the electrochemical plants in Canada and the States and loaned by the producing companies.

Particular attention was directed to the many electrochemical and electro-metallurgical products that are used in our industrial life, including caustic soda, chlorine, bleaching powder, hydrogen, oxygen, graphite, carbide, cynamide, ferro-alloys and electric steels. The importance of each material was firmly impressed by the collection of products made from it and grouped around the primary product.

By means of a large water power map, the situation of every commercially available waterpower over 50,000 h.p. near the lines of the C.P.R. was shown. There were nearly one hundred having a total of 7,000,000 h.p. of which only about ten per cent. has been developed.

New Sugar Factory at Chatham

The Dominion Sugar Company has completed within the past few months their third factory, that at Chatham. With the exception of two plants in California, this new plant ranks as the largest on the continent, while in equipment and design it is regarded as being in the forefront of similar industries in the world. An indication of its size may be obtained from the statement that the main building is 518 feet long, being 141 feet wide at the beet end and 73 feet wide at the sugar end.

Two diffusion batteries of twelve units each, ten carbonation tanks, twelve filter presses, nine being of the self dumping type; five evaporators; and four vacuum pans fourteen feet in diameter, each dropping 40 tons of refined sugar every two hours. 24 centrifugals and eight crystalizers complete the plant. The barium process is used to recover the sugar in the molasses.

Other plants of this company are situated at Wallaceburg and Kitchener, having a capacity of 850 and 800 tons of sugar a day, respectively. The Chatham plant was designed for 1,800 tons and it is expected that 2,000 tons will be produced when running at full capacity. Provision has also been made to refine cane sugar, which can be brought direct to the plant through the Erie canal.

A large chemical laboratory has been placed in the very centre of the factory and has been equipped with all the apparatus necessary to ensure complete chemical control throughout the process.

Industrial Chemical Club

This little club consists of the students in chemistry of the Faculty of Applied Science of the University of Toronto. Its members meet several times in the college year for informal dinners, at which papers are read by student members and sometimes by graduates in practice in the industries. Discussion of the subjects presented is encouraged, and the meetings serve to supplement the students' lecture courses by bringing the students of the upper and lower years together, and also by familiarizing them to some extent with industrial conditions.

The papers presented during the past year included such subjects as "Graphite and Carborundum," "Acid Resisting Alloys," and "Industrial Poisoning and Occupational Diseases," the papers being read by Messrs. E. J. Tyrrell, C. P. Sale, and C. W. Hancock, respectively. The president of the club for the past year was Mr. J. V. Dickson, and Mr. C. W. Hancock has been elected president for the coming year.

Much Progress on New Nickel Plant

Considering the bad weather, much progress has been made on the new plant of the International Nickel Company at Port Colborne. On April 20th it was reported that with the exception of the power plant, the foundations were practically all in, the steel work on the main building was nearly completed, three of the smaller brick buildings were almost complete and with good weather and no labor troubles it is expected that the first nickel will be turned out in December of this year. The estimated cost of the completed refinery will be about $4,000,000.

The plant is situated east of the entrance to the Welland canal and consists of 350 acres, with a frontage of about one mile on Lake Erie. Transportation facilities are good, connection being established with the Grand Trunk and the Welland canal may be utilized for the transportation of materials if necessary.

The entire construction is in the hands of the Foundation Company, Limited, Montreal, with whom the operating and engineering departments of the nickel company are cooperating, who have employed four hundred men during the winter and have made preparation to enlarge this number to one thousand this spring.

It is expected that the initial output of the refinery will be 15,000,000 pounds of refined nickel a year, but provision has been made so that the capacity can be increased to two or even four times this amount, if necessary. The operating force will be about four hundred men. The two main stacks will be 350 feet high and 12 feet across the top, the whole resting on heavy concrete bases 40 feet square. Most of the supplies for the construction have been purchased in Canada, very little being imported.

In operation, the plant will consume 100,000 tons annually of bituminous coal, coke, cordwood, fuel oil, nitre cake, charcoal, silica, rock salt, soda ash, soda nitrate, sulphuric acid, fire clay and fire brick, in addition to the copper-nickel matte which will be supplied from the company's mines at Sudbury.

British-America Nickel Corporation

Important Development in the Canadian Nickel Industry

That every stage of nickel production should be carried out in Canada from the quarrying of the ore to the chemical and mechanical processes involved in making the scientific appliances and metal products which nickel alone can supply, is now the general conviction. This conviction is founded on the fact that roughly speaking eighty per cent. or more of the world's nickel is mined in Canada and the percentage is increasing rather than diminishing.

The establishment of a nickel industry which shall be Canadian from the ground up is the plan upon which the recently incorporated British America Nickel Corporation is working. This company, whose headqurters are in the Royal Bank Building, Toronto, have acquired 17,000 acres of nickel lands in the Sudbury district, and have planned an extensive smelter and refinery plant at a location on the celebrated Murray mine about four and a half miles from the town of Sudbury. Here a small village has already sprung up and one hundred and twenty-five hands are employed clearing the ground and laying foundations for the various structures. There will be direct connections with the Algoma Eastern Railway and the Canadian Pacific. Arrangements have been made for obtaining electric power through the Hydro Electric Commission from a power dam about twenty-five miles distant, and 15,000 horse power has already been arranged for.

An interesting feature of these important works is that a process new in nickel refining methods in America will be introduced, that is, the Hybinette process, named after one of the discoverers and tested in practice for some years at Kristiansand, Norway. By the Hybinette process nickel has been refined to a degree of purity of 98.7 per cent. and at an operating cost in Norway of about 13 cents per pound. It will require about a year to complete the first units of the works.

The British America Nickel Corporation has ample capital for its extensive works, having in fact the financial assistance of the Imperial Government. The chief executive officers of the company are: J. H. Dunn, president; W. A. Carlyle, vice-president; E. P. Mathewson, general manager; F. J. Brule, chief engineer, and W. H. Coade, secretary.

The Carbon and Alloy Steel Company, which has a Dominion charter for a company of $1,500,000 capital propose to erect a plant at Hamilton, for making steel castings by the Moffat process, taking over the Moffat-Irving Steel Works at Toronto. Plans are being prepared for an electrical plant, foundry, etc., to cost $300,000, with a capacity of about thirty tons of steel per day.

Ferro-Molybdenum Production at Belleville

The work undertaken by the Tivani Electric Steel Company at Belleville illustrates the many important changes in the world's chemical industries, arising out of the war. Years ago a certain amount of molybdenum was mined in Canada for steel making, but the steel interests in combination with the chemical interests of Germany by an astute manipulation of the market, were able to displace molybdenum by tungsten in the making of steel and by getting control of the world's chief tungsten mines sought to control the tool steel markets. The processes of refining tungsten were understood to be a German secret and British and American steel makers were up against a new problem when the war came. The necessity for a substitute brought a new demand for molybdenite ore, the chief European source of which was Norway. The British Empire furnishes two good sources of molybdenum in Canada and in Australia. The numerous deposits in Central Ontario are now being looked up, and the Tivani Steel Company are already turning out from five to seven hundred pounds per day, in their electric furnaces, designed for the treatment of this ore. The ore is furnished by the Canadian Government and the entire output of this smelter goes to Great Britain and Russia. Most of the ore at present comes from the County of Hastings, and is found among the granite and older Laurentian rocks in association with pyrrhotite. The molybdenum ores smelted here will make high-speed tool steel of twenty times the hardness and toughness of tungsten steel and there seems every reason why this special industry should become permanent, and of great importance to the Canadian steel industry.

The Tivanic Electri-Steel Company now have six furnaces in operation and have been turning out metal for the la t three-months. Another addition will soon be made to the furnace capacity when they will be able to operate three furnaces night and day, with a apacity of 1,100 pounds per 24 hours. The steel made from this metal is now the only kind that will stand up to the duty of rifling the big British eighteen inch guns. Tests have been made which show that the Canadian molydenum steel will stand the firing of four hundred rounds, where formerly the efficiency of such guns rifled with tungsten steel began to diminish after twenty rounds.

The president of this company is Mr. J. W. Evans, formerly with the Rathbun Company, of Deseronto, later with the Waddell Bridge Company, of Trenton, and afterwards on special survey work for the Canadian Copper Company in the nickel region. Mr. Evans was the first mining and civil engineer to open business in Cobalt. He is to be congratulated on having so successfully worked out the problem of ferro-molybdenum production in Canada. We hope soon to lay before the readers of The Canadian Chemical Journal a fuller account of the striking success achieved by him and his company in this field.

Patents Continuous Induction Furnace

Parvin Wright, of Vancouver, has patented an electric induction furnace for the melting of metals and for smelting iron and other ores. In smelting, the charge is fed continuously into smelting furnaces ajacent to a crucible the different smelting furnaces overflowing into the same crucible, the molten metal being withdrawn continuously from it. Furnaces and crucibles are heated by induction, it being claimed that this continuous operation gives a constant consumption of current, maintaining a constant load on the generator. (U.S.P. 1,218,151, Mar. 6, 1917).

Chemical Glassware Now Made in Canada

Chemists generally will be interested in learning that the Richards Glass Company of Toronto have commenced the manufacture of chemical glassware in addition to their regular glass business. At present operations are confined to working up glass tubing into various sizes of condensers, test-tubes and articles of similar nature. About a dozen six-flame burners are employed which enable the company to turn out apparatus at a rapid rate. Other forms of chemical glassware such as extraction apparatus, potash bulbs and special apparatus are also made on order.

A German Monopoly Broken
The Rare-Earth Industry

At the annual meeting of the Society of Chemical Industry in Edinburg, a paper was contributed by Mr. S. J. Johnstone, B.Sc., on the position of the British rare-earth industry, one of the most important branches of which is the manufacture of incandescent gas mantles.

Notwithstanding the fact that the most valuable deposits of monazite sand so far discovered are in territory under British protection, that is, in Travancore, these deposits and the gas mantle industry dependent on them, were before the war virtually under German control. The sand was obtained in Travancore at a cost of about £4 per ton and shipped to Germany, for the use of the manufacturers of thorium nitrate and incandescent gas mantles in that country. Only a limited quantity of the sand was allowed to be sold to gas-mantle manufacturers and others in the United Kingdom, and from them a price of about £36 per ton was demanded and obtained. For most of the mantles made in England, however, thorium nitrate made in Germany was used. The only other important deposits of monazite sand are in Brazil, and these also are controlled by the German thorium ring.

Mr. Johnstone, in his paper, said that the manner in which the Germans obtained practically control of the Travancore monazite deposits was most interesting and significant. A lease for working these deposits was granted some years ago by the Travancore Durbar, with the approval of the Government of India, to the London Cosmopolitan Tin Mining Company, a condition being that the concession could be transferred only to a British company. The Travancore Minerals Company was formed to work the deposits and contracted to sell the whole of its output to a German firm. Soon after the outbreak of war it was found that the whole of the Preference shares and 11,000 of the Ordinary shares of the Travancore Minerals Company were held in trust for the Auer Company, of Berlin.

The India Office has now decided that in future all the directors of the company working the concession must be British-born. German contracts had been cancelled, and the company must be ready at all times to sell monazite sand direct and at a fair price to British firms. A second company, Thorium (Limited), had now obtained a twenty years' lease to work 150 acres in Travancore for monazite sand and was now exporting the sand and manufacturing thorium nitrate from it at works in this country.

During the past year a good deal of Travancore monazite had been shipped to the United States, and many manufacturers of gas mantles in this country had been getting their supplies of thorium nitrate there. At least four of the British makers, however, were making thorium nitrate from Travancore sand in quantities sufficient for their own requirements, and there is no reason why British makers should not supply in the future a large part of the world's requirements of thorium nitrate from the Travancore monazite. Nevertheless the new British industries might need some form of Government assistance, either by tariff or otherwise, since the German manufacturers would still be able to obtain Brazilian monazite sufficiently rich in thorium to enable them to compete with the British industry.

Interesting News Items

A company has been organized in Salt Lake City to develop sulphur lands in Utah.

The Edmonton (Alberta) Portland Cement Company will build an addition to their cement plant.

The Ladysmith Smelting Corp., Limited, of Ladysmith, B.C., contemplate an enlargement of their smelting works to cost $100,000.

La Fonderie d'Acceri des Trois Rivieres (Three Rivers Steel Company) have let a contract for an addition to their works to cost $100,000.

A company to treat ores electrolytically is being promoted by Orillia and Toronto capitalists. The proposal is to erect a $200,000 plant at Orillia, using hydro-electric power.

The new sulphite pulp plant of the Ontario Paper Company recently started up at Thorold, Ont., has two digesters each 15x49 feet. The paper department will have a capacity of 50 tons per day.

The Wax and Glassine Paper Company are erecting a plant at Cookshire, Que., for the manufacture of greaseproof, wax and "glassine" papers. J. L. McNicol, late of the Provincial Paper Mills, Georgetown, is manager.

The contract has been let for the new mill of the Port Arthur Pulp & Paper Company, near Port Arthur, Ont. The temporary offices will be removed from Toronto to Port Arthur this month. This mill will make sulphite pulp. A. G. Pounsford is manager.

Among the young men just graduating in Applied Chemistry at Toronto University is G. G. Macdonald, of Toronto. Mr. Macdonald, who has the journalistic instinct and has made a good record as editor of "Varsity," the University newspaper, has joined the editorial staff of The Canadian Chemical Journal.

D. A. Brebner, of the Manufacturers' Corundum Company, is organizing a company to make abrasives in Canada, and an effort will be made to export abrasive wheels, in addition to supplying the home market. Mr. Brebner has located his plant in Hamilton with offices at 58 King Street West, and the company will be known as D. A. Brebner, Limited.

The United States government commission on the fixation of nitrogen has not made any decision regarding the process to be used in the $20,000,000 plant authorized by Congress. The principal localities suggested have been visited but it is likely that no decision will be made until the process has been decided on.

The "Compagnie Nationale de Matieres Colorantes et de Produits Chimiques" has been established in Paris with offices at 134 Boulevard Haussmann. The company, with a capital of 40,000,000 francs, will make chemicals and dyestuffs for the textile trades. This is another step in the movement to make France self-sustaining in the production of chemicals for French industries.

A company has been formed at St. John, N B., to manufacture Larvacide insect destroyer, and have secured a site

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It is inevitable, in starting to create groups of new chemical industries from the "ground floor," that some miscalculations will be made. The only wonder is that such miscalculations have not been more serious in countries like the United States and Great Britain, where so many things had to be attempted at once during the war. The production of aniline oil is an instance of this miscalculation. Before the war the imports of aniline oil to the United States averaged about 3,000 tons, but one chemical firm alone has recently attained an output at the rate of 35,000 tons a year. The price in pre-war days was a few cents a pound, but in the first year of the war it had reached $1.50 per pound, but now it has dropped to 26 cents and is not likely to go beyond that. It is more likely to fall, and when foreign demands are met the smaller firms will have to get into other lines.

A sum of one million pounds is allotted in the estimates of the British government as a grant in aid to encourage scientific and industrial research in 1917-18. It will be paid to the account of the Imperial Trust, and any balance will not be surrendered at the close of the financial year. Grants will be made by the directions of a committee of the Privy Council over an agreed period. Following an expenditure of £20,000 in the current year, another £15,000 is needed to pay for the relief expedition fitted out by the admiralty to rescue members of the Imperial Transantarctic Expedition from Elephant Island and also in respect of one-half of the expenses of the relief expedition sent in conjunction with the governments of Australia and New Zealand to Ross Sea.

Dr. George E. Hale, chairman of the National Defense Council, of United States, has sent the following cablegram to the Royal Society, London; the Academie des Sciences, Paris; the Academy of Sciences, Petrograd, and the Academia dei Lincei, Rome:

"The entrance of the United States into the war unites our men of science with yours in a common cause. The National Academy of Sciences, acting through the National Research Council, which has been designated by President Wilson and the Council of National Defense to mobolize the research facilities of the country, would gladly cooperate in any scientific researches still underlying the solution of military or industrial problems."

One of the troubles into which manufacturers in Great Britain, France and the United States were plunged when the war broke out was from the failure of the supply of casseroles, evaporating dishes, and other appliances used by chemists and assayists in their laboratory work. These appliances, like many other things, were practically controlled by German and Austrian makers and when the supply was cut off, even the Royal Doulton China people were doubtful whether they could produce the required quality of goods. Having fortunately found raw material in the British Dominions the Doulton works have now succeeded in producing these articles in a quality equal to the best German goods. The representative of The Canadian Chemical Journal has been shown samples among the laboratory supplies of Lymans, Limited, of Montreal. Mr. Smith, in charge of the chemical department of that company, assures us that the workmanship and quality of the British porcelain are equal to the best that ever came from Germany.

Recent Incorporations

Of Interest to the Chemical and Metallurgical Industries

At Ottawa, Ont.—The International Feldspar Co., Limited; capital, $50,000. Applicants, J. V. Poaps, N. Hollister, F. Curry.

At The Pas, Man.—Northern Manitoba Mining & Development Co., Limited, $250,000; R. Kerr, G. R. Bancroft, H. S. Johnson.

At Sherbrooke, Que.—Universal Asbestos Co., Limited, $50,000; H. R. Fraser, F. S. Rugg, H. M. Terrill.

At Cookshire, Que.—The Wax and Glassine Paper Co., Limited, $225,000. R. A. Pringle, T. A. Burgess, T. Cote.

At Winnipeg, Man.—Anglo-Canadian Engineering Co., Limited, $20,000. C. N. Dalgeish, D. N. Stevens, W. P. Rourke.

At Toronto, Ont.—The Radium Institute of Toronto, Limited; $40,000. W. H. Aiken, A. H. Robertson, Evelyn W. Booth.

At Toronto, Ont.—Anzac Porcupine Mines, Limited, $1,000,000. J. E. Day, J. M. Ferguson, J. P. Walsh.

At Montreal, Que.—Lytle Engineering Co., Limited, $50,000; R. Drennan, H. W. Jackson, M. J. O'Brien.

At Montreal, Que.—Atlas Metal and Allays Co. of Canada, Limited; $50,000. C. M. Holt, A. C. Cosgrain, E. M. McDougall.

At Lethbridge, Alta.—The Mastodon Mining Co., Limited; $100,000.

At Cobalt, Ont.—Groch Centrifugal Flotation, Limited, $25,000. F. Groch, J. W. Moffett, A. Roscoe.

At Chatham, Ont.—Richmond Gas and Oil Co., Limited; $40,000. W. G. Ryan, W. W. Scane, B. Jasperson.

At Chatham, Ont.—Pure Gas & Oil Co., Limited; $40,000. J. C. Stewart, R. A. Richardson, G. D. Aikin.

At Winnipeg, Man.—Hygiene Products, Limited, $40,000. W. Scott, W. Berlon, B. J. Cossey.

At Vancouver, B.C.—Columbia Equipment Co., Limited; $100,0000. Pacific Lime Company, Limited, $1,500,000.

At Toronto, Ont.—Porcupine V. N. T. Gold Mines, Limited, $3,000,000; J. S. Duggan, T. S. H. Giles, J. W. Bicknell. Atlantic Coast Development Co., Limited, $50,000; R. A. Nevitt, W. Lunan, H. R. Burrows. Cluff Ammunition Co., Limited, $1,500,000; A. W. Homstead, N. R. Kay, L. F. Lambier.

At Fernire, B.C.—McLean Drug and Book Co., Limited, $20,000.

At Victoria, B.C.—Aetna Iron & Steel Co., Limited, $250,000.

At Sarnia, Ont.—The Acme Oil & Gas Co., Limited, $1,000,000. C. P. Smith, F. R. Reeves, W. J. Barber.

At Three Rivers, Que.—Three Rivers Industrial Co., Limited, $45,000. T. A. Lymburner, J. A. Lymburner, E. Lemieux.

At Edmontin, Alta.—The Spokane Athabasca Oil Co., Limited, $1,000,000.

Toronto, Ont.--Harland Development and Mining Co., Limited, $40,000. W. W. Watson, G. Cooper, J. S. Emery.

Grimsby, Ont.—The Metal Craft Co., Limited, $40,000. F. P. Macklem, H. D. Walker, E. B. Darley.

At Sherbrooke, Que.—The Dominion Metal Co., Limited, $20,000. N. B. Pritchard, H. Irwin, G. E. Borlase.

At Kingston, Ont.—St. Lawrence Smelting & Refining Co., Limited, $100,000. F. H. Mackey, W. W. Skinner, W. G. Pugsley.

At Montreal, Que.—New Brunswick Sulphate Fibre Co., Limited, $200,000. G. W. McDougall, L. Macfarlane, W. B. Scott.

At Toronto, Ont.—The Thessalon Copper Company, Limited, $2,000,000. G. Waldron, W. N. Robinson, L. Wright.

At Montreal, Que.—International Magnesite Co., Limited, $250,000. E. D. Wintle, Elsie Bramson, L. Davust.

At Montreal, Que.—Metal Foundries of Canada, Limited, $50,000. J. M. Duff, J. G. Hamilton, Ina F. Marshall.

At Ottawa, Ont.—Water Purification, Limited, $40,000. J. L. Mitchell, E. M. Knight, A. Wyman.

At Montreal, Que.—Industrial Chemicals, Limited, $2,750,000. G. W. McDougall, L. Macfarlane, W. B. Scott.

At Brantford, Ont.—Canadian Oil Fields, Limited, $500,000. T. Cox, L. G. Finch, W. A. Hollinrake.

Vancouver, B.C.—The Britannia Extension Copper Mines, Limited, $100,000.

At Vancouver, B.C.—Western Tanneries, Limited, $300,000. Sea Gull Soap Works, Limited, $10,000.

At Montreal, Que.—American Brewing Co., Limited, $500,000; J. G. Duguette, N. Pepin, A. Malo. The Canadian Hospital Supply Co., Limited, $75,000; A. E. W. Snyder, L. P. Dorval, A. H. Desloges.

At Toronto, Ont.—The Carter Welding Co., of Toronto, Limited, $40,000. H. W. Carter, P. M. Sorley, H. W. Carter.

Montreal, Que.—Aetna Development Co., Limited, $140,000. G. V. Cousins, N. R. Curry, A. H. Elder.

At Toronto, Ont.—Ontario Oil and Turpentine Co., Limited, $40,000. F. C. Culler, E. F. Abell, J. S. Thompson, J. F. Malo.

At Quebec, Que.—Quebec Cement Co., Limited, $1,000,000. P. Joncas, N. R. Rousseau, A. Crepin.

At Vancouver, B.C.—The Union Copper Mining Company, Limited, $300,000.

At Montreal, Que.—Paint Products of Canada, Limited, $500,000. J. B. D. Legare, R. T. Mullin, A. Mathiew.

At Toronto, Ont.—Penn-Porcupine Mining Company, Limited, $3,000,000. H. H. Shaver, J. Parker, J. MacBeth.

At Madoc, Ont.—Mineral Products, Limited, $100,000. C. H. Learborn, C. R. Ross, G. S. Wyman.

At Vancouver, B.C.—Mineral Resources Exploration Co., Limited, $500,000.

At Winnipeg, Man.—Canadian Disinfecting and Chemicals Limited, $10,000. W. S. Smith, B. C. Parker.

Toronto, Ont.—Metal Specialties, Limited, $40,000. J. E. Belfry, E. G. Long, H. S. Sprague.

At Toronto, Ont.—Medical Appliance Co., Limited, $15,000. R. B. Bond, J. Mitchell, A. P. Ridley.

At Toronto, Ont.—Continental Development Co., Limited, $250,000. M. Macdonald, E. Smily, B. Williams.

At Ladysmith, B.C.—The Ladysmith Smelting Corporation, Limited, $1,000,000.

At Banff, Alta.—The Alberta Electro Chemicals, Limited, $20,000.

At Hamilton, Ont.—Carbon and Alloy Steels Company, Limited, $1,500,000. J. B. O'Brien, W. E. Vallance, H. J. Waddie.

Canadian Society of Chemical Industry

Montreal Branch

About 70 members attended the annual meeting of this society in Montreal on the 27th of April, when the following officers were elected.

Chairman—T. H. Wardleworth.

Vice-Chairmen—N. N. Evans, W. L. Goodwin, Kingston; and S. B. Chadwick, B.A. Sc., Toronto.

Council—D. G. Buchanan, W. H. Thom, J. W. Bain, J. S. Bates, L. T. Acton, Robert Job, R. W. Perry, R. S. Pincott, C. R. Hazen and W. O. Walker.

The Canadian Society of Civil Engineers has appointed Mr. Fraser Keith, late editor of "Construction," as secretary. Mr. Keith is to devote his whole time and talents to the interests of the society, which is fortunate in securing the services of a young man who has such a clear understanding of the essentials of his new work and is able to make good use of the intimate connections he has had with men at the head of our large engineering and structural undertakings.

Chemical Prices

The quotations below represent average prices for the quantities indicated at the time of going to press. Larger amounts, of course, may be obtained at lower figures.

Inorganic Chemicals

Alum, lump ammonia	100 Lbs.	$6.00
Aluminium Sulphate, high grade, bags	100 Lbs.	4.00
Ammonium Carbonate	Lb.	.18
Ammonium Chloride, white	Lb.	.21
Aqua Ammonia .880	Lb.	.12
Bleaching Powder, 35% drums	Lb.	5
Blue Vitriol	100 Lb.	16.00
Borax, crystals	Lb.	.13
Boric Acid, powdered crystals	Lb.	.30
Calcium Chloride, crystals	Lb.	.12
Caustic Soda, ground, Bbl.	Lb.	6½
Chalk, light precipitated	Lb.	.10
Fuller's Earth, powdered	Lb.	5
Glauber's Salt, in bags	100 Lbs.	.80
Hydrochloric Acid, carboys	Lb.	3
Lead Acetate, white crystals	Lb.	.28
Lead Nitrate	Lb.	.40
Lithium Carbonate	Lb.	1.70
Magnesium Carbonate, B.P.	Lb.	.40
Mercury	Lb.	2.75
Nitric Acid, carboys	Lb.	8
Phosphoric Acid, syrups	Lb.	.60
Potassium Bichromate	Lb.	.65
Potassium Bromide	Lb.	2.25
Potassium Carbonate	Lb.	1.50
Potassium Chlorate, crystals, spot	Lb.	.75
Potassium Cyanide, bulk, 98-99 per cent	Lb.	1.25
Potassium Hydroxide, sticks	Lb.	1.55
Potassium Iodide, bulk	Lb.	5.75
Potassium Nitrate	Lb.	.35
Potassium Permanganate, bulk	Lb.	3.00
Silver Nitrate	Oz.	.70
Soda Ash, bags	Lb.	4
Sodium Acetate	Lb.	.80
Sodium Bicarbonate	100 Lbs.	3.25
Sodium Bromide	Lb.	.75
Sodium Hyposulfite, bbls	Lb.	.2¼
Sodium Nitrate, crude	Lb.	8
Sodium Silicate	Lb.	.10
Sodium Sulphate	Lb.	4
Strontium Nitrate	Lb.	.50
Sulfur, flowers, sublimed	100 Lbs.	6.00
Sulfur, roll	100 Lbs.	5.00
Sulphuric Acid, 66°Be, carboys	100 Lbs.	3.00
Tin Chloride, crystals	Lb.	.60
Zinc Oxide	Lb.	.37
Zinc Sulfate, comm	Lb.	.18

Organic Chemicals

Acetanilid, C.P.	Lb.	$1.15
Acetic Acid, 56 per cent. in bbls.	Lb.	.7¼
Acetic Acid, glacial, 99½% in carboys	Lb.	.25
Acetone	Lb.	.80
Alcohol, methylated	Gal.	1.75
Alcohol, grain	Gal.	6.85
Alcohol, wood, 95 per cent., refined	Gal.	1.90
Carbolic Acid, 35 deg	Lb.	1.20
Carbon Bisulfide	Lb.	.30
Chloroform, com.	Lb.	1.35
Citric Acid, domestic, crystals	Lb.	1.60
Ether, S. 725	Lb.	.35
Glycerine	Lb.	.75
Oxalic Acid	Lb.	.80
Salicylic Acid	Lb.	2.00
Tannic Acid, commercial	Lb.	1.45
Tartaric Acid, crystals	Lb.	1.10

Index of Advertisements

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A Canadian Journal devoted to Metallurgy Electro-Chemistry and Industrial Chemistry.

Vol. 1, No. 2 TORONTO, JUNE, 1917 20c. a copy; $2 a year

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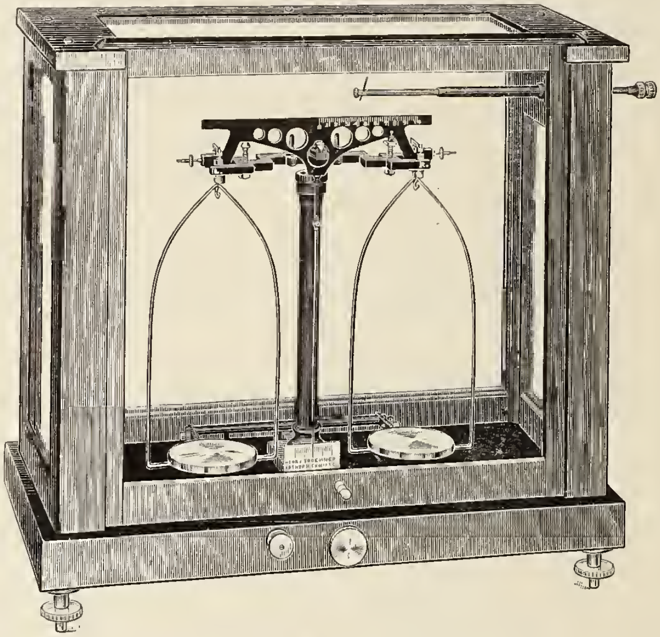

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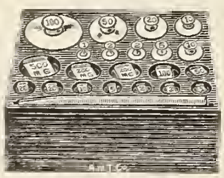

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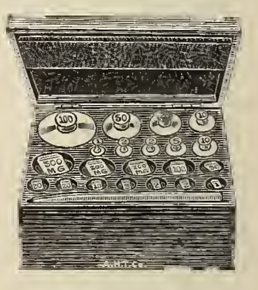

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CANADIAN
CHEMICAL JOURNAL

A Canadian Journal devoted to Metallurgy
Electro-Chemistry and Industrial Chemistry.

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CANADIAN CHEMICAL JOURNAL

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Contents of June Issue

Contents of May Issue

The Importance of Fertilizers

IN such an agricultural country as Canada where the production of foodstuffs is one of the leading industries, the rational use of fertilizers is one of the best aids to an increased production that can be developed on short notice. As would be expected, the varieties of soil in Canada range from the most fertile that may be found anywhere in the world to soils that are so poor that any attempt at ordinary methods of farming would be hopelessly unsuccessful. As each class of soil requires different chemical treatment, it is obvious that the work of the Central Experimental Farm, with its many branches throughout the Dominion has had a large amount of work to do in analysing the soils of each locality and prescribing a fertilizer which would make up for any deficiency that existed in the soil as found or to replace the necessary elements that have been taken out of the soil by growing one kind of product continuously.

In another part of this number appear some extracts that have been taken from a bulletin issued during May on "Fertilizers and their Use in Canada," by Dr. Frank T. Shutt, the Dominion Chemist. As is pointed out, the need of added fertilizer varies according to the locality, fertilizers having little use in the west where the largest and most continuous areas of soil are found. In fact the alluvial prairie land of the Red River valley is a veritable mine of plant food, the natural fertility of which would be difficult to exaggerate. In the older provinces, however, where the land has usually been worked for many years without the application of any kind of fertilizer in many instances, the need for some kind of assistance to the soil is at once apparent in order that the soil may be raised to a high state of productivity.

A great amount of work has been done by the various experimental farms throughout the country in determining the kind of fertilizer best adapted to the soil in the vicinity as well as its effect on the plants, as each plant, to a more or less extent, requires that the amount of substance taken out of the soil by it be replaced by artificial means if the ground is not to be allowed to suffer.

Reference is made in the article to experiments that have been carried on with the use of pulverized limestone and the valuable results obtained, also the use of fish-waste manures, ground seaweed and the host of naturally occurring substances, valuable in this connection. It is to be hoped that details of these experiments will be available so that the farmer will be benefitted in obtaining a supply of good fertilizing material at small expense.

The application of chemistry to agriculture should result beneficially to both and THE CANADIAN CHEMICAL JOURNAL hopes, from time to time, to be able to give further particulars of new ideas and materials, calculated to improve the fertility and productiveness of the soil.

Restrict the Use of Platinum

NOW that the price of platinum has risen to such a figure that its use by chemists and chemical manufacturers is now practically prohibited, large stores of the metal are in the hands of jewellers who are holding it for making up into rings and other similar articles to sell to people who will pay for it the present inflated price, which is five times that of gold. When sold in small quantities, such as is usually the case, an insignificant amount of platinum will go a long way, it being the third most ductile, as well as malleable, of the metals, but the total of all these small sales reveals the fact that the price of the metal has been forced up to such an extent that its purchase for chemical use, except in these microscopic quantities is indeed at a minimum.

Platinum is one of the essentials in the manufacture of sulphuric acid by the contact process, in the methods of obtaining nitric acid by the oxidation of ammonia, in the production of explosives and as a catalyst in so many other operations that if its use were denied to chemical manufacturers through a prohibitive price the wheels of many industries dependent would likely slow down and stop. In chemical analysis also, platinum is of great value, although the use of quartz in crucibles and other similar forms of apparatus has reduced the first cost to many laboratories.

The dependence of the world on Russia for its supply of platinum is shown by the fact that out of a total of 4,632,000 ounces of the crude metal that have been mined since 1843, 4,400,400 have come from a small belt of basic igneous rocks in the Ural Mountains.

To render the use of platinum for other than chemical industries impossible, it is understood that the British Government has made regulations covering the use of the metal so that all stocks in the hands of jewellers and others have been diverted to their proper use in the chemical industries. In the United States, the jewellers, through their National Vigilance Committee are assisting the Government in locating the available supplies of the metal in that country which will likely be diverted to better uses.

One thing that the Government might well do would be to prohibit the usage of platinum so far as jewellers and others are concerned, who make no use of it in a manner calculated to advance the best interests of the country.

As an acceptable substitute for jewellers, the wider use of palladium might be recommended. This metal is similar to and occurs usually with platinum, over 4,000 ounces having been extracted from the Subury nickel ores along with 2,300 ounces of platinum from 1907 to 1912, the total production since 1902 from all sources being 14,632 ounces. There is no doubt but that this production could be greatly increased according to the demand for it, since no special effort is made usually to recover the full amount that is contained in the ore. Palladium is the most fusible metal of the platinum group and thus could be employed advantageously for small castings. Its inability to resist the action of nitric acid, however, render this metal somewhat unsuitable for chemical work.

Oleomargarine

THE agitation for the manufacture of oleomargarine in Canada is one that should receive the support of every chemist who knows or should know what this material is composed of. The man on the street usually thinks that it is a fancy name for lard, being sold to poor people in other countries who cannot afford to pay the high price at present demanded for butter and that if we wanted it in Canada, the only way would be to import it from the States. Such is not the case. As is described in an article on this subject in another part of this number, most of the materials necessary for the manufacture of oleomargarine are at present produced in this country, but are all shipped to the States where they are made up into oleo for the American consumer.

It is said that a good part of the butter now being sold consists of butters of all kinds and conditions unfit for consumption, which are collected at a very low price and transported to receiving centres, where they are melted, washed and otherwise "purified" to remove the rancidity and bad taste. Then the product is rechurned with milk or cream to incorporate again the flavor of butter and necessary amount of moisture and color in order that it may resemble the original article.

Those who have seen the usual processes of butter-making can testify that absolute cleanliness is not always observed. In the manufacture of oleomargarine, however, it is necessary that scrupulous conditions be observed in order to avoid tainting the product, which is very much more susceptible to any foreign odor.

In the early days of its production, oleo was given a bad reputation because there was no supervision over its manufacture and at that time was known as "table lard," "axle grease" and other similar names. It was not surprising, therefore, that the producers of butter in those days arrayed themselves against that substitute. Through the modern methods of manufacture, however, the taste, color and wholesomeness are such that it takes an expert to tell the difference between the two.

To ensure the production of a wholesome article, it would not be difficult to have proper factory inspection, since the staffs of government inspectors, now maintained in the abattoirs, could be enlarged to see that the product was wholesome and properly marked. Such an inspection would give the necessary assurance to the consumer that the article was of good quality and could be carried out easily since the production would likely be centralized in the abattoirs that are now shipping the raw materials to the States.

To Readers

WE regret we are not able to fill all the demands for copies of our first issue. Those who have received the first number and do not intend to bind it at the end of the year will confer a favor by forwarding their copy to this office. An allowance of two months will be made to subscribers on each such copy received at this office.

NICKEL

The Magic Mineral Nickel—Amazing Properties When Alloyed with Other Metals

By E. B. Biggar

ARTICLE 2

NICKEL may well be called the mystery metal. Chemical research has endowed it with a power to bring about the ruin or the triumph of the greatest nations. By itself it does not possess qualities that compare with a score of other metals in long use; but when alloyed with other metals it becomes that wonder-working stone which the ancient alchemists believed would transform base substances into the most precious and magical minerals. No known alloy imparts to the metals of commerce qualities so new and distinct as nickel, and while these new qualities bestowed by nickel are capable of adding so much to the physical comforts of the human race and to its range of knowledge of the earth's material, yet the main uses to which such mixtures are actually being put have brought more pain and degradation to the world than at any time in history—for most of us know that nickel has made modern armament what it is. Not because of its capabilities, but because of its actual applications, the original German word nickel has been well derived—Devil's copper.

Pure nickel is a greyish white metal, very hard, very malleable and very ductile. These are valuable qualities, but the world's supply of the pure metal is so small when compared with iron, copper, and other economic minerals, that nickel would not have much influence on the world's industry if it were not for the wonderful changes it effects on the cheaper metals when introduced as an alloy; and the wonder of these changes is not yet at an end, for combinations of nickel with third and fourth metals produce new results, and a change of proportions in the alloys will often produce new qualities and capacities, brought out by experiment, and quite as often by accident.

If only 2 to 5 per cent. of nickel is added to iron, the resulting metal is made immensely harder, tougher, of greater tensile strength, almost rust-proof and acid-proof, except as to one or two kinds of acid. In structural steel alone nickel has revolutionized the method of building cities, bridges and railways. The London and Northwestern Railway, of England, tested a three per cent. nickel alloy in a set of locomotive boiler tubes and the locomotive ran 123,896 miles against 34,000 to 40,000 miles, the limit of other steel. Even then the nickel steel tubes failed more by abrasions from coal handling than from strain or all-round wear. In 1902 the Pennsylvania railroad, after a test, found a nickel steel rail cheaper, at nearly double the price, than ordinary steel. While ordinary steel is weakened one-third by punching, the same section of nickel steel is weakened one-sixth. Nickel has already transformed the heavy iron and steel industries to the extent that alloys of from 1 per cent. to 5½ per cent. are in almost universal use for weldless steel tubes and boiler plates, for cranks and crank shafts, for steel tires for connecting rods and axles, and almost every kind of iron and steel machinery. When the percentage of nickel is increased to from 8 to 25 per cent. the steel may be classed as self-hardening, and its use as a cutting steel is immensely expanded. An increased percentage of nickel creates another new quality and that is that the tendency of iron to expand or dilate with heat is almost completely overcome. This quality persists until about 36 per cent. is reached, and beyond that percentage there is an actual contraction of the metal with a rise of temperature—an unexplained transformation, which is the more curious because both metals by themselves are very expansible under the influence of heat. Formerly platinum was the only metal which expanded in a ratio equal to glass, and therefore was the only metal that could be used in making electric lamps. Now an alloy of nickel and carbon, called platinite supercedes it. But this is not the only important use of such a combination, for this quality of non-expansion by heat makes it invaluable as a metal for watches, chronometers, clocks and especially for scientific instruments, because every advance in applied science requires more accuracy and delicacy in the instruments of measurement. This alloy is now known as invar, and for such purposes it has the additional advantage imparted by the element of nickel that it does not easily rust. Still another quality imparted to iron is that when 25 per cent. of nickel with four-fifths of one per cent. of carbon is added its resistance to the electric current is increased ten fold, and hence it has superceded other metals for resistance coils in electrical work. When reduced to a low temperature nickel becomes highly magnetic and retains its magnetism until brought to a very high temperature. And yet, while nickel and iron are the most magnetic of all known metals, a certain combination of the two makes a metal which has no magnetism.

Bear in mind that all these important effects are produced by combinations with iron and steel only. New modifications and new results are produced by alloys with other metals. German silver is a combination of nickel, copper, and zinc, but in slightly varying proportions. It is known by a great many names, a few of which are: nickel-silver, argentan, pack-fong, white-copper, silveroid, silverite, Nevada silver, Potasi silver, Virginia silver, and electran.

Add a small percentage of tungsten to German silver and we have an alloy that is now indispensable in the electrical trades. German silver is readily soldered, and this increases its usefulness in various industries. Nickel is used in alloy in a number of other metals to prevent rust, and this widens its usefulness still more.

There are four metals, of which nickel is one, which when combined make an alloy so hard that it can be worked at a red heat for sawing or cutting other metals.

New alloys adapted to the yearning needs of special industries, are being discovered every year, and nickel seems to be the most versatile of all metals in the unexpected qualities it contributes to these new combinations. Take, for example Monel metal, so-called after Mr. Monel, (now president of the nickel corporation) which takes a particularly brilliant polish, can be cast like copper, bronze, or steel, and yet is as flexible as copper, and so ductile that Monel wire can be drawn down to a diameter of one four-thousandth of an inch. Metal cloth woven from this is as pliable as silk. Such a metal giving so high a polish and so flexible and ductile, and at the same time acid resistance, comes in for a hundred uses where it is considered indispensable in the complicated processes of modern science and industry. The curious relation of this to the Canadian ores is that a large body of ore in the Sudbury district supplies this nickel and copper in the very proportions required for this alloy, so that it can be used directly from the smelter without the intermediate and after processes of separation which other ores have to undergo.

One more curious property of nickel is that when finely divided and applied in a certain way it has the effect of solidifying vegetable oils, such as cotton-seed oil, and hence we are indebted to this metal for an increasing percentage of our lard and margarine butter.

Nickel when added to aluminum so hardens, toughens, and increases its strength that the nickel-aluminum alloy is indispensable in many machines. Nickel has, in fact, made feasible, not only the automobile, but the machine that enables a man to mount into the sky or safely plunge into the ocean. Not only is the airship as well as the submarine the offspring of nickel and its alloys, but without it the German guns would have battered vainly against the fortresses of Liege and Namur, and there would have been a different tale to tell in Gallipoli and on the Russian front.

Without nickel the modern dreadnought would have been impossible. To get the strength now possessed by the dreadnought without nickel, would involve such an increase of material that the effectiveness of the ship would be decreased in three ways: She would have less coaling capacity, less net tonnage, or carrying capacity, and less speed; while all the electrical and munition-handling apparatus would be heavier and more cumbersome. Moreover, the guns would be increased in weight and weakened in striking power. In short, if nickel were withheld, the whole machinery and equipment of modern armament on sea and land would go back with one slide almost to the days of Nelson and Napoleon. In the dread arts of war nickel figures at every turn from the automobile, the "tank," heavy howitzer, and siege gun, to the armor-plate and armament of battleships and cruisers, the skin of the submarine, and the complicated fittings of all of the mob of slaughter craft.

The loudest thunder-clap cannot be heard more than ten or twelve miles, but the might of nickel joined to the power of high explosives outroars and out-blasts the thunders of heaven till concussion alone will kill. It is credibly reported that on quiet days the boom of big guns on the Somme and Meuse Rivers could be heard in the suburbs of Paris one hundred miles away.

All these marvels are made possible by nickel, but the marvel of these many marvels is that nine-tenths of the material that could revolutionize the peaceful development of the whole human race is used to brand that race with the crime of Cain. Nine-tenths of the world's nickel used in human slaughter, and certainly four-fifths of this total comes from Canada.

What an accountability, therefore, has this country in the administration and control of this dread asset.

(To be continued)

Oleomargarine and Its Manufacture

By H. E. Rothwell, B.A. Sc.*

Oleomargarine is a substitute for butter, composed wholly or in part of fat, other than butter fat. In England this product is called margarine and in the United States a common name is butterine. It is also manufactured and sold in large quantities on the continent, where the Dutch are said to be most expert in producing this article of food. While the United States is manufacturing and using more and more oleomargarine every year, its manufacture in Canada is absolutely prohibited. As a result of this prohibition Canadian abattoirs are forced to export all of one of their most valuable by-products, oleo oil, this material being a very important constituent of oleomargarine. In the United States there is an internal revenue tax of ten cents per pound on oleomargarine, which has been artificially colored to resemble natural butter, while the uncolored pays ¼ cent per pound.

In view of the fact that the question of food and food materials looms largely at the present time in the public mind, it is a matter of prime importance that the consumer should know something of the nature of such materials as are produced in abundance here in Canada. It is with this in view that the writer purposes to describe briefly the manufacture of the different constituents of oleomargarine.

Oleomargarine is composed of oleo oil, neutral lard, milk, and pure butter. These constituents are churned together, salted, and worked up in the same manner as natural butter. Sometimes, usually in the cheaper grades, cottonseed, peanut, and other vegetable oils are used. A good grade would consist of 35 per cent. oleo oil, 35 per cent. neutral lard, and 25 to 30 per cent. butter or cream sufficient to make that much butter with a small percentage of salt moisture, etc.

Preparation of Oleo Oil

Oleo oil is prepared from the fat of beef cattle. The higher grades consist of caul fat, ruffle (intestinal) fat, and the fat of the heart. The preparation must be attended with the utmost cleanliness, failing which the quality of oleo oil is very much lowered. Oleo oil is extremely sensitive to conditions of cleanliness.

The fat from the freshly killed cattle is removed and placed in tanks of water at a temperature of 50°F. From these tanks it is transferred to other tanks of cold water and chilled until all the animal heat is removed. The object of this gradual chilling is to allow the animal heat from the middle of the heavy pieces to escape. If the fat was suddenly chilled the surface of these heavy pieces would solidify and thus prevent the heat from escaping. The result of the retention of this heat would be to cause the oil to become "sour" and thus render it unfit for the highest grades of oil. Some twelve hours are required for these transfers of the fat which should not be kept for over forty-eight hours before making into oil.

The next operation is hashing, directly preceding which the fat has been kept for about one hour in ice cold water. In the hasher the fat is disintegrated and converted into a pulpy mass by means of revolving knives. The hasher is provided with a steam jacket, but this heat is not utilized except when it is desired to cause the fat to move through the worm and spout into the melting kettle. The pulpy mass is then transferred to water jacketted kettles, which are provided with paddles to stir the mixture. Heat is gradually applied until the temperature of the fat is 150° to 160°F. The cooking time is about one and a half hours after which the melted fat is allowed to stand for one-half to one hour when the oil is siphoned off. Straining through cloth removes the floating scrap which is composed of connective tissue, etc. Addition of salt assists in the removal of this floating scrap.In the settling kettle into which it is strained the oil remains for two hours at a temperature not over 140°F. On account of the fact that dry heat has a detrimental effect on oleo oil these settling kettles are water jacketted. In former years it was thought necessary to allow the oil to settle in a series of two or three such kettles transferring from one to the other after a period of settling in each one. The present practice is to allow it to settle in but one kettle. It is then run into seeding or graining trucks, which are kept in a room, the temperature of which does not vary from 85° to 90°F. Here the oleo stock, as it is called, separates into a grainy mass and a clear yellow oil. By this fractional crystallization the fat resolves itself into two fats of different solidifying points, the solid part being known as oleo-stearine and the liquid part as oleo oil.

The oleo stock is now mixed and dipped into cloths. These cloths are folded and the cakes placed in a press with sheet iron plates between each cloth. The form of press universally used is known as the knuckle-joint press. In this press the mass is subjected to powerful pressure, the pressure being applied very slowly so that the oil may have ample time to drain away from the solid part or stearine. It must be noted that the filter cloths are a matter of great importance. In order to stand the heavy pressure they are made of closely woven heavy duck. These cloths are never used for more than one day's pressing before being thoroughly washed and dried free from all moisture.

The oleo oil which runs out of the press is drawn into tierces which are then transferred to the chill room. These are let stand for seven days at a temperature of 55° to 60°F. in order that the oil may acquire a grainy condition. Care is taken that the tierces are not disturbed or moved about during this time.

Good oleo oil has a titre of 40° to 43°C. and the free fatty acid content is usually about .3 to .4 per cent. The yield of oleo stock from fat is about 75 per cent., while the yield from pressing the oleo stock is about 50 per cent. oleo oil and 50 per cent. oleo stearine. Conditions under which the pressing is conducted determine the relative proportion of the two fats, the manufacturer adjusting these conditions so that he will obtain the larger proportion of the product which commands the higher price on the market.

Neutral Lard

Neutral lard is made from leaf lard which is the fat surrounding the kidneys of the hog. The manufacture of neutral lard differs materially from that of other kinds of lard. A brief description of the method of preparation will show with what care this important constituent of oleomargarine is produced.

The leaf from the freshly killed animal is taken to the chill room where it remains for about forty-eight hours. The temperature of the chill room is regulated to about 33° to 34°F. From here it is taken to where it undergoes a method of treat-

*Chief Chemist, The Harris Abattoir Co., Limited, Toronto

ment very similar to that used in the manufacture of oleo oil. This treatment differs in that the lard is not pressed as is oleo oil and also the temperature at which the lard is melted is lower.

The chilled fat is first put through the hasher which grinds the fat up into a pulpy mass, the hasher being steam jacketted. From the hasher the fat is transferred to a water jacketted kettle, provided with paddles and the heat gradually raised to a temperature of 110° to 120°F. In the early days of the industry these kettles had a capacity of from 1,500 to 1,800 pounds, but they are now built to hold as much as 5,000 pounds. Modern oleo melting kettles also have the same capacity.

As soon as all the fat is melted, which will be in about one hour from the time the finely ground leaf begins to enter the kettle, the heat is shut off and the stirring discontinued.

The temperature has now risen to about 130°F. and the melted mass is allowed to remain at this temperature for about twenty minutes. The fine scrap floating on the top is skimmed off, this operation being assisted by the addition of fine salt. From the melting kettle the lard is run into a settling kettle, from which after remaining four to six hours it is drawn into tierces. Preliminary to the drawing into tierces the lard is strained through cheesecloth, being drawn into the tierces at a temperature of about 130°F. The tierces are then taken to the graining room which is kept at a temperature of about 60°F. The lardy odor is allowed to escape by removing the bungs of the tierces. After about three days in the seeding room the lard will have acquired a grainy condition, signifying that the olein and stearine have separated. In this condition the lard is ready for shipment.

Precautions with respect to conditions of cleanliness and freedom from odor of the rooms in which the operations are conducted apply in case of neutral lard as well as oleo oil, only with double force. Neutral lard is very susceptible to taint if these precautions are neglected. It must also be kept in cold storage as it very quickly becomes rancid otherwise. Neutral lard made as above described is white in color and has scarcely any odor.

The milk used in the production of oleomargarine is allowed to ripen. This fermentation gives a flavor to the oleomargarine which resembles natural butter.. The method of treatment consists in first pumping the milk through a fine strainer into a centrifugal separator. Here the cream is separated from the milk at a temperature of 75°F. The cream is then pasteurized at a temperature of 170°F. Then it is allowed to stand for twenty-four hours at a temperature of 65°F. in order to undergo fermentation. The ripened cream is then ready for mixing and churning with the oleo oil, neutral lard, etc.

It has been stated earlier in this article that cottonseed and other vegetable oils are used in the manufacture of oleomargarine. In 1915, it might be interesting to know, 26,500,000 lbs. cottonseed oil were used in this way in the United States. Only the choicest grade of crude oil is used in the manufacturer of oleomargarine. A description of the process of converting crude cottonseed oil into an oil suitable as an ingredient of oleomargarine is as follows:

The preliminary step is agitation of the crude oil with caustic soda solution in a large steam jacketted tank provided with stirring apparatus. These tanks can easily accommodate 8,000 gallons, the capacity of the average tank car. The strength and volume of the caustic soda solution used varies with the quality of the oil. The heat is gradually raised until a maximum of temperature of 105 to 110°F is reached. The oil and caustic soda are thoroughly mixed by means of the large paddles. After thorough agitation for some time the oil "breaks," that is, the soap formed by the caustic soda and the free fatty acids in the oil, together with the impurities in the oil settles off. This operation takes varying lengths of time. The refined oil is now known as summer yellow and the next operation is bleaching with fuller's earth. This bleaching is done in steam jacketted tanks provided with apparatus for thorough agitation of the mixture. Varying quantities of Fuller's earth are used, but the usual amount is 3 per cent. The oil is now forced through a filter press. It is then ready for mixing with the other ingredients of oleomargarine.

Natural butter is used in varying proportions. The manufacturer buys butter for use in oleomargaraine if market conditions and prices are favorable. The proportions of the other ingredients also vary. The cheaper grades, as has been mentioned, contain cottonseed oil, this material taking the part of, for instance, some of the butter.

The different ingredients of oleomargraine are run into a mixer or churn and agitated for seven or eight minutes. Although the graining of oleo oil and neutral lard has been described, these materials do not have to be grained for use in oleomargarine. They are run into the mixer at a temperature of 110°F., while the cream is introduced at a temperature slightly above, and the cottonseed oil, at room temperature.

The mixture is transferred from the mixer to a large vat containing ice cold water. After remaining here for about ten minutes the oleomargarine has assumed a crystalline condition. It is then transferred to a truck, allowed to drain, and at the same time, salted. After ample time has been allowed for draining, the oleomargarine is taken to the worker. Here it is worked up in much the same way as natural butter, the excess moisture being pressed out, and the salt, by this working, being evenly distributed throughout the mass.

Oleomargarine is white in color and is sold colored and uncolored. There is, however, a certain grade of oleo oil which can give the oleomargarine, in which it is incorporated a yellow color. This oleo oil is made from specially selected fat. Artificial coloring matter is of course used but the largest manufacturer of oleomargarine in the United States prefers to put his best grade on the market uncolored.

Oleomargarine has been investigated with a view to determining the nutritive value and its wholesomeness as a food. It has been found to be quite as good as most high grade butters and much superior to some.

Acknowledgment is made to Messrs. H. D. Tefft, O. O'Connor and D. Imrie for information received on this subject.

Metal Melting at the British Mint

At the annual general meeting of the Institute of Metals in Great Britain, held recently, the various methods of melting non-ferrous metals was considered. Mr. W. J. Hocking described the reorganization of the Royal Mint effected several years ago for the melting of the various metals required in making coinage, when a long series of experiments was carried out resulting in adapting the furnaces then in use for the use of coal gas instead of coke. The gas is used at a pressure of 3 inches and the air at 2½ inches. During the five years from 1911 to 1916 nearly 10,000 tons of metal were melted and cast into bars for coinage with a total consumption of 121,000,000 cubic feet of gas and in comparison with the previous five years when coke was used, showed considerable economy in favor of gaseous fuels as regards both rate of output and costs of fuel.

Making Fuel From Peat in Norway

According to Tidens Tegn, Christiania, a company is in process of formation in Norway for making fuel from peat by the Rosendahl method. The capital of the company is to be between 600,000 and 1,000,000 kroner. The raw material for the new industry will be chiefly peat from the extensive Norwegian moors, but any organic material may be used which is sufficiently abundant in the neighborhood of the factory, e.g., wood waste. The product is said greatly to resemble English coal. Preliminary experiments have been conducted, not only in the laboratory, but also under factory conditions on a small scale, and the product is stated to have been satisfactorily tested in Christiania households.

Fertilizers and Their Use in Canada*

By Frank T. Shutt, M.A., D.Sc.

Dominion Chemist

Recognizing that employment of fertilizers in Canada to date has been limited, and that, to-day, their use is practically restricted to certain areas devoted to potatoes, sugar beets, tobacco, market garden, or other specialized "money" crops, and further, that our experiments, from which reliable conclusions could be drawn, have been carried on at a comparatively small number of points in the Dominion and over comparatively short periods of time, it should be distinctly understood that our conclusions are, more or less, tentative in character. We do not wish to be dogmatic as to the interpretation of the results obtained and we shall be extremely cautious in the matter of prophecies for the future.

Small as our use of fertilizers has been, that use is steadily, though certainly slowly on the increase, and, doubtless, with the adoption of more intensive methods (which will follow as our country becomes more thickly settled) and with better, steadier markets for farm produce at home and abroad, this use will more and more increase. Indications are all in this direction, but it would not be wise to advocate, throughout Canada, the general and indiscriminate use of fertilizers on all soils and for all farm crops. While we are anxious that our yeilds should reach the highest possible profitable limit, there are no grounds for preaching the doctrine, as is the opinion of some, that this can be effected simply by the application of fertilizer.

Fertilizers Are Supplementary

Fertilizers have a place in a rational system of farming; but farmers should first clearly understand what that place is, if our land is to improve rather than to deteriorate, and if financial loss, due to injudicious purchase of fertilizers, is to be avoided. We must first have sound education, the outcome of science with practice, on the principles involved in the up-keep of soil fertility, on the composition, value, care and application of farm manures, on the desirability of more live stock on our farms and the greater consumption on the farm of the land's produce; on the importance of rotations, and especially the value of clover and other legumes in the rotation for maintaining the humus and nitrogen of the soil, on the proper working of the land and the preparation of a good seed bed. When all these matters are correctly understood and practised, then, and not before, may we advocate the judicious employment of fertilizers with advantage, in general framing. Fertilizers are no panacea for the evils of poor farming—they cannot be depended on solely to give profitable yields, to leave the land richer for posterity than when first broken, or entered upon. That is what we ought to aim at, for our native fertile soils are a great and important national asset and inheritance. Our experience has shown that fertilizers cannot profitably be used as substitutes for manure, for the growing of clover, or for good soil management, but that their role is rather supplemental to all these rational means for the up-keep of soil fertility.

Helping the Farmers

But there is a place for fertilizers in farming, and we are helping our farmers to find it. There are those of the old school still in the land, however, who have no faith in fertilizers, those who relegate them to the class of quack medicines, as frauds, and fakes, and who say they act merely as a whip to a tired horse—as stimulants and not food. The number of these persons is happily decreasing. Again, there are others who, almost as ignorant of the principles of agriculture as those just referred to, argue that if fertilizers are sources of available plant food, all that is necessary to increase our crop yields is to apply them generously. These persons are ignorant of the fact that there are limiting factors to crop growth other than the presence of available plant food.

*Extracts from a bulletin recently issued by the Committee on Lands of the Commission of Conversation.

As is well known, the province of Manitoba, Saskatchewan and Alberta contain the largest and most continuous areas of the richest soils. Many of these, as our analyses show, are veritable mines of plant food; for example, the alluvial prairie of the Red River valley, the uniform fertility of which it would be difficult to exaggerate.

Without discussing the relative agricultural values of the arable lands of our several provinces, the indications are that fertilizers will be found more particularly helpful in the Maritime Provinces, in Quebec and in British Columbia. This does not mean that profitable farming will not be possible in these provinces without fertilizers, but that they possess areas of cultivable land upon which these aids to fertility can be used profitably and to advantage when coupled with rational methods of soil management.

With respect to the future, my opinion is that the time may come when phosphates will be found useful, especially in the prairie provinces. My reason for this conclusion is that, of the three essential elements, these soils are least rich in phosphoric acid, and that the extensive growing of grain crops will tend to diminish the available store of this element that it more or less available for crop use. Moreover, phosphates may be found of value in inducing an earlier maturity of the crop—a matter of much importance in districts where early autumnal frost endangers the ripening wheat crop. The introduction of mixed farming, with the adoption of rotations which will serve to maintan the humus content of the soil, should be sufficient, in my opinion, to obviate any necessity for relying generally on fertilizers for the up-keep of the fertility of these soils. At the present time, I feel assured that the determinative factors in crop production in these regions are the seasonal conditions, more especially as to the amount and distribution of the spring and early summer rains, and the thoroughness with which the land is prepared, which latter, of course, is intimately connected with the vital question of the conservation of soil moisture. If our northwestern lands are not to be allowed to deteriorate, mixed farming must be more and more introduced, and it is, above all, imperative in the highest degree that the humus content be constantly replenished, not only to keep fibre in the soil that will prevent loss from "blowing," but to maintain their present high capacity for holding moisture.

British Columbia

With regard to British Columbia, the results that we can review for the purpose of this paper have been chiefly obtained at the Experimental Farm at Agassiz, eighty miles from the coast, the soil being of a poor, gravelly or sandy nature. Potatoes and mangels are the two crops that have been chiefly used. The most profitable results have been obtained from the use of a "complete" fertilizer, that is, one supplying nitrogen, phosphoric acid and potash. In the larger number of instances the fertilizers yielded a good profit. The more profitable formulæ contained nitrate of soda, 100 to 160 pounds; superphosphate, 350 to 400 pounds; and muriate of potash, 100 to 200 pounds, these amounts being per acre. The evidence so far is satisfactory, in pointing to a profitable use of fertilizers on hoed crops, provided that use is judicious and rational.

Central Experimental Farm

Investigational work with fertilizers was instituted on the Central Experimental Farm, Ottawa, in 1888, and is still in progress. As the data are very voluminous, time will not permit a review of all the numerous lines undertaken. It must suffice here to indicate some of the more important or outstanding of the results obtained. The soil is a light sandy loam, of medium quality, and, in the larger number of the experiments, especially during the latter years, a three-year or four-year rotation has been followed. Great difficulty has been experienced at this station from lack of uniformity in the land under experiment; indeed, this is a difficulty we have been forced to contend with at a considerable number of our stations though all possible care was taken at the outset to select a suitable area for the work. It should be added that the work at Ottawa has included the comparison of fresh with rotted manure, the manurial value of clover as compared with farm manures and fertilizers, and the testing out of a number of materials not generally recognized as fertilizers.

While, in general farming, fertility cannot be economically maintained and profitable yields obtained by the exclusive use of fertilizers, our experiments have shown that fertilizers may be used to good advantage in conjunction with farm manures. This deduction is probably true for the greater number of our agricultural areas in Eastern Canada and on the western coast. When manure is scarce, or has to be purchased at a high price, then it will assuredly be found desirable to purchase fertilizers, not to take the place of the manure, but to supplement its scanty use. If we cannot apply manure at the rate of fifteen tons per acre, our experiments indicate that we can use half that quantity and dress with judicious amounts of fertilizer without materially affecting the results. The probability is that, to-day, on the average farm the net profits per acre would be much the same under either system of procedure. With cheaper fertilizers, or with a higher rating for farm manures, than we have to-day, there would probably be a more profitable showing from the manure and fertilizer mixture than from the exclusive use of manure.

No profitable response has been obtained from the direct application to the soil of finely ground untreated mineral phosphate (apatite), though special experiments, in which this material was mixed with actively fermenting manure, the whole being left for several months, showed that small amounts, practically traces, of the insoluble phosphate were converted by this means into soluble forms.

Basic slag has proven the most useful phosphatic fertilizer on sour soils or heavy clay loams, on soils naturally deficient in lime, and on peats and mucks, while on the lighter soils rich in lime, superphosphate has given the quickest returns, especially for turnips and the cereals.

On land in fair condition a top dressing of nitrate of soda, applied in the early weeks of growth, has been found beneficial to grass, more particularly when intended for hay.

No potassic fertilizer has proved more valuable than good hardwood ashes. Of the three essentials, potash appears to be the least needed, but, on many light loams, it has given a good return, for encouraging the growth of clover and for vegetables and leafy crops generally. Muck and peaty soils frequently stand in need of this element. On heavy clay soils potash is not, as a rule, remunerative.

Summarizing

Our experiments, in general, have gone far towards establishing that a judicious and rational use of fertilizers may be depended on to yield a profit, that the exclusive use of fertilizers will neither keep up the fertility of the soil nor yield profitable returns, and that it is on soils of medium rather than poor quality that a lucrative response from their employment is to be expected, and, lastly, that it is on the "money" crops that we shall find the application most profitable.

Had time permitted, we might have informed you of the valuable results we have obtained with liming and the use of finely ground limestone, especially in Eastern Canada, of our experiments with fish-waste manures and with dried ground seaweed; of the many naturally-occurring materials of manurial value in our country that might be more generally used, and many other phases of this great and important subject of maintaining and increasing soil fertility. In this address I have endeavored to tell you, briefly, of our extensive experimental work with commercial fertilizers and its results, and, further, what is perhaps more important, our teachings and the position we have taken based on these results. The advice that is constantly and increasingly asked of us by our farmers to guide them in their use of fertilizers finds its foundation largely in the deductions brought forward to-day, and we trust we have in some small measure made clear the general lines upon which that advice is given.

Acid Resisting Properties of Some Iron-Silicon Alloys*

By O. L. Kowalke

Various acid-resisting alloys of commercial importance have been produced within recent years, and among these the iron-silicon alloys seem to give satisfactory service in many operations. There seems to be, however, but little published information on the acid-resisting properties of the iron-silicon alloys, and it was the purpose of this investigation to determine the resistance to several common acids. This paper is offered as a progress report with the hope that suggestions may be made which will be of assistance in the subsequent tests.

The assistance of Mr. Stanton Umbreit in obtaining these data is hereby gratefully acknowledged.

W. Guertler and G. Tamman[1] worked out the equilibrium diagram for these alloys. The curve shows mixed crystals or a solid solution of Fe and FeSi between 0 and 20 per cent. silicon. At 20 and at 33.7 per cent. silicon there are two compounds, Fe_2Si and FeSi respectively, which combine to form a eutectic at about 21.4 per cent. silicon. The compound FeSi and free silicon form a eutectic at 60.6 per cent. silicon, which corresponds to the formula $FeSi_3$. The melting point of Fe_2Si is about 1,250°C. and that of FeSi about 1,443°C. The alloys made for this investigation lay in the region of mixed crystals, and did not contain over 20 per cent. silicon.

Preparation of the Alloys

The alloys were made from electrolytic iron and ferro-silicon which analyzed 49.5 per cent. silicon; no test was made for carbon. Acheson graphi e crucibles lined with magnesium oxide were used so melt the alloys. Each charge was made up to a total weight of 200 grams and the amount of ferro-silicon for each alloy was computed from the amount of silicon to be added. The charges were melted in the covered crucibles in a granular carbon resister furnace.

The mold for casting the alloys was made from Acheson graphite. Recesses $4 \times 1\frac{1}{4} \times 1/16$ in. ($10.15 \times 3.2 \times 0.15$ cm.) were cut into a slab of graphite and a cover clamped onto the slab; pouring cups were also cut at the mouths of the recesses. This provided means for making a specimen about $3 \times 1\frac{1}{4} \times 1/16$ in. ($7.62 \times 3.2 \times 0.15$ cm.).

The alloys were not stirred while in the furnace, but as the crucibles containing the fluid alloys were removed from the furnace they were given a gyratory motion so as to mix the molten charge thoroughly. The melted alloys were then poured from the crucibles into the molds. As soon as the alloys solidified in the mold, the cover clamped over the recess was removed, and the alloy taken out.

Since the alloys cooled very rapidly upon being poured into the mold, there was undoubtedly a negligible amount of carbon absorbed, but no chemical analyses were made to prove this point.

The alloys of low silicon content made good soft castings. Above 3.5 per cent. silicon the alloys were brittle. In alloys of 7.5 per cent. silicon and above there were such severe strains developed on casting that they would frequently break into small pieces in the mold. Some alloys with more than 11 per cent. silicon would fly apart with great violence. Two castings with 16 per cent. and 17 per cent. silicon broke in the acid during corrosion tests the second week after casting the same.

*Presented at the Thirty-first General Meeting of the American Electrochemical Society, Detroit, May 2-5, 1917.

[1] Zeit. Anorg. Chem., 47, 163-179.

Acid Corrosion Tests

The acids used were ten per cent. solutions by weight of sulphuric, hydrochloric, nitric, acetic, and citric acids, made to this strength by using a hydrometer. The temperatures of the acids when made and when used in the tests were between 20° and 25°C.

Owing to the great brittleness of the alloys, the specimens thereof used for the tests were very irregular in shape. The faces and edges of the specimens were therefore ground to fairly smooth surfaces.

The specimens were placed on edge in hard-rubber racks, which held the specimens rigidly and prevented them from touching one another. From thirteen to eighteen specimens could be placed on the various sized racks. The specimens on the racks were then placed in crystallizing dishes about 2 inches (5.1 cm.) deep and covered with the acid. A glass cover was placed over the dish to prevent evaporation.

From time to time the specimens were removed from the acid to be weighed. They were first washed in distilled water, then rinsed in denatured alcohol, and dried quickly in a current of hot air, after which they were weighed on an analytical balance.

Results

The results of these tests are shown in Tables I to V. The per cent. loss is cumulative.

Sulphuric Acid.—Tests given in Table I show that the loss is greatest at about 3.7 per cent. silicon, then the resistance increases to a maximum with a silicon content of 16 per cent. Beyond this content of silicon the resistance seems to decrease.

Hydrochloric Acid.—Tests given in Table II show that the loss is greatest at abut 3.7 per cent. silicon, and least at about 18 per cent. silicon. Beyond this content of silicon there is a decrease in the resistance. Nitric Acid.—The loss diminishes quite steadily until the silicon content reaches 16 per cent., after which it increased. The results are given in Table III.

Acetic Acid.—The loss as shown in Table IV increases up to a content of silicon of about 5 per cent., beyond this point it decreases steadily to 16 per cent. silicon, beyond which it again increases.

Citric Acid.—From Table V it is seen that the corrosion increases up to a content of 3.3 per cent. silicon, beyond which it gradually decreases to the point where the silicon is 17 per cent.

Table I.—Loss in 10 Per Cent. Sulphuric Acid

Cumulative Loss, Per Cent.

Composition Per-cent Si	Area sq.cm.	51 Hours	75 Hours	141 Hours	15 Days	22 Days	29 Days
1.2	14.6	0.99	3.7	9.4	100.	....	....
2.5	14.7	1.6	4.1	6.5	31.9	39.2	65.3
3.7	11.0	51.3	66.8	100.0	....	....	....
6.6	13 0	13.8	23.9	30.2	....	....	....
9.9	12.7	10.7	19.8	23.1	....	....	....
11.1	13.0	5.0	8.8	13.1	34.3	42.5	73.1
13.6	16.6	0.2	0.6	0.9	1.9	2.0	3.4
16.1	10.2	0.03	0.04	0.04	0.04	0.04	0.04
17.3	11.9	0.03	0.03	0.03	0.03	0.03	0.03
19.8	9.6	0.13	0.2	0 25	0.5	0.6	0.7

Table II.—Loss in 10 Per Cent. Hydrochloric Acid

Cumulative Loss, Per Cent.

Composition Per Cent. Si	Area sq. cm.	7 Days	16 Days	21 days	28 Days
2.5	8.4	2.4	10.0	15.7	20.4
4.9	11.4	2.3	8.6	10.0	14.0
7.4	11.2	5.5	19.0	27.3	33.8
11.1	10.4	4.9	8.1	9.4	11.0
12 4	13.1	1.4	2.7	4.0	4.6
13 6	11.7	0.18	0.51	0.67	0.93
16 1	11.4	0.12	0.27	0.36	0.48
17.3	11.2	0.31	0.40	0.41	0.40
18 5	8.9	0.03	0.03	0.04	0.04
19.8	10.8	0.1	0.28	0.28	0.52

Table III.—Loss in 10 Per Cent. Nitric Acid

Cumulative Loss, Per Cent.

Composition Per Cent Si	Area sq. cm.	115 hours	166 Hours	14 Days
2.5	8.4	20.8	48.0	53 5
4.9	11.4	12.3	18.8	19.5
6.6	18.3	10.7	13.1	13.5
9.9	7.3	5.9	8.7	8.9
12.4	13.1	2.3	4 6	4 6
14.8	6.3	0.013	0.02	0.02
16.1	11.4	0.006	0.003	0.0015
17.3	11.2	0.006	0.007	0.007
18.5	8.9	0.037	0.044	0.46
19.8	13.8	0.01	0.01	0.01

Table IV.—Loss in 10 Per Cent. Acetic Acid

Cumulative Loss, Per Cent.

Composition Per Cent Si	Area sq. cm.	7 Days	14 Days	20 Days	27 Days
1.6	7.3	0.5	1.0	1.4	2.2
4.9	9.0	1.4	3.7	5.5	8.10
6.2	13.5	0.4	0.9	1.3	1.9
7.4	10.0	0.26	0.7	1.0	1.8
9.9	6.5	0.2	0.4	0.5	0.8
12.4	10.4	0.1	0.24	0.3	0.4
14.8	8.1	0.03	0.03	0.03	0.03
16.1	7.0	0.006	0.008	0.01	0.013
18.5	8.3	0.014	0.014	0.015	0.016
19.8	8.5	0.07	0.08	0.08	0.08

Table V.—Loss in 10 Per Cent. Citric Acid

Cumulative Loss, Per Cent.

Composition Per Cent Si	Area sq. cm.	7 Days	14 Days	21 Days
1.2	13.9	5.3	16.3	20.0
1.7	11.9	10.0	19.3	21.0
3.3	11.6	54.6	95.1	95.6
6.2	9.5	4.6	9.5	9.8
8.7	13.6	2.8	7.4	....
12.4	10.6	1.8	2.8	3.1
13.6	17.0	0.4	0.4	0.4
14.8	8.9	0.07	0.07	....
16.1	8.1	0.04	0.04	0.5
17.3	12.8	0.006	0.009	0.009

Conclusions

Silicon-iron alloys of about 3 to 5 per cent. silicon are attacked very readily by sulphuric, hydrochloric, acetic, and citric acids. These alloys are not excessively brittle.

Silicon-iron alloys of about 16 to 18 per cent. are exceedingly resistant to action of sulphuric, hydrochloric, nitric, acetic, and citric acids. These alloys are so brittle that they must be ground; they cannot be machined.

A solid solution of FeSi in iron near 20 per cent. silicon is resistant to mineral acids.

Search is in progress for a third metal which can be added to the iron-silicon alloys to improve their strength and still retain the resistance to the action of acids.

Chemical Engineering Laboratories,
University of Wisconsin.

Fireproof Paper Severely Tested

That no foreign ingredient increases the resistance of asbestos to fire is the conclusion reached as a result of scientific experiments conducted in England to determine the most suitable composition for fireproof, which is made of combustible materials that hold water in molecular combination. So far as texture and tensile strength are concerned, the best results were obtained with pulps embodying precipitated hydroxides, arsenites, tungstates and silicates. Stock in which mangnesium arsenite was used proved to be the best of all that were subjected to the tests. No paper was found to be wholly satisfactory when subjected to a temperature of about 1,000 degrees C. (1832 degrees F.) for ten hours. Some papers, however, were practically uninjured after being exposed to dull red heat for one or two hours.

Platinum and its Production in Canada

According to the report of the Department of Trade and Commerce, recently issued, the quantity of platinum in concentrates or other forms, exported in 1916, amounted to 399 troy ounces, which is nearly ten times the amount exported the previous year and nearly three times the amount exported in 1914. The total quantity exported from 1912 to 1915, inclusive, was 336 oz., but the most notable increase, of course, is in value, the 1916 production being valued at $25,426 which is nearly double the value of the total production of the four previous years put together.

This production does not begin to fill the needs of the country, since the value of the metal imported, mostly as manufactured ware, amounts to over $100,000 annually. In fact, platinum to the value of over $220,000 was imported in 1913 which is the highest on record for some time.

The greater part of the world's supply of platinum has been derived from the Ural Mountains in Russia, although it is found in small amounts in Columbia, Brazil, San Domingo, Borneo, California, Oregon and British Columbia. It occurs only in the native state, usually occurring in small glistening granules of the familiar grey color, which contain copper and iron and varying proportions of the other metals of its group, such as gold, iridium, rhodium, palladium, osmium and ruthenium, the latter five being rarely found except in association with platinum. In addition to the granules mentioned, the metal may also occur in masses some of which have weighed ten or even twenty pounds.

The early method of obtaining the metal reasonably free from impurities was to put the granules through a treatment with aqua regia, precipitating the platinum with ammonium chloride and igniting the residue, which gave spongy platinum. Deville and Debray's method consists of first forming an alloy with lead, by exposing the ore with equal weights of galena and litharge, gradually added, with a little glass to act as a flux, to full redness in a clay-lined reverberatory furnace. The sulphur contained in the galena is expelled and the molten alloy of lead and platinum is allowed to rest for a time until the osmium-iridum alloy has sunk to the bottom of the furnace. The upper portions are then decanted into moulds, then cupelled and the metallic platinum which remains is again melted and refined in a small lime-lined furnace heated by a oxy-hydrogen or oxy-acetylene flame.

Platinum has a smaller coefficient of expansion when heated than any other metal and this property has been utilized for a long time in the manufacture of electric lights, a small section being placed to allow the current to pass through the glass. A new alloy has been developed, however, since the price of platinum started rising and this alloy has practically replaced platinum in electric light manufacture. Canadian lamp makers report that the alloy generally used by them now has a secret formula and method of preparation, being put on the market by a concern in Cleveland.

Owing to the high price at which platinum has been selling, it has been taken up by jewellers and it is made up into jewellery to sell to people with expensive tastes—although it is very difficult to tell the difference between platinum and several cheaper metals which are also used for the same purpose. The use of the metal in this connection has caused the price to increase greatly in the last year, and to go as high as $105.00 an ounce, which is the highest on record. This has caused much distress to the manufacture of sulphuric acid by the contact process and also to the many laboratories where platinum cones, crucibles and electrolytic apparatus have to be bought and used. In this connection it is interesting to note that the United States Government has taken the matter in hand and will likely take steps to secure the supply that is being held by jewellers so that the metal may be diverted to where it will do the most good to that country.

The United States Geological Survey is also planning an immediate survey of all the areas, both in the States and Canada, where platinum is likely to be found, with a view to relieving the situation. Small amounts of the metal have been found at various points along the western mountain ranges and also in certain alluvial deposits in Alaska and with the exception of the platinum obtained in the refining of nickel and a few other metals, all the metal has been obtained from these placer deposits. Attempts to trace the metal found in this way to its source have been fairly successful, but it has not repaid working to any extent on a commercial basis. On account of the high price of platinum at the present time, however, a primary deposit is being developed in Russia, according to recent advices.

Working on a systematic basis, a geologist in Spain has been able to locate deposits on the assumption that the best place to find the metal was in rocks similar to those in which it is found in Russia, where it occurs in basic igneous rocks. In a similar way, it is only reasonable to assume that systematic search in the western Rocky Mountains may lead to the discovery of platiniferous gravels of economic importance, but it should be remembered that much work of a similar nature has been done in Russia for many years and the results in many cases have been lower than had been expected. The Russian gravels are found in a discontinuous belt of elliptical outcroppings of basic igneous rocks which come to the surface near the summit of the western side of the Ural mountains. By a process of erosion, and weathering, the rocks have been broken up and, along with the platinum have been washed down and by a process of washing, have been concentrated to a small amount of gravel. Although many deposits are known, the main deposits that are worked to any great extent are in the Perm, North and South Verkhoturshi and Cherdinak districts.

The second largest producer in the world is Columbia in South America, where the principal deposits are found in the reconcentrated stream placers at the headwaters of the San Juan River, which flows into the Pacific Ocean north of Buena Ventura. The production in the States is limited to California, where the metal has been found in streams in the serpentine areas in the central part of the state and southern Oregon in Curry, Josephine and Jackson counties where similar deposits also exist. Traces have also been noticed in the Blue mountains of eastern Oregon and in the Cascade mountains of central Washington. In British Columbia the principal source is in the placer gravels of the Similkameen districts, where 23 ounces were reported to have been recovered in 1915. Other smaller deposits have been located in the Quesnel district and also in the Cariboo district where some activity has been reported from time to time.

The nickel ores found near Sudbury have yielded a considerable supply, 2,366 ounces of platinum and 4,216 ounces of palladium being recovered at the refinery of the International Nickel Company in the six years ending in 1912, although the company reports that there had been no recovery from Canadian ores since.

Chemical Glass and Porcelain in England

Possibly the most noticeable feature of the recent British Industries Fair was the display of laboratory and surgical glass and porcelain, which industries did not exist at all previous to the war, all supplies being furnished from enemy countries. In this connection it is interesting to note that the manufacturers who have inaugurated this new industry have formed themselves into an association, so as to enable them to deal with the requirements of the trade upon an organized basis. They already number nearly a dozen.

Further increase and also improvement in design and finish was noticeable in the output of fancy goods and fancy leather goods, both of which industries were formerly largely dominated by foreign manufacturers.

Occupational Diseases in the Chemical Industry*

By C. W. Hancock

Practically all of the countries of the world have begun to realize the necessity of investigation and research into the working conditions of various chemical plants in order to minimize the chance of chemical poisoning or disease reaching the workman. Germany, who prior to the war led the world in the production of many chemical products, was the first country to begin a thorough study of the chief hazards to the industrial health. In the United States within the last few years, committees have been formed to learn the specific conditions in particular chemical trades which might call for improvement.

In the past the chemical industry has been but little studied in Canada from the standpoint of industrial hygiene. Chemical works were usually located on the outskirts of communities and the general public had always been convinced of the mysterious and alchemistic character of the chemical processes, many of which are so-called trade secrets and therefore jeaously guarded by the manufacturer. Notwithstanding these conditions which tend to discourage investigation, there have been certain investigations in the United States by various commissions and much good has come of them.

It will suffice, I think, to touch lightly on the ordinary hazards to industrial health as most of us are already familiar with them.

Defective Illumination.—Although the chemical industry does not call for close eye work, yet the fact must not be lost sight of that dangerous substances are handled and consequently adequate illumination is required to assist the worker in escaping accidents or injury to health.

Ventilation.—This is doubly important in the chemical industry, due to the continuous presence of numerous poisonous materials, such as poisonous dusts, fumes and gases peculiar to the processes involved.

Long Hours.—Being very detrimental to the health of the worker.

Factory Sanitation.—Such as drinking water, ample washing facilities, etc.

In the chemical industry where so many irritating, corrosive, poisonous and dusty materials are handled, to have ample facilities for the care of the body is the duty of every progressive manufacturer.

Specific Hazards

These hazards to health consist of the effects upon the body of irritating or posionous dust fumes and gases. To make a quotation, they are known as "Foes of industrial life." It is true that highly dangerous substances are handled daily with but little danger in chemical laboratories. It should be remembered, however, in chemical trades that workers, especially unskilled workers have but little idea, as a rule, of the dangerous character of many of the materials with which they come in daily contact. Acute poisonings are fortunately rare, with usually the cause and the effect self-evident, but who would detect "Chronic Manganese" poisoning when they saw a man gradually weakening, laughing impulsively, moving with uncertainty, unable to go down a hill without running or being unable to walk backwards, or who would ascribe the gradual clouding of his vision to long continued exposure to the weak fumes of nitro-napthalene.

Without going into exhaustive detail, I will attempt to discuss briefly the injurious effects on the body of certain well recognized classes of compounds. They are generally divided into three classes.

1. Poisons, which act superficially, viz., irritant and corrosive poisons such as caustic alkalies and the mineral acids.

2. Blood poisons, viz., poisons that are absorbed by the blood such as carbon monoxide and nitrobenzol.

*An address before the Industrial Chemical Club, Toronto.

3. Poisons with definite internal actions. To this class belong the poisons which upon absorption act upon definite organs or tissues in a specific manner. They are also classified according to their physical characteristics, i.e., poisonous dusts, poisonous fumes, and poisonous liquids.

Poisonous Fumes and Gases

There are the irritating gases or fumes which attack the muscuous membrane of the respiratory tract. If their concentration is sufficient, immediate death may ensue, less concentrated doses attack the delicate lining membrane of the pulmonary air cells, bringing about a condition of acute pulmonary oedema or swelling. Doses still less concentrated may cause penumonia and chronic bronchitis. Chlorine gas is a good example of this. This has been illustrated in the present war to the fullest extent, carbonyl chloride, SO_2, HNO_3 HNO_2 and NH_3 having been used.

With regard to nitrous fumes so often encountered in chemical works, especially while cleaning out sulphuric acid lead chambers and towers, after inhaling a certain amount of these fumes the worker may feel but a momentary sense of suffocation from which he apparently recovers when reaching the fresh air; only to be seized several hours later with symptoms of a severe and rapidly fatal oedema of the lungs. In addition to this, the fumes exert a deleterious effect upon the teeth, dissolving the enamel and causing them rapidly to rot.

Passing now to fumes more distinguished for their posionous than for the irritating action. For instance, vapours of mercury, lead and arsenic have a special action on the hæmoglobin of the blood. Carbon bisulphide and fumes of coal tar have action both on the blood and the nervous system. Also organic compounds such as higher alcohols of the fatty series, wood alcohol, amyl nitrite, nitroglycerine, camphor, etc., have special action on the nervous system. The inhalation of 1 m.g. of arsenuretted hydrogen may produce fatal results. Phosphorous fumes cause a disease of the jaw bone, necrosis and for this reason, white phosphorous is no longer used in the manufacture of matches. Coal tar compounds have a poisonous and irritating action, e.g. benzol, xylol, phenol, nitro derivatives, etc. Aniline is a chemical which causes more cases of industrial poisoning than any other organic compound and will be dealt with more fully later. Wood alcohol has a selective action on the optic nerve thus causing blindness.

Poisonous Dusts

The most important of these is lead. Other harmful dusts such as the chromates which attack the skin and muscuous membranes producing painful and extractable ulcers known commonly as "chrome holes." There are many others.

Aniline Oil Poisoning

The effects arising from aniline poisoning are very conspicuous. Men working in the fumes of aniline would complain of dull headaches, giddiness and show the familiar bluing of the gums, lips and ears as well as a rash on the arms, particularly where the skin came into contact with the aniline oil. The first symptom noted is the bluing, then in most instances boils with considerable inflammation which are easily infected. Cuts ann sores, if exposed to the fumes are quickly infected, causing paid and swollen limbs. Cleanliness is an absolute necessity, and bathing after working in the fumes or handling it is absolutely essential. It is very difficult to remove the aniline oil from the body with water, being almost insoluble in it. A dilute solution of acetic acid is found to be very effective in removing the oil as it forms a soluble salt with the aniline. Wooden soled shoes are being worn in aniline plants by the workmen as the wood does not absorb the aniline as quickly as leather. Rubber gloves are also used. To give an example of the effect of this poisoning, an Austrian, who in his haste to quit work, placed his shoes under a tank which contained aniline. During the day some aniline was splashed into the boots. He had only worn them a few hours when he complained of weakness in his legs and became very dizzy shortly afterwards. Becoming unconscious and his body turning blue a physician was called. It took several days before the patient fully recovered. Another case was of a man who was cleaning a still. Removing his rubber gloves and absorbing the aniline oil through the hands he became very rigid and was unconscious for hours and took six days to recover.

It would take a considerable period to investigate the subject to any great extent and I believe it has been sufficiently discussed to show that all necessary precautions should be taken in a chemical plant for the benefit of the workers. Some manufacturers are doing much toward the protection of their labor while others are absolutely inconsiderate. The former manufacturers are governed by motives altruistic, an appreciation of the efficiency of a healthy worker. The latter group of manufacturers, fortunately relatively few in number, are selfishly inhuman in some instances and go their way lawlessly and more often in blind ignorance, for the untoward action of some chemicals is slow and insidious.

The Outlook in Chemical Industry

A Plea for Larger Views

***By Professor H. E. Armstrong**

One of the most striking results of the war is the advance of the chemist into public favor; before it, he was scarce considered except as the drug dispenser, though there was a vague idea abroad, and a very wrong one, that he was a person who could analyse and find out of what anything put into his hands was made; in fact he was either thought nothing of or his powers were vastly overrated. The first thing to be done when the war is over will be to give him the status he has won; by Act of Parliament to recognize that he alone has the right to be called chemist, so that he may be distinguished from the pharmacist.

A recent French writer on the wonderful development of German chemical industry, particularly in connection with the production of materials required for the manufacture of explosives, speaks of the chemist as having saved Germany; at the outbreak of war her chemical factories were so fully organized that she was able, if not to make all that was required, at once to take the necessary developments in hand.

After the Marne, very large Government subsidies were forthcoming to aid the extension of factories for the production of ammonia and nitric acid, the basic substances of the high explosives industry, by purely artificial processes; the figures given of the outputs achieved approach the fabulous. Deprived as she has been of raw materials, the manner in which Germany has mastered her difficulties is very wonderful; when, if ever, the story is fully told, it will probably be the most astonishing revelation conceivable of the power that man has achieved through science—both for evil and for good. When viewed in proper historical perspective, it must afford lessons of a development of man's command over nature which will be altogether amazing in extent and variety.

But if the chemists—associated necessarily with the engineers—have saved Germany, in the sense of enabling her to wreak her foul purpose upon those whom she has made her foes, they in turn have been able to make use of their services in their defence and in a far higher degree. Our advance within a couple of years is comparable almost, it has been said, with that made by Germany during forty years—we had made scarcely any preparation, and yet it is now admitted that, in not a few respects, we are in advance of her. It may well be imagined that one of her greatest regrets will be that she has made us realize what we can do if forced into action; we were quietly asleep in the mountains, and had matters remained as they were we should have awakened only to find her in possession of the fertile plains.

*In the London Times Trade Supplement.

Though not an "organizable" people, we have a far greater innate gift of organizing than the Germans; under compulsion, we have at last allowed ourselves to be organized; the conservatism, which in ordinary times has made us chary of adventure, and checked experiment, has necessarily been waved aside, though not always with the requisite promptness.

The question of questions concerning our future is whether we shall have learnt our lesson sufficiently not to return to our old slothful, ignorant ways, especially whether we shall be willing to work together. The augurs seem to speak hopefully, though they warn us against any slackening of effort.

Agriculture

To refer first to our chief chemical industry. It is recognized that the greatest of all the world's industries is agriculture, especially if it be held to include forestry, yet few realize that agriculture is, in large measure, a chemical industry of a quite special character and one which presents altogether peculiar difficulties, concerned as it is with the processes of life. No one who has not a very thorough and broad knowledge of chemistry can have real feeling with regard to the problems of modern agriculture; though the phenomena to be interpreted are in no way exclusively chemical, chemical principles are everywhere in operation.

Manufacturing Industry

Turning to manufactures, the future of the chemical industry is intimately bound up with that of British industry as a whole, in particular that of the great textile trade, which is not only dependent upon dyestuffs but is also the chief consumer of so-called heavy chemicals—of alkali, of soap, of acids, and of bleaching powder. The prosperity of the industry can only be the consequence of a general industrial prosperity.

The success of the chemical industry will depend upon the development of economical methods in every branch of its work; the disastrous internecine competition of the past must be eliminated and for it must be substituted an effective co-operation; not only must the highest technical efficiency be secured through wise and generous management, but the ever-present need for continued development must be kept constantly in mind.

It is beyond question that we shall be called upon to face highly organized competition from every quarter—Germany has made the whole world live once more; this can only be met by an equal, if not a superior, degree of technical organization on our part. Whether traders shall be assisted by any protective system is not a suitable subject for this article nor one with which the writer can deal; yet it is impossible to overlook the fact that, in many quarters, the view prevails that the necessary development cannot be secured without State assistance, at least during the early stages.

Although certain special branches have been highly prosperous, it is beyond question that the chemical industry has languished in this country largely because it has been in a disorganized condition; many reasons have been assigned to explain the failure, but it is clear, particularly if the cases of success be analysed that they are all included in this general statement.

Using this term in the broad sense in which the engineering or textile industries are referred to, it is hardly possible to speak of the existence of a chemical industry. The industry has never been in a position to represent its requirements and views in any collective form—a political demonstration such as the textile industry has made recently is inconceivable.

The war has played the part of the fairy prince in leading us to recognize Cinderella's virtue. For the first time, chemical industry is regarded as of national importance—as a primary factor of national safety.

Union or Disaster

But it must none the less work out its own salvation from within—it must develop ideals and ideas—it must become progressive; above all, it must present a united front. The chemical industry has too long suffered from the inability of firms to work together for any common end. It cannot be insisted too strongly that unless the tendency can be overcome, which so unhappily exists in this country, of regarding all matters from a purely personal point of view, of allowing entirely personal proclivities and considerations, likes and dislikes, and jealousies, to prevail, there can be no success in the future. The recent formation of an Association of Chemical Manufacturers is therefore a step of outstanding importance.

It is to be hoped that ere long the new Association will be able to work in effective conjunction with the Society of Chemical Industry, and that the two bodies will develop complementary activities. The Society has failed hitherto to exert any real influence on chemical industry, and it has been far too much under academic control. But it has never been supported in any proper way by the higher industrial element, one chief reason being that this element itself was without corporate existence and often too narrowly commercialized to appreciate even its own requirements. The coming expansion of the industry must carry with it recognition of the value of science and automatically determine the development of the Society's activity and sphere of usefulness.

But a far more extensive organization of the forces of chemical science must be brought about in the near future if these are to be utilized with effect in the service of the nation. A multitude of special societies now exist representative of a variety of special interests, but largely composed of the same men. The system is wasteful in every respect; and it neither serves to promote fellowship nor to encourage breadth of outlook; on the contrary, it is a direct incentive to an undesirable degree of specialization; it only ministers to our very human tendency to form cliques within each of which a set of men can assume importance. We must hope that we shall have learnt sufficient wisdom through the war to bring all agencies together which can contribute to the development of chemistry as an abstract science or in its technical applications.

The Day of the Expert

Complete organization combined with breadth of outlook in every direction are the essential conditions of future success. Sound finance, a bold and conciliatory sales policy, intelligent buying on a large scale, first-class commercial representation, are all requirements of fundamental importance, which are more or less commonly recognized. But of equal importance, though too often neglected, are the works requirements; the need of a staff of special efficiency, including an adequate research department, not forgetting also the labor element. Success necessarily involves a progressive outlook; in these days, to stand still is to go back. In future, the technical man must be given a real voice in the commercial control of the works; our failure to recognize this need is more than anything else perhaps at the root of the errors of the past. Chemistry as a science and the problems of manufacturing chemistry in particular demand for their understanding a point of view, a mental attitude and an experience which are foreign to the community at large, and cannot, as a rule, be acquired by commercial men; but it is well within the mental ambit of the man trained to understand scientific problems also to appreciate the problems which the commercial and industrial control of works present. The main cause of the phenomenal success of German chemical industry has been the admission of the technical experts to a full share in the management; chemist, commercial man, and engineer have been treated alike and given co-ordinate rank. Such must be the case here, if we are to succeed.

The larger firms are already alive to the value of co-operation, but this is in no way recognized at resent by the smaller. If wasteful internal competition in the manufacture of substances of which but limited quantities are required should continue, it is clear that no form of protection will enable makers to meet the competition of foreign manufacturers operating on a much arger scale with more perfect plant. Charges for labor and establishment make up so great a proportion of the cost that the manufacture of, say, four times the quantity of an article may have the effect of reducing cost to one-half or even less, in which case a 100 per cent. tariff would be the least that would be effective. The salts of bismuth may be taken as an illustration. Although largely used in medicine, the quantity required in this country is well under two tons per week, a quantity which could easily be manufactured in one small works; in point of fact, the manufacture is now distributed over a considerable number of works, perhaps ten. If only a single works were in operation it would be possible to cut down the supervising staff, the analytical work, and the cost of maintaining plant, labor-saving devices would be worth introducing which cannot now come under consideration, by-products might be utilized, and much waste prevented by proper association of the work with other branches of industry.

Only a large firm can afford the expense of a competent research staff and of the many specialists required under modern conditions. Savings of a fraction of a penny per pound, which seem of no importance to the small man, mean many thousands to his competitor who makes on the large scale. It cannot be economy for forty firms each to make forty products at forty different works—but such has been our method; in some way they must combine to close the older works and specialize by small firms making only a few products at the remainder.

Much more than is commonly supposed has been done here to manufacture the more valuable chemicals; alkaloids, for example, such as atropine, emetine, etc. But in future some more definite national policy must be developed if the industry is to be maintained and enlarged.

Imperial Supplies of Drugs

Better control of raw materials could be secured by co-operation among buyers, as well as by assistance from Government and Consular agents and Government Departments generally.

What the Dutch have done in Java with respect to supplies of cocoa leaves for the production of cocaine and cinchona bark for the production of quinine England might do in her various colonies and so provide most, if not all, of the raw materials that are required, though we must take care that foreign competitors do not corner these.

When in Java, in the autumn of 1914, at the wonderful botanic garden at Buitzenzorg, and elsewhere in the island, the writer had full opportunity of appreciating Dutch economic organization and of contrasting it with our own half-hearted unsystematic measures in the East. But we have made a great advance in the interval.

India has long since met her own needs in quinine. The writer can testify from his inspection of the factory near Darjeeling that the manufacture is carried on in a most efficient manner; the plantations are now becoming so extended thatk at no distant date, it should be possible to produce in India all the quinine that is required by the Empire.

The opium produced in India was long regarded as unsuitable for pharmaceutical purposes and very little of it was used, but it is now being exclusively used by manufacturers for the production of morphine. It is true it is inferior to the Turkish and Persian varieties in the amount it contains of this alkaloid, but work is now being carried on to produce an improved material, and there can be little doubt that success will be secured, such is the control we now have of problems of the kind.

Vigorous action is also being taken, under the auspices of the Government of India, to promote a resuscitation of the natural indigo industry, and there is good reason to believe that this will be possible, if complete co-operation can be secured of all who are concerned. Not a few other illustrations could be given.

There are not a few successful firms in the country as completely organized as any to be met with on the Continent, and these have quietly done their work in the past without particular advertisement. It is recognized, however, that a much wider field has now to be covered, and that, in particular, those branches must be developed in which we were at such a disadvantage. But a new spirit is alive in the country. Great developments have been brought about under the exigencies of war, as those of us who have been privileged to see the new works erected of late can testify. The value of experiment is now understood in a way that it never was before—it is realized that if you are forced to meet a situation and know what you want to do, it is usually possible to effect your purpose; and the value of ideas and of opportunity to test ideas in practice is at last recognized.

The great want of industry in future will be skilled men and gentlemen. It must attract to its ranks on the technical side—the men of business aptitude will take their place naturally—the best type of university graduate. The literary professions and the Civil Service must no longer have the monopoly of the best brains. The leaders of science must preach the dignity of industry—its value as national service. Now that business men have at last gained admission to the Ministry, it is clear that commerce and industry will secure due recognition at the hands of the nation; some day even science may be considered competent to help.

Bituminous Sands of Alberta

New Process for Their Commercial Use

The Mellon Institute of Industrial Research at Pittsburgh, Pa., is now investigating the possibilities of using the asphaltic sands of Alberta for commercial purposes.

Since the first explorer descended the Athabaska River, upwards of one hundred and fifty years ago, the existence, in the northern part of the Province of Alberta, of deposits of asphaltic or bituminous sand has been recognized. This material consists of approximately 15 per cent. of high grade bitumen and 85 per cent. of silicious sand. That the deposits were of large extent was evident, but, until quite recently, little was definitely known regarding their true economic importance.

For many years, the remote geographical position of the deposits, as well as lack of transportation facilities, effectually prohibited any attempt at actual development. Apart from widely scattered fur trading posts, there was an entire absence of settlements throughout great tracts of Northwestern Canada. Methods of transportation were of the most primitive sort—dogs and toboggans in winter, scows and canoes in summer. Gradually, however, with the opening up of the country, conditions have changed. New railways and highways have been built and settlements have come into existence.

The old historic fur-trading post of Fort McMurray, three hundred miles to the north of the city of Edmonton, stands near the southern border of the bituminous sand area. During the past two years, a railway, known as the Alberta and Great Waterways, has been under construction between Edmonton and Fort McMurray, and, with the early completion of this road, the last serious hidrance to the actual development of the great asphaltic deposits will have been removed.

Three outstanding features presented by a consideration of these deposits may be stated:

(1) They represent the largest known deposits of solid asphaltic materials;

(2) The deposits are as yet totally undeveloped;

(3) At the present time every ton of asphalt used in Canada is imported from foreign countries.

The areal extent of the deposits is probably not less than one thousand square miles and the average thickness is upwards of 100 feet. With adequate markets and transportation facilities, there seems reason to believe that within the next five years important development may be expected.

Recently, the Mines Branch of the Canadian Department of Mines has undertaken an investigation not only of the deposits themselves, but also of methods best adapted to the commercial treatment of the crude bituminous sand. As a result of this work, there appears to be three possible commerical applications for the material from these deposits:

(1) The use of the bituminous sand in a more or less crude form in the surfacing of streets and highways. Experimental pavements recently constructed in the City of Edmonton, Alberta, indicate that the material is well adapted for such uses.

(2) To separate the asphalt or bitumen from the crude material in order to derive a more or less pure product. The actual commercial applications of this product are as yet not definitely determined, but it should be well adapted for paving purposes, as well as suitable for the manufacture of certain varieties of paints, varnishes, roofing preparations, etc.

(3) To destructively distil the crude bituminous sand for the purpose of obtaining crude petroleum therefrom. Considering the absence of developed petroleum fields of commercial importance in Canada, such distillation could be undertaken under exceptionally favorable conditions.

A study of possible separation and distillation methods is being made at the Mellon Institute of Industrial Research in Pittsburg. Mr. S. C. Ells, of the Mines Branch of the Canadian Department of Mines, is Industrial Fellow in charge of the investigation.

He has developed a process for economically effecting the separation. No information relating to this method is, at the present time, available, but suffice it to state here that the asphalt may be satisfactorily recovered by heating the bituminous sand, in water under pressure. It is difficult to eliminate the fine sand above 200 mesh, but such a procedure answers for most purposes.

It is of interest to note that practically the entire area of bituminous sand is at present held under Government reserve. There is reason to believe, however, that, within a reasonable time, this reserve will be removed and provision made whereby private individuals or companies may acquire areas for developmental purposes. The future development of these deposits will be awaited with the interest that their great extent appears to warrant.

Sulphuric Acid Manufacture in Russia

The British Consul at Ekaterinburg, Russia, states that the war has been responsible for the starting of a great number of chemical industries in the Ekaterinburg district, as well as increasing the output of those already in operation and has brought about the discovery of new mineral deposits by the increased activity in prospecting.

Although sulphuric pyrites is to be found in large quantities in the vicinity of Ekaterinburg, the largest acid plants are found in the south, being formerly supplied from Spain and Portugal. The shortness of tonnage occasioned by the war has caused considerable attention to be paid to the Ural deposits, which now supplies the existing plants in South Russia as well as the existing and newly erected plants in the Urals.

The Ural works, and their annual output of sulphuric acid is as follows: Polevskoy, 600,000 poods; Roudyanka, 300,000 poods; Kishtim, 500,000 poods and Perm, 300,000 poods; making a total of 1,700,000 poods (a pood is a little over 36 pounds).

The Kishtim works, which were only built two years ago were burnt down last winter, are being rebuilt, it being expected that they will recommence operation this month. The total home demand for sulphuric acid is estimated at 20,000,000 poods (360,000 tons) annually so that it will be seen that the Urals play but a small part in the actual manufacture of the acid, especially when the huge deposits of raw material situated in the Ekaterinburg district alone are taken into consideration.

The University of North Dakota has established a reference bureau for municipal research in connection with its Extension department. It is intended to go into the problems of public health, economic organization, water supply and elimination of wastes as they affect the municipality. The State Geological Survey and the Public Health Laboratory are at work on a comprehensive water survey of the entire state.

WORDS OF WELCOME

The publishers are grateful for the many words of welcome extended to THE CANADIAN CHEMICAL JOURNAL upon its advent into the field of technical journalism.

The ideal is always far ahead of the actual, but we shall at least endeavor to deserve the good opinions given, and shall try to fulfil the predictions made that the JOURNAL will advance the great interests which it is established to serve.

The following are a few of these expressions:

A Thesis on Technical Journalism

It had seemed as though all the trades had their interest represented by their own special journal, but a new field is constantly being found, and the latest and very necessary venture is THE CANADIAN CHEMICAL JOURNAL. Trade journalism is a far more important development than is usually recognized. The man who means to keep abreast of his business must be familiar with every phase of the work in which he is engaged. Consequently, a trade journal is the eyes and the brains of its particular interest. It must necessarily be produced by an expert for experts, for no one will patronize a journal from which he can reap no advantage. The editor of the trade journal must be able to help everybody in his line. He can do it by pooling their knowledge and experience. The old line of thought about business was to hoard the secrets of the trade. It is recognized now that there are no secrets but ability and efficiency, and, however these may be implicated, they cannot be stolen, so that, with few exceptions, the trade journals have a wide field to draw on. THE CHEMICAL JOURNAL starts with an article on the war, "The Great Adventure." It points out the use of electrolysis in chemical production as one of the modern marvels. This would seem to justify those who recognize the new Zodiacal period of Aquarius, the Water-bearer, as prophetic. "The New Era in Chemistry" is another article on resources, followed by one on "The Water Powers of Canada." There is the first of what promises to be an illuminating series of articles on nickel by the editor. The general contents and the appearance of the journal leave nothing to be desired.—*Toronto World.*

A By-product of the War

THE CANADIAN CHEMICAL JOURNAL is a by-product of the great war. It is launched as the champion of new and important Canadian industries created by the war. Prior to August, 1914, Germany largely monopolized this department of industrial life, but since then Canada, like other Ally countries, has made considerable progress in the realm of practical chemistry. In three years millions of dollars have been invested in the chemical industries of the Dominion, and the Government, together with the universities and scientific institutions, is earnestly co-operating. The Advisory Council for Industrial and Scientific Research set up by the Ottawa authorities is carrying on an invaluable work. According to this new Canadian periodical, Canada must ultimately become a leader in the electrolytic production of chemicals, for the simple reason that it has the mineral resources and the water powers required as the basis of such a development. It is estimated by some authorities that forty per cent. of the water powers of the world are found in this Dominion, and that these are capable of producing nearly 18,000,000 horse power. Only about one-tenth of this potential energy is being used. The electrolytic treatment of metals has transformed a group of towns and villages in the Niagara district. The population of Welland has in three or four years increased from 5,000 to 11,000 and the town will become a city on Dominion Day. The application of chemistry to the manufacture of potassium and nitrogen is of incalculable importance to Canada, because these elements enter into many chemical compounds, and because potash and nitrates are indispensable for use as fertilizers in a country whose chief industry must always be agriculture. Canada is the most promising source of these substances. It has extensive areas of feldspar, which is the basis of potash, and a great number of water powers are available for the production of nitrogen from air. The future of chemical manufacturing in this country now seems assured.—*Toronto Evening News.*

Nickel as a National Trust

In THE CANADIAN CHEMICAL JOURNAL, a new publication which usefully covers a wide field, there is the first of a series of articles on nickel by E. B. Biggar. He makes the remarkable statement that if the Canadian Government and people, in 1912, had chosen to use the power contained in their control of the nickel supply, the military power of Europe would have been stricken with paralysis before it was lifted to strike. To put it in another way, we could have strengthened our friends and weakened our enemies, or those of whose friendship we had doubts. That opportunity has been lost, but we can still make use of our nickel as a means of defence—using it ourselves, supplying it freely to our friends, and letting no enemy get a pound of it.—*Toronto Daily Star.*

The Need of the Day

Many new chemical industries have been developed since war was declared and this fact has led to the introduction of this new journal. Its aim is to advance science and the chemical industry. The May issue contains interesting articles on the Canadian potash and nitrate industries; wood alcohol and the tariff; Chemistry in Canadian Woods; antimony production; the nickel companies' extensions; and many other instructive contributions. Mr. G. G. Macdonald, a graduate in applied chemistry at Toronto University, is editor, and Mr. E. B. Biggar, manager. The paper has none of the defects which are usually associated with first issues.—*Toronto Globe.*

The Ground of Appeal

The first issue of THE CANADIAN CHEMICAL JOURNAL, the only one of its kind in Canada, is devoted to the chemical and metallurgical interests of this country. It is an attractive number and will appeal to those numerous people associated with the chemical and allied industries. It is estimated that the Dominion has forty per cent. of the water powers of the world—which if proved will ensure pre-eminence in the chemical industries. Many of these have been developed since the war, and the attention of the world is now being directed to the natural advantages of Canada by means which call for further progress when the new and increasing demands of peace come. This movement explains the advent of the new journal which aims to advance the science and the industries based upon chemistry. —*Monetary Times.*

Good Will Letters

We wish you every success and we think there is a good future for a new journal of the kind.—Arthur T. Dimmock, Limited, London, Eng.

Permit me to offer you my congratulations upon the first number of THE CANADIAN CHEMICAL JOURNAL, and to wish it a long and successful career. An organ of this character is badly needed in Canada and can render great service in developing the chemical industry in the Dominion.—M. L. Davies, vice-president Standard Chemical Iron & Lumber Company.

I was very much interested in your Journal, a copy of which you sent me, and also I want to congratulate you in gaining such a position in the production of such an excellent journal.—C. W. Hancock, Sault Ste. Marie.

I do not know of any technical journal that has ever made a more timely appearance than THE CANADIAN CHEMICAL JOURNAL. It will serve many industries at the most important period of their growth.—T. D. Wardlaw, Toronto.

It is with great pleasure I write to compliment you, on the excellent appearance and general get up of your new-born monthly. If it does nothing else (and it will do more) it certainly opens the eyes of the world to the wonderful achievements and opportunities that nature has so lavishly bestowed upon Canada.—H. Spurrier, Chemist, Detroit, Mich.

Foreign Trade Inquiries

The following inquiries of interest to the chemical trade have been received at the Department of Trade and Commerce, Ottawa. The names of the firms making these inquiries, with their addresses, can be obtained only by those interested, on application to "The Inquiries Branch, The Department of Trade and Commerce, Ottawa," quoting the reference number. The Secretary of the Canadian Manufacturers Association, Toronto, and the secretaries of the various Boards of Trade can also supply this information.

38, asbestos aircell paper; 43, bronze powders; 59, calcium carbide; 127, chemicals for glass manufacture; 181, general chemicals; 219, refined nickel for pyrometers; 234, potash, ferro-chronium and other alloys; 245, wood distillation and electrolytic products, also manganese, magnesite witherite; 256, corundum or other abrasives; 257, iron ore; 258, manganese and iron ores; 259, plumbago and graphite; 261, copper ores and copper in ingots or bars; 268, lactic acid; 277, talc (white chalk and soapstone); 281, graphite, wood alcohol; 290, Mond nickel; 291, spent liquor from sulphide wood pulp, s.g. 607° T.; 320, chemical products; 321, cobalt oxide and salts; 323, copper oxide red, yellow mercury oxide; 334, graphite, cleaned, powdered; 335, graphite, flake; 348, rare metals and earths; 349, gold and aluminium leaf, bronze powders, glue in cakes; 353, oil cakes (for cattle food); 354, Oleo oil, oleo stearin; 366, paraffin wax.

400. **Chemicals.**—A reliable English firm of commission agents located in Buenos Aires would like to hear from the Canadian manufacturers of sulphate of alumina and other heavy chemicals used in the manufacture of soap, matches, paper, etc.

402. **Asbestos.**—A Japanese firm in Tokyo wishes to get into touch with suppliers of asbestos in Canada.

403. **Sulphuric Acid.**—A London firm who deal in sulphuric acid would be glad to receive offers from Canadian manufactuers.

408. **Cheese Rennet.**—A Danish firm makes inquiry, through their London agents, for the names of Canadian importers of cheese rennet.

409. **Honey.**—A firm of provision merchants at Plymouth wishes to get into touch with Canadian exporters of honey.

410. **Kieselguhr, Magnesite, etc.**—A London firm wishes to get into touch with Canadian producers of refractory materials, including kieselguhr, magnesite, etc.

412. **Oxides of Cobalt.**—A London manufacturing company asks to be placed in direct touch with Canadian producers of oxides of cobalt, both black and prepared, and also of cobalt metal.

429. **Epsom Salts; Glauba.**—A British firm of importers, located at Sao Paula, Brazil, requires prices c.i.f. Santos (to serve as a basis for comparison only) on ten-ton lots of sulphate of magnesia (Epsom salts) and sulphate of soda (Glauba). Any actual business will be arranged by cable and orders will be placed for immediate delivery.

444. **Steel Shafting.**—A manufacturers' agent prominently connected with and favorably known to the wholesale trade of St. John's desires to be put in touch with Canadian manufacturers of cold-rolled steel shafting.

498. **Linseed Cake.**—A Bristol concern is very desirous of entering into communication with a good reliable firm in Canada manufacturing linseed cake with a view to making connections.

550. **Acetic Acid.** A Lancashire firm asks to be placed in touch with Canadian manufacturers of acetic acid, of which they seek supplies.

557. **Rutile and Ilmenite Oils.**—A French firm wishes to get into touch with Canadian producers of rutile and ilmenite oils.

570. **Formaldehyde.**—A London company will be pleased to receive offers of formaldehyde, 40 per cent. volume, from Canadian manufacturers. They purchase in lots varying from 5 to 25 tons.

571. **White Powdered Arsenic.**—A Liverpool firm desires the addresses of Canadian producers of white powdered arsenic, of which supplies are sought.

576. **Chemical Glassware.**—An Edinburgh firm desires to get in touch with Canadian exporters of chemical glassware such as graduated measures, clinical and chemical thermometers, hydrometers, burettes, etc.

591. **Linseed Oil Cake.**—A Liverpool firm who are buyers of linseed oil cake asks to be placed in touch with Canadian manufacturers who can fill orders for export.

595. **Soap-making Tallows, Distilled Stearine and Paraffin Wax.**—An Aberdeen soap manufacturer asks for quotations on the above.

625. **Magnesia Pipe Coverings.**—A Liverpool firm of engineers' merchants wishes to get into touch with Canadian exporters of magnesia sectional pipe covering and magnesia plastic for boiler and steam pipe covering.

626. **Asbestos Goods.**—A Liverpool firm is in a position to place very substantial orders for asbestos cloth unproofed, asbestos twine, asbestos rope and asbestos fibre. Samples and prices are asked for.

654. **Asbestos.**—A British firm in Yokohama desires to be put into communication with manufacturers of asbestos goods in Canada.

660. **Mining Supplies.**—An old-established firm dealing direct with the mining interests of South Africa, is prepared to take up Canadian agencies in any line of mine supplies except timber. Will arrange to act as agents or purchase direct. Immediate correspondence requested, if only in preparation for supply after the war.

671. **Pine Tar.**—A Liverpool firm asks to be placed in touch with Canadian exporters of the above.

677. **Asbestos Cement Sheets and Roofing.**—A Glasgow firm wishes to get into touch with exporters of the above.

685. **Formaline, Mineral Manures, Paris Green, Sulphate of Copperas.**—A Russian buyer of these products on a large scale desires to hear from strong Canadian manufacturers with quotations f.o.b. New York.

688. **Flower Oils.**—A correspondent in Shanghai wishes to be put into communication with Canadian firms manufacturing flower oils, etc., for the preparation of perfumes. He states that a large business is done there in these oils and in synthetic perfumes, mostly with Holland, and desires to know if Canada can compete for this trade.

698. **Refined Vegetal Tar.**—A correspondent in France desires to purchase refined vegetal tar.

718. **Wood-meal or Wood-flour.**—Australian manufacturers of explosives desire to obtain from Canada samples and quotations for annual requirements of wood-meal or wood-flour in conformity with samples and specification received by the Department of Trade and Commerce, Ottawa.

733. **Sulphate of Ammonia.**—A firm of manufacturers' agents, covering entire West Indies, with head office at Trinidad, would like an agency for sulphate of ammonia.

743. **Linseed Oil Cake.**—A Liverpool firm who use 3,000 to 5,000 tons of oil cake per annum wishes to get into touch with Canadian exporters of the above. If shipping space difficulties render present business impossible, it is suggested that preliminary arrangements may be made for the future.

778. **Vinegar.**—A Bristol house desires to be put in touch with a manufacturer of vinegar.

787. **Glue.**—A Glasgow firm, in a position to buy in 5-ton lots, makes inquiry as to the possibility of obtaining the above from Canada.

788. **Mineral Wax.**—A Glasgow firm wishes to hear from Canadian exporters of the above.

789. **Potash.**—A Glasgow firm of drysalters makes inquiry as to the above.

791. **Wood Flour.**—An English firm requires supplies of wood flour or wood meal to be used in the production of explosives and linoleum. They could take from 500 to 1,000 tons monthly at the present time provided quality and price are satisfactory.

792. **Refined Copper, Lead and Zinc.**—A London metallurgist wishes to secure the agencies of Canadian producers of copper, lead and zinc.

801. **Ores and Minerals.**—A Liverpool firm offers to act as agents for exporters of ores and minerals.

806. **Bottles.**—An important firm in London, England, wishes to get in touch with Canadian manufacturers of bottles with a view to business after the war.

838.—**Malleable Castings.**—A Glasgow firm wishes to get into touch with Canadian houses in a position to export the above, for after-the-war business.

825. **Crude Asbestos.**—A small British firm in Tokyo desires to be put in touch with suppliers of crude asbestos, also asbestos mine owners.

826. **Bottles.**—An important firm in London, England, wishes to get in touch with Canadian manufacturers of bottles with a view to business after the war.

827. **Asbestos.**—A Buenos Aires firm of manufacturers' representatives desire to be placed in communication with an exporter of plastic asbestos for use in filtering wine. A sample may be had on application to the Department of Trade and Commerce, Ottawa.

828. **Chemicals.**—A Buenos Aires firm of manufacturers' representatives desire to be placed in communication with manufacturers of heavy chemicals.

Recent Incorporations

Of Interest to the Chemical and Metallurgical Industries

Buckingham, Que.—Buckingham Abattoirs Company, Limited, $50,000. R. J. Cameron, J. Murphy, J. H. Cameron.

Toronto, Ont.—The Collier Oil Company, Limited, $2,000,000. H. P. O. Savary, L. H. Fenerty, H. A. Chadwick.

London, Ont.—The London Smelting and Refining Company, Limited, $45,000. J. Harris, D. Harris, M. Harris.

Brampton, Ont.—Dextrine Products, Limited, $40,000. W. Unsworth, W. J. Hood, E. R. Colbert.

Haileybury, Ont.—McGinley-Teck Gold Mines, Limited, $2,000,000. P. McGinley, J. W. Hamilton, G. G. Taylor.

Newcastle Bridge, N.B.—The Ridge Coal Co., Limited, $24,000. R. M. McCarthy, A. Sinclair, H. H. Brewer.

St. Theophile-du-Lac, Que.—Impervious Fabric Company, Limited, $20,000. E. Dallaire, O. Courteau, J. E. Paquet.

Merlin, Ont.—The Merlin Oil and Gas Company, Limited, $40,000. W. S. Hallatt, H. Gosnell, J. Flaherty, G. McPherson.

Winnipeg, Man.—Prairie Chemical Company, Canada, Limited, $100,000. W. C. Graham, D. R. O'Neil, H. E. Buchan.

Calgary, Alta.—The Parsnip River Gold Dredging Company, Limited, $850,000. W. A. Matson, J. C. Worth, J. H. Mercer.

Vancouver, B.C.—Whalen Pulp and Paper Mills, Limited, $10,102,500.

Toronto, Ont.—The National Potash Corporation, Limited, $1,500,000. T. A. Gillen, S. Grand, F. C. Lee.

Toronto, Ont.—Canadian Coal Fields, Limited, $10,000,000. F. H. Phippen, A. J. Reid, R. H. M. Temple.

Toronto, Ont.—Hazelton Gold, Silver and Lead Mining Company, Limited, $40,000. A. L. Malone, A. Mearns, H. S. Sprague.

Montreal, Que.—Canadian Reduction and Mining Company, Limited, $200,000. L. A. David, L. P. Crepeau, S. H. R. Bush.

Orillia, Ont.—Electro Foundries, Limited, $200,000.

Coleraine, Que.—The H. and O. Mining Company, Limited, $1,000,000. D. Oppenheim, M. Harris, P. A. Miller.

Port Arthur, Ont.—The Hennepin Mining Company, Limited, $40,000. W. F. Langworthy, A. J. McComber, G. A. McTeigue.

Winnipeg, Man.—Reahil Gold Mines Company, Limited, $1,500,000. G. E. Horton, C. G. Stewart, J. Reckman.

Haileybury, Ont.—Anglo-Kirkland Gold Mines, Limited, $500,000. W. A. Gordon, F. A. Day, Edna M. Reilly.

Ottawa, Ont.—The Canadian Wood Molybdenite Company, Limited, $1,000,000. O. E. Wood, H. Fitzimons, G. D. Kelley.

Haileybury, Ont.—Kirkland-Townsite Gold Mines, Limited, $2,000,000. W. A. Gordon, F. A. Day, Edna M. Reilly.

Winnipeg, Man.—Copper King Mining Company, Limited, $1,000,000. E. E. McLaskey, G. A. Pow, B. L. Deacon.

Saskatoon, Sask.—Northern Saskatchewan Oil and Gas Company, Limited, $1,500,000.

Quebec, Que.—Quebec Munitions, $190,000.

Victoria, B.C.—Lime Producers, Limited, $20,000.

Youngstown, Alta.—Ontario Western Mining Company, Limited, $25,000.

Toronto, Ont.—Dominion Mica Mining Company, Limited, $50,000.

Toronto, Ont.—Tory Hill Marble and Mica Company, Limited, $100,000.

Toronto, Ont.—Buffalo Kirkland Mines, Limited, $1,500,000.

Toronto, Ont.—Independent Metal Company, Limited, $100,000.

Toronto, Ont.—North Davidson Mines, Limited, $2,000,000.

Toronto, Ont.—Atlas Gas and Oil Company, Limited, $300,000.

Montreal, Que.—Smelters, Limited, $45,000.

Montreal, Que.—Compagnie des Terrains Productifs, $49,000.

Toronto, Ont.—Ontario Molbydenum Company, Limited, $40,000. T. Burrell, Irene O. Allan, Irene Rouse.

Nottaway, Que.—The Nottaway Pulp and Lumber Company, Limited, $20,000. J. E. Fortin, U. Fortin, D. Gourd.

Vancouver, B.C.—Chace Automatic Valve Company, Limited, $15,000.

Toronto, Ont.—McConnell Consolidated Mines, Limited, $1,000,000. R. McConnell, H. F. Meech, Ethel M. Drake.

Montreal, Que.—Rochlieu Quarry, Limited, $20,000. O. Gagnon, L. Choquette, J. A. Parent.

Montreal, Que.—The Nomininigue Pulp and Lumber Company, Limited, $300,000. E. Patenaude, H. G. Boyle, J. G. Shearer.

Toronto, Ont.—Feldspar Milling Company, Limited, $50,000.

Midland, Ont.—Midland Wood Products, Limited, $200,000.

Owen Sound, Ont.—Union Cement, Limited, $1,000,000.

Toronto, Ont.—Reeve Doble Mines, Limited, $2,000,000.

Toronto.—Thackeray Mines, Limited, $2,000,000. D. A. McPherson, E. W. Miller, H. H. Woulfe.

Toronto.—Dominion Molybdenites, $1,000,000.

Toronto.—The Cascade Lead Silver Mines, Limited, $1,000,000.

Toronto.—Chaput-Hughes Gold Mines, Limited, $2,000,000. A. W. Roebuck, Margaret Egan, Ida H. Harrison.

Toronto.—Pontiac Molybdenite Company, Limited, $500,000.

Hamilton, Ont.—Dominion Foundries and Steel, Limited, $6,000,000. E. H. Ambrose, H. A. Burbage, J. R. Marshall.

Toronto.—British-American Rubber Company, Limited, $250,000. G. E. Kellar, E. J. Swift, R. K. Grimshaw.

Haileybury, Ont.—United Kirkland Gold Mines, Limited, $2,000,000.

St. Catharines, Ont.—Turnbull Electro Metals, Limited, $50,000. R. Turnbull, J. B. Tudhope, H. R. Tudhope.

Vancouver, B.C.—Western Mines Exploration Syndicate, Limited, $25,000.

Vancouver.—Western Packers, Limited, $600,000.

Vancouver.—Superior Copper Company, Limited, $1,500,000.

Vancouver.—The Fairwell Mines, Limited, (N.P.L.), $500,000.

Nelson, B.C.—Kootenay Consolidated Mines, Limited, (N.P.L.), $1,000,000.

Victoria, B.C.—Lime Producers, Limited, $20,000.

Amos, Que.—Martin Gold Mining Company, Limited, $1,500,000. W. A. Gordon, F. A. Day, O. R. Vallee.

Sudbury, Ont.—The Shing Tree Mining and Milling Co., Limited, $500,000. J. A. Moore, S. Freer, R. Manwell.

Molybdenum

An interesting and instructive article on molybdenum by Professor O. J. Stewart, of New Hampshire College, is obtained in the May issue of Mineral Foote Notes, a house organ published by the Foote Mineral Company, 207 North 19th Street, Philadelphia. The mineralogical occurances are given and also the metallurgy and properties, both of the metal itself and its alloys, the principal of which is molybdenum steel which has many desirable properties which render it better than tungsten steel for its ability to stand up under rough treatment without developing cracks. A sample copy will be sent to anyone interested.

Interesting News Items

The Newfoundland Government is assisting in the work of developing copper mining activities on the northeast coast of Newfoundland, in the expectation of providing additional supplies of the metal for the Entente Allies.

Chicoutimi, Que.—Work will start shortly on the construction of waterworks fifteen miles long, for Pitre Laberge. Wood pipes will be used with cast iron fittings.

South Montreal plans installing waterworks and sewerage system consisting of steel tank, 100,000 gallon capacity, centrifugal pumps, 800 gallons per minute; 350,000 gallon filter plant, etc.

St. Hyacinthe, Que.—City let contract filter plant to Roberts Filter Manufacturing Company, Darby, Pa., $121,000.

Toronto.—Despite the refusal of the city council to give Works Commissioner R. C. Harris $50,000 to experiment in activated sludge, the commissioner will proceed with the plans so that the plant can be built if the money is voted next year.

L. E. Dowling, 167 Yonge Street, Toronto, has been awarded the general contract for $35,000 concrete plant for the Hoyt Metal Company, 356 Eastern Avenue.

The National Abrasives Company, Hamilton, have awarded contract to the Traylor Engineering and Manufacturing Company, Allentown, Pa., for a 7 foot rotary calciner to handle bauxite.

The Quality Canning Company, McGregor, Ont., plans erection of a $25,000 brick and reinforced concrete factory. Manager, William Welles.

Brantford, Ont.—The fire chief has recommended the installation of a storage battery system at a cost of $2,000.

The St. Thomas, Ont., city council may install a gasoline engine at the waterworks. City engineer, M. Ferguson.

The general contract in connection with the erection of a $27,000 concrete and brick addition to factory of the Canadian Lamp and Stamping Company, Ford, Ont., has been awarded to Wells and Gray, Bank of Commerce Building, Windsor.

Imperial Oil Company, Lethbridge, Alta., plans addition to warehouse. Manager, W. E. Green.

Edmonton, Alta.—City council have let the contract for the supply of 6,000 pounds of liquid chlorine to Smiley and Company at $1,241.40.

Work will start at once on a warehouse at Peace River Crossing, Alta., for the Imperial Oil Company, Edmonton.

According to the figures recently issued by the United States Geological Survey, the coal and iron production in 1916 exceeded all previous records. Total shipments from the mines of iron ore amounted to 75,500,000 gross tons, valued at $78,000,000. Nearly all this production came from the Lake Superior district. The production of bituminous coal was estimated by the survey at 509,000,000 net tons, being an increase of more than 65,500,000 tons over the previous year. Anthracite production dropped slightly from 1915, 88,312,000 tons being the 1916 figure.

The United States Steel Corporation has appropriated additional funds for the rapid construction of buildings and the installation of machinery at its Canadian plant at Ojibway. It will be recalled that work on this plant to be constructed and operated by the Canadian Steel Corporation was begun early this year. The plant will produce plates and shapes for ship building to the exclusion of all other finished products, at least temporarily.

The National Abrasive Company, of Boston, and Amesbury, Mass., manufacturers of carbolon, an abrasive material for grinding and polishing purposes, have decided to locate in Hamilton and have bought an acre and a half of land on Biggar Avenue, near Lottridge Street.

The Three Rivers Casting Co., corner Hertel and Charlevoir treets, plans $35,000 brick foundry.

A patent has been taken out in Sweden for the use of phenol ethers, such as guaiacol, cresol, etc., as a stabilizing agent for hydrogen peroxide.

The Aetna Iron and Steel Company have commenced operations at their rolling mill at Port Moody, formerly occupied by the Port Moody Steel Works.

The British Chemical Company, Trenton, Ont., is erecting a $30,000 clubhouse and Y.M.C.A. here for their employees.

The plant of the National Portland Cement Co., Durham, Ont., has been closed since June last, is being reopened.

Plans are being prepared for a sixteen-story building at Amherstburg, Ont., for the Brunner-Mond Company, a subsidiary of the Solvay Process Company, of Detroit. Estimated cost, $2,000,000. More than ten million dollars will be spent in constructing new waterworks, lighting and power systems.

Negotiations are under way for the purchase of the Kingston Foundry plant by the Kingston Shipbuilding Company.

A new automatic chlorination system has recently been installed at Windsor, Ont., for the sterilization of the drinking water.

The Thames Quarry Company, St. Mary's, Ont., plans to rebuild crusher building recently destroyed by fire at a loss of $20,000. Complete new machinery will be required. Manager, J. W. Graham.

A report on a proposed filtration plant at Pointe Claire, Que., has been made by R. S. and W. S. Lea, Montreal. At present a chlorinator is being installed.

A gas well has been struck near Port Stanley, Ont., with a flow of a million feet a day.

The Great Eastern Pulp Company has been organized and will erect pulp and saw mills on the Madeleine River, Gaspe County, Que. John Mullen, Bangor, Me., president; A. H. Cook, K.C., Quebec, vice-president.

Immediately outside Port Arthur, Ont., beyond Bare Point, J. J. Carrick, M.P., and his associates, will very shortly commence the erection of a huge pulp and paper plant, the initial unit of which will turn out 360 tons of pulp a day. The mill will use, when first put into operation, 18,000 horse power. The Hydro-Electric Power Commission of Ontario will develop Nipigon power for this service. The power will be delivered in Port Arthur at high tension and stepped down to low tension at a large sub-station which will be situated in Port Arthur. Either a new sub-station will be built, or else the present one on Hill Street, near the stand-pipe, will be considerably enlarged.

The plant of the Union Cement Company, Owen Sound, Ont., manager, T. L. Dates, will be doubled in capacity this year. The present capitalization of the company, $200,000, is to be increased to $1,000,000, the additional amount being supplied by investment of Chicago capitalists. The contract for the enlargement has been let provisionally to the Fuller Engineering Company, of Allentown, Pa., and the work is to be gone on with at an early date. Estimated cost, $275,000.

The first foreign shipment from the new plant of the Vancouver Creosoting Company, Limited, Vancouver, was made in March as part cargo of the steamer Hazel Dollar, and consisted of creosoted railway ties, the destination being China.

The Laurentian Water and Power Company have been awarded the contract for a $20,000 pulp mill for La Cie Generale de Pulpe, Visitation Street, Montreal.

Lincoln County Council let contract for road oil to the Crescent Oil Company, Toronto.

The Hamilton Cement Company, Limited, Point aux Trembles, Que., a new company which is headed by Claude Bordier, of Montreal, will erect a plant.

The British Columbia Tanning Company have sold their plant and equipment on Main Street, Vancouver, to the Western Tanneries, Limited, who will manufacture lace and glove leather and will also tan seal skin.

Foundations are in for a $20,000 stone and brick sub-station for the Calabogie Light and Power Company, Renfrew, Ont.

The Seagull Soap Works, Vancouver, have ceased business.

A. E. Wallberg, Royal Bank Building, Toronto, will start work shortly on addition to factory of the Canada Wire and Cable Company, 1170 Dundas Street, Toronto.

The pulp mills of the D'Alma Peribonka Pulp Company, at St. Joseph D'Alma, Lake St. John, P.Q., have been sold to Messrs. R. W. Barclay, of Montreal, and V. N. Theriault, of Nicolet. The price paid runs about $100,000. The plant of the company will be improved and work will be started immediately.

During April there were examined at the Toronto Filtration Plant Laboratory, 1,121 samples of water. The slow sand filter removed 98.6 per cent. of the bacteria.

Plans for the construction of a $10,000,000 iron and steel plant in Vancouver, are being made by a group of financiers according to information submitted to the City Council.

The Imperial Oil Company plans to erect a refinery in Vancouver. Estimated cost, $2,000,000.

The nickel refinery at Christiansand has been destroyed by fire. The damage is so extensive that production will have to be entirely discontinued, it is said.

The pulp mills and sash and door factory belonging to F. N. McRea, M.P., and E. W. Tobin, M.P., at Nicolet Falls, Que., were completely destroyed by fire on April 29th. The damage is estimated at $80,000.

Consolidation of all the marble interests of Georgia in one organization to be known as the Georgia Marble Company, was effected at a meeting of the officers of the different companies in Atlanta. The new company will represent a capital of many millions and will be the second largest of its kind in this country, the Vermont Marble Company taking first place.

The United Alloy Steel Corporation, New York, is expected to attain an ingot output of 48,000 tons for May. This is an increase of twenty per cent. over the output of any previous month, and an increase of 140 per cent. over the scale of operations when the company was financed last fall.

The metric system of weights and measures will be introduced in the plant of the Goodyear Tire & Rubber Company, Akron, Ohio. This means that in all weighing systems, in all its mold designs and in all of its machinery designed in the plant the company will use the metric system. The completion of this move will extend over a period of months. Draftsmen are already provided with metric scales, and drawings are being arranged along this line.

A scientific commission, representing the British and French Governments, has arrived in the United States to arrange for co-operation with the scientists of the United States, who are devoting their attention to war work through the American National Research Council. Sir Ernest Rutherford and Commander Bridges represent Britain, while France is represented by Commandant Fabry, professor of the University of Marseilles; Commandant Henri Abraham, professor of the University of Paris; Captain de Grammant de Guiches, Captain Dupouey and Lieut. Peterno. Sir Ernest Rutherford, who was born in New Zealand in 1871, first attained world-wide fame while in Canada. It was while he was professor of physics at McGill University that his experiments and discoveries in radium and radioactivities were given to the scientific world. From Montreal he went to Manchester University, where he took charge of the physics laboratory. In 1908 he was awarded the Nobel prize in chemistry.

Testing Nitrate Processes

J. B. Davis, chemist of the United States Bureau of Mines, has been working for some time in co-operation with the Semet-Solvay Process Company in Syracuse, in regard to the domestic production of nitric acid to make the United States wholly independent, if necessary, of Chilean nitrate. It is understood that Mr. Davis has been at work for some time developing a process for oxidation of ammonia into nitric acid, developing the same process that is believed to be now in use in Germany, but one that has never been utilized in this country.

Paul J. Fox, a chemist of the Bureau of Soils of the United States Department of Agriculture, has also been for some time working on the same experiments in Syracuse, looking to the fertilizer properties of by-products made by the Semet-Solvay Process Company.

American Iron and Steel Institute

Manufacturers who were present at the meeting of the American Iron & Steel Institute, on May 25th, were all of one opinion—that while capacity was larger than ever before, the demand was also record-breaking, and that the wants of consumers this year could not be satisfied. One of the largest subsidiaries of the United States Steel Corporation has notified consumers that it can make no further contracts until fifty per cent. of the orders now on the books are worked off. Many consumers want to buy steel for delivery as far forward as 1919. The steel companies will be the heaviest war taxpayers this year, and the incomes of shareholders will be greatly increased. This will make additional revenue for the Government. Steel manufacturers have been assured that nothing will be done in the way of price fixing for Government needs that will disturb their business in the least.

Royal Society of Canada

"It is my firm conviction that had the allied nations cultivated the sciences as they must do henceforth there would have been no war such as this." This was the dictum of Dr. A. B. Macallum, F.R.S.C., University of Toronto. in his presidential address on "The Old Knowledge and the New," before the Royal Society of Canada.

Mankind to-day, as a result of this war, has parted with some fondly cherished illusions, he stated. It was a dark and sombre picture that would be thrown on the screen after the war was over.

"It will indeed be a new world and a new age in which all the shibboleths will be discarded and mankind will see things as they are," he asserted. "Free trade and protection, the laissez faire doctrine, individualism, socialism, and all the creeds and counter creeds will be only memories from the past, because the conditions to be will refuse to be solved by doctrinaries and idealists."

Treating of the solution of labor problems after the war, replacement of human wastage and food, he declared that no matter what resulted from the war an altered viewpoint regarding the utilization of science was inevitable.

Exit German Magnet Steel

One of the lines in which the German magneto makers formerly held an important advantage was in the special quality of the steel used for the magnets. Consequently they were able to create something like a monopoly in magnet steel not only for magnetos but for electrical instruments, and they supplied all parts of the world, so great was the demand for German magnet steel. The British steel makers are now able confidently to announce that they are producing better magnet steel than the former German product, thanks to the metallurgical researches of the past two years, and therefore this important industry is now taken from the Germans.

Society of Chemical Industry

The Montreal members of the Society of Chemical Industry held a meeting in conjunction with the members of the Canadian Society of Civil Engineers and the Canadian Mining Institute on May 10th for the purpose of discussing the collection of information for the Honorary Advisory Council for Scientific and Industrial Research. Captains of the thirty teams were selected to collect the information asked for in the questionnaire concerning the industries of the country.

In Other Lands

The manufacture of artificial fertilizers is a new Rhodesian industry.

The prickly pear in Queensland is being gassed with arsenic trichloride.

Butter and margarine are being temporarily admitted into Sweden duty free.

The restrictions on the importation of borax and boron compounds into Norway have been cancelled.

Large reserves of asbestos are actually developed and in sight at Koegas and Westerberg, C.P.

Canadian carbide makers have nearly tripled their exports to New Zealand in the last year.

The richest deposits of asbestos so far opened up to any considerable extent in South Africa are those at Koegas, on the Orange river.

Sanitary regulations, recently issued in Venezuela, prescribe the standards for milk products, lard, oils, wines, spirits and vinegar. Adulteration is prohibited.

The demand in South Africa for sulphuric acid is great, and will be greater. The first steps are now being taken towards the establishment of local manufacture.

The Transvaal Vinegar Works, Pretoria's newest industry, can turn out 100 gallons per diem. Previously all the vinegar consumed in the Transvaal was imported, although the raw materials were to be had on the spot.

Scheelite is widely distributed in small quantities in the gold reefs of Rhodesia. It is a point for investigation whether in many cases appreciable quantities of it could not be saved as a by-product in the extraction of gold.

Newfoundland's imports in the fiscal year, June, 1915-16, amounted to £3,286,000, as compared with £2,470,000 in the previous twelve months. As much as £1,800,000 came from the British Empire and £1,400,000 from the United States.

United States exports last year amounted to the huge sum of £1,125,000,000, a world record. Great Britain's highest level of export trade was reached in 1913, when it amounted to £525,245,289. America has more than doubled this.

The chief ores of tungsten are wolframite and scheelite. Wolframite has been found on the Sabi river, Rhodesia, but the more important deposits are west of Essexvale station, in the Umzingwane district. Lumps of it may be picked up on the surface over a large area.

Yokohama.—Although the output of caustic soda—for which article there is a market practically without limit just now at very high prices, whilst the demand on the home market is not so brisk—in Japan has considerably increased, the Japanese Government have now placed an absolute embargo on all exports.

According to the National Tidende, Copenhagen, a company has lately been formed in Norway, with a capital of 4,000,000 kroner, for utilizing, mainly for the production of dyes and pigments, the abundant deposits of titanium iron ore which occur in Norway. The first factory is to be erected at Frederikstad.

Saccharine in Italy

The British Embassy at Rome has forwarded a translation of a decree which empowers the Minister of Finance, inter alia, to provide and to place on sale within the kingdom, saccharine for use as a substitute for sugar. Saccharine may be provided either by importation, or by manufacture within the kingdom on the State's account and under the permanent supervision of the Ministry of Finance. Saccharine imported for this purpose is to be admitted duty-free.

Production of Camphor in Japan and Formosa

The British Commercial Attache at Yokohama, Mr. E. F. Crowe, C.M.G., reports that the production of camphor in Japan for the year ending March 31, 1917, is estimated at 1,627,422 kin, (kin = 1.32 pound) an increase of 26,607 kin as compared with the actual yield in 1915-16, while the estimated production in Formosa amounts to 5,014,743 kin, an increase of 394,561 kin as compared with the actual yield in the preceding year.

The production of camphor oil in Japan for 1916-17 is estimated at 3,210,494 kin, an increase of 209,073 kin as compared with the actual yield in 1915-16; the estimated production in Formosa is 7,827,560 kin, or 946,328 kin in excess of the actual yield in 1915-16.

Light Alloys for Aircraft

In order to coordinate the work that is now being done in Great Britain in connection with the use of light alloys in the construction of aircraft and aircraft engines, the Advisory Committee for Aeronautics has appointed a sub-committee to advise the government departments on questions relating to such alloys, to institute research for developing and improving them and to assist in the removal of practical difficulties which may arise in their production and use. The sub-committee is composed of men who are in close touch with the experimental work that is being done on light alloys in the National Physical Laboratory, the Royal Aircraft Factory, the University of Birmingham and elsewhere, and hopes to be able to give advice and assistance to manufacturers undertaking the production of light alloys and to founders making engine parts such as cylinders, pistons and crank cases. It will be glad to receive suggestions and to give any possible help in answer to inquiries.

The Future of the Petroleum Industry

In the course of the Presidential address read before the Institution of Petroleum Technologists of Great Britian recently, Mr. C. Greenway, remarked:

"The importance of the petroleum industry to the civilized world develops with the course of years, but in this country it is, so far, only in its infancy. It is only now, as a lesson of this terrible war, that we are awakening to the fact that petroleum, and the securing of our own sources of supply of this valuable commodity, are a national necessity—not only for the great economic struggle which will certainly take place between the chief commercial nations after the conclusion of this war, but as a safeguard against this country ever again being drawn into such a barbarous and destructive conflict as that in which we are now engaged. Until within the past few years, petroleum was only regarded as being of value for the production of artificial light, lubricating oils and wax; but later developments have shown that its greater value lies in what were formerly regarded merely as its by-products—benzine and fuel oil for motive power, solvents for a host of chemical and allied processes, dye stuffs in various manufactures, unguents in pharmacy, jellies and aromatic hydrocarbons for high explosives, etc.—and it is, I think, no exaggeration to say that the demand for these so-called by-products, and the uses to which they will be put as time goes on, are practically illimitable."

American Electrochemical Society

The thirty-first general meeting of the American Electrochemical Society was held at Detroit from May 2nd to 5th, inclusive, and was one of the most successful held by the Society.

Twenty-six papers were read, and all received close attention from large audiences. Among the Canadians who registered were the following: F. W. Myers, Montreal; Chas. F. Lindsay, Ottawa; R. Turnbull, John Guinther, J. Kellcker, of Welland; F. Clark Atwood, Thorold, Ont., and F. J. A. FitzGerald, of Niagara Falls, Ont., and Niagara Falls, N.Y. The last named was president of the society, and chairman of the convention.

President FitzGerald, in his address followed the precdent set in recent years by dealing with the relations of the society to public questions, rather than technical topics, and he referred to the creation of the Committee on Public Relations as an important step in bringing the society into closer touch with legislative and other public bodies. The relation of the society to technical questions arising out of the war was naturally of first importance. The electro-chemist would fail if he attempted to carry on the political affairs of the country, but his work should be co-ordinate with that of the statesman and of the workers in other branches of science. He concluded with this observation: "No matter what advances we make towards the development of new processes and inventions, we are only doing half of our duty and cannot in justice pose as benefactors of humanity unless we also see to it that the results of our labors are so wisely employed that they prove a blessing and not a curse."

Six of the papers of the convention related to electric steel processes, to which reference will be made in another issue.

In a paper on the corrosion of cast iron, by E. A. Richardson and L. T. Richardson, the authors stated that in a test it was found that in an exposure to rusting influences for seven months it was found that pure iron corroded least, cast iron 25 per cent. more and steel 100 per cent. more. According to the electrolytic theory of corrosion cast iron should rust faster than steel or pure iron, but such is not the case.

In the paper by O. P. Watts and Albert Brann on the evolution of hydrogen from cyanide plating solutions, it was stated that experiments were made with silver and copper cyanide solutions, with the addition of varying amounts of free potassium cyanide to determine the effect of the potassium cyanide in liberating hydrogen at the cathode. The effect is much greater with copper solutions than with silver.

A paper by F. C. Mathers and A. B. Leible, on essential oils as agents in plating baths, was read. The authors took squares of sheet metal which were shaken with aqueous solution of the oils and the amount of absorption was determined by titrating the residual solutions. The metals absorb oil in decreasing order as follows: lead, antimony, copper, calcium, zinc, iron, tin, silver. This corresponds to the relative difficulty of preventing rough crystallization deposits by the use of addition agents.

In a paper on antimony plating baths F. C. Mathers and K. S. Means, experiments were reported in making depositions of antimony from various electrolytes. Among these were tartrate, chloride, oxalate and fluoride with glue, peptone, aloin, etc., as addition agents. The most staisfactory bath was the fluoride, containing free hydrofluoric acid and a small amount of aloin, resarcinol, alpha-naphthol, beta-napthol or salicylic acid.

M. DeKay Thompson and T. C. Atchison gave a paper on the properties of magnetite electrodes. These were extensively used in Chile as anodes in the electrolysis of acid copper sulphate solutions; but though they withstand the oxidizing effect of the current better than any other substance they have been given up on account of their brittleness, and "Durion" has taken their place. The toughness of anodes was increased by the addition of copper oxide, but the experiments were not pursued fully for lack of time.

The election of new officers resulted as follows:

President, C. G. Fink, Edison Lamp Works, General Electric Company, Harrison, N.J.

Vice-presidents—H. C. Parmelee, president Colorado School of Mines; F. C. Frary, Niagara Falls; J. W. Beckman, San Francisco.

Managers—L. E. Saunders, Niagara Falls; J. A. Mathews, Syracuse, N.Y.; A. T. Hinckley, Niagara Falls.

Treasurer—P. G. Salom, Philadelphia.

Secretary—Dr. J. W. Richards, Lehigh University, South Bethlehem, Pa.

Acetone

Our attention has been drawn to the following paragraph from the May 10th issue of "Motorboat." The italics are ours.

"With the war came a quick demand from the British government for cordite, C-O-R-DI-T-E, the stuff that England fights with. Ammunition firms in the United States were appealed to, and one of these companies, secure in its belief that its Yankee experts would develop anything needed in the manufacture of this explosive, took on a contract for twenty-four million pounds of the stuff. Cordite requires great quantities of *acetone, a chemical substance resembling hard rock-sugar candy,* and this was the stumbling block in the path of most of the powder companies."

Acetone in the form described certainly would be a stumbling block in the path of almost anyone.

More Paper Mill Activities

The paper plant at Port Mellon, Howe Sound, established some years ago, but which has been idle for a long time, is being altered for the manufacture of kraft paper. The Rainy River Pulp and Paper Company has been organized by a syndicate of New York capitalists, headed by Mr. Robert Sweeney. Kraft paper will also be manufactured by the Pacific Mills Company, Limited, which has nearly completed its plant at Ocean Falls. A second and larger unit is now under construction directly across Link River from the present plant.

R.U.V. Company Appoints Canadian Agents

The R.U.V. Company, 50 Broad Street, New York City, announces that the Northern Electric Company, of Montreal, will hereafter have exclusive Canadian selling rights for Ultra-Violet-Ray water sterilizers. These sterilizers have been installed for purifying water for municipalities, industrial institu, tions, residences, swimming pools, bottlers, brerweries, etc.

Record Iron Output

The output of pig iron in Canada increased largely last year, according to statistics prepared by the American Iron and Steel Institute. Production in 1916 was 1,069,541 gross tons, compared with 925,420 in 1915, and a previous high record of 1,015,180 tons in 1913.

Production of steel ingots and castings was 1,286,509 tons, against 912,755 in 1915; 743,352 in 1914, and 1,015,118 tons in 1913.

We hope many Canadian chemists will visit the third exposition of the chemical industries of the United States, to be held at the Grand Central Palace, New York, during the week beginning September 24th. Two new features this year will be a special department devoted to the paper and pulp industries and one setting forth the resources of the Southern States. The chairman of the advisory committee of the exposition which has been so wonderfully successful is Charles H. Herty, editor of the Journal of Industrial and Engineering Chemistry, and the secretary, Charles F. Roth, from whom all information may be obtained. E. F. Roeber, editor of Metallurgical and Engineering Chemistry, is also a member of the committee.

Personals

McGill University has conferred the honorary degree of doctor of laws on Dean W. H. Ellis, of the Faculty of Applied Science of the University of Toronto.

The Institute of Chemistry, London, has presented a silver bowl to Mr. R. B. Pilcher, registrar and secretary, in appreciation of his twenty-five years' service.

Professor J. C. McLennan, of the University of Toronto, has been appointed by the Imperial Government to the high position of member of the Imperial Board of Inventions, presided over by Lord Fisher, and organized for the purpose of solving the submarine issue.

The medal which was given to the chemistry class of the Industrial Evening Classes at Thorold, was won by Miss Ruby Justice, of the Montrose Division of the Provincial Paper Mills. Mr. John Sims, of the Ontario Paper Co., was a close second. A public presentation of the medal was made by Mr. George Carruthers, chairman of the industrial advisory committee.

J. V. Dickson, B.A.Sc., who was chairman of the Industrial Chemical Club of the University of Toronto, has gone to Bethlehem, Pa., where he will be employed in the testing laboratory maintained by the British War Office.

Mr. B. E. Michel has been appointed city engineer of Kitchener, Ont.

The honorary degree of doctor of science was conferred on Colonel G. G. Nasmith, by the University of Toronto, at the recent convocation.

T. H. Rieder has been elected to the presidency of the Canadian Consolidated Rubber Company, Limited, Montreal. He was formerly vice-president and general manager.

R. Young, of Pittsburg, Pa., has been appointed manager of the gas plant at St. Thomas, Ont.

H. Baron, electrical superintendent of Stettler, Alta., for the past two years, has received the appointment of chief engineer of Camrose, Alta.

E. S. Cole, of the Pitometer Co., New York, was recently elected president and treasurer of that firm, succeeding John A. Cole, resigned.

Rudolph Hering, M. Can. Soc. C.E., announces that he is continuing practice as a consulting engineer in New York City. The firm of Hering & Gregory has been dissolved, Mr. Gregory also continuing in practice individually.

Sydney F. Rickette, A.M.I.E.E., has joined the staff of the Canadian General Electric Company, Toronto office. He was with the Ross Rifle Company until the government took over the factory, and has also been engaged in engineering work in England and China.

Fred. W. Ward, B.A.Sc., has been appointed chemist; A. Cliffe, assistant technologist, and G. H. Chapman, media maker, at the filtration plant laboratory at Toronto Island.

Mr. Harry Darling, formerly manager of the Dome mines at Porcupine, has gone to California where he will look after the Crown Reserve interest at the Globe mine.

Mr. Alexander Allaire, M.E , M. Can. Soc. C.E., has resigned from the staff of the Foundation Company, of New York, to become vice-president of Fraser, Brace and Company, contractors, 1328 Broadway, New York.

E. R. Gray, B.A.Sc., formerly joint manager of the Hamilton Works department, has been placed in charge of the department with the title of city engineer and manager of the waterworks and sewage disposal plant.

F. Tissington has resigned from his position as chief engineer of MacKinnon, Holmes & Company, Limited, Sherbrooke, Que., to take a short holiday before commencing work again.

Mr. W. I. Gear, of the Robert Reford Company, Montreal, has been appointed to take charge, under the Imperial Munitions Board, of steel merchant ship construction in Canada for the British Government. Mr. Gear will establish an office at Ottawa.

A statue of Berthelot, the great chemist, has been unveiled in the gardens of the College de France. He did much of his work in the laboratories of the college.

Sergeant C. C. Anderson, a former Toronto chemical student, has been transferred from France to England, where he is engaged in munition work.

Mr. W. B. Swanton has succeeded Mr. A. Greig as manager of the woods department of the Standard Chemical, Iron and Lumber Co. Mr. Swanton has been with the company for the past fourteen years, and was formerly in charge of the operating and woods department of the company's plant at Sault Ste. Marie. Mr. Grieg is now manager of the lumber business of Seaman, Kent & Co.

Obituary

S. R. Sheldon, vice-president and chief engineer of Sheldon's, Limited, Galt, Ont., manufacturers of heating and ventilating equipment, passed away recently after an operation for appendicitis. Mr. Sheldon was born in Bucharest, Rumania, in 1877, and moved to Galt when seven years of age, and has lived there ever since. After receiving his education at Galt public and collegiate schools he attended Ridley College and the School of Practical Science. Mr. Sheldon was originally with the McEachren Ventilating Co., and about fifteen years ago took over the business with his brother, W. O. Sheldon. The company was at a later date incorporated as Sheldon's Limited.

The news that Major Gerald Godfrey Knighton, of the Oxford and Bucks Regiment, for three years science master at St. Andrew's College here, has succumbed to wounds received in battle, has been received by friends in the city. The late Major was a graduate of Cambridge University. He was at St. Andrew's from 1910 until 1913, and was in England when the war broke out. He at once enlisted and crossed to the war zone with one of the first Imperial contingents.

Export Tax on Chilean Ores

A commission is at work in Chili preparing recommendations for laws imposing taxes on the exportation of copper and other minerals.

"Hero"—Young Chemist

The "hero" of the new Kronstadt revolution which recently deposed the Petrograd Provisional Government is a chemist of the Petrograd Technological College, Anatole Lamanoff, who by his eloquence and his flaming enthusiasm and his unexampled energy recently made himself President of the local Council of Workmen's and Soldiers' Deputies, and virtually Kronstadt's dictator.

A chemical firm whose business has expanded very rapidly since the war is that of Madero Bros., Inc., 115 Broadway, New York. To cope with this expansion the company has had to rent an entire building for their chemical offices at 100 John Street, where they keep stocks, while the executive offices, accounting department, import and export departments are retained at 115 Broadway.

The interests of the Franklin H. Kalbfleisch Company, the Erie Chemical Works, the Kalbfleisch corporation and the Kaloid Company have been purchased by the Kalbfleisch Corporation of New York. This company will now own five chemical plants, from which there will be a greatly increased output of heavy chemicals, and acids. Among the chemicals made by the Kalbfleisch Corporation are sulphuric acid, nitric acid, muriatic acid, sulphate of alumina, sulphate of soda, alum, etc. The Kalbfleisch sulphuric acid is made from brimstone only. The corporation is represented in Canada by A. M. Huestis, Mail Building, Toronto. Mr. Huestis has wide and intimate connections with the pulp and paper industry of Canada.

International Nickel Record Earnings

The fiscal year ended March 31st last was the most profitable one in the hsitory of the International Nickel Company. Earnings applicable to the 1,673,384 shares of common stock were $13,023,214, or $7.77 a share on that issue compared with $6.70 a share in 1916, the previous record year.

The expansion in the company's business in the past three years has been remarkable. last year's earnings comparing favorably with $5,063,315 reported for 1915. While other metals have advanced in price, nickel has remained practically unchanged so that the increase in earnings was brought about by finding new uses for the metal, increased consumption by automobile makers and manufacturers of certain war materials.

Port Colborne Refinery

Considerable money was expended during the past year for additional property, construction and equipment, the amount being $3,483,775, compared with $1,414,807 in 1916 and $595,976 in 1915. The heavy increase in this item was mainly due to the $1,046,740 spent last year on the new refinery in Canada. That the company means to end the Canadian opposition to all nickel ore being refined in America is shown by President Monell's statement that the refinery at Port Colborne, Ont., will cost $5,000,000 and that it will be ready for operation by the beginning of 1918. He states that the property is located at the Lake Erie entrance of the Welland Canal, and is considered the best point in Canada for assembling materials.

Chemistry in the Paper Industry

The paper mill of the near future will be more reliant upon its chemists than has hitherto been the case. Economy, efficiency and development will be attained through the introduction of paper mill chemistry, helped by mechanical science. There is ample and accumulating evidence that the struggle for commercial supremacy, interrupted by the war, will be renewed after the coming of peace with a fierceness and energy equalling anything displayed in the war. Education will win, provided that it is backed up by character. As we now stand, we have the character, but lack the education. Germany has the latter, but lacks the former. Let the Government solve the education problem, but let the paper trade fix its own ideals in the trade application of education. Scientific papermaking will ultimately command the world's market.—Pulp and Paper Magazine.

American Intitute of Chemical Engineers

The ninth semi-annual meeting of the American Institute of Chemical Engineers will be held in Buffalo, June 20-22, 1917. The program includes an excellent list of chemical engineering papers, describing important recent advances which have been made in various industries. Excursions to some of the interesting chemical plants in Buffalo and vicinity had been arranged for, but at the outbreak of the war, it was considered necessary to absolutely close these plants to visitors. An exception was made in the case of the Buffalo Foundry and Machine Company. An inspection of this very extensive and interesting plant will, doubtless prove very profitable. Many Canadians will, no doubt, attend as members or visitors.

The secretary of the Institute is John C. Oslen, Cooper Union, New York.

Discovery of "Terror-All," an explosive said to be so powerful that five grains would be sufficient to crumble the tallest building in New York, was announced by Dr. Dayve B. De Waltoff during a meeting of the Medico-Pharmaceutical League at which Dr. De Waltoff was a speaker.

Prospecting for petroleum in Venezuela is being carried on with encouraging success by one American and two English companies.

Besides the new pulp mill now being erected at Port Arthur, Ont., there is projected at Fort William a new pulp mill of a capacity of 150 tons per day, to be followed by a news print mill and a sulphite pulp mill of 100 tons per day.

Two chemical products, manufactured for the first time in Canada, are being placed on the market by the Standard Chemical Iron and Lumber Company, Toronto. These are methyl acetate and acetic anhydride, concerning which we hope to give some information in an early issue.

One of the new Canadian products incidental to the development of the chemical industries is that of steel barrels, which are now manufactured in a variety of styles and sizes by the Smart-Turner Machine Company, of Hamilton. This company has issued a bulletin illustrating the various types of steel barrels made.

The Whelan Pulp and Paoer Mills, Limited, has been incorporated with capital stock of $10,102,500, to take over as running concerns the British Columbia Sulphite Fibre Company, Limited, and the Empire Pulp and Paper Mills, Limited, and to carry on business as lumber manufacturers. The head office is at Vancouver.

The Giscome Lumber Company, of Giscome, B.C., the Kamloops Sawmill, Limited, of Kamlopps, B.C., and the A. P. Allison & Company, Limited, of Green Point Rapids, B.C., have been incorporated and their charter empowers them to erect pulp and paper mills. The first named company is capitalized at one million dollars.

A new course has been started in "Chemical Engineering Practice" at the Massachusetts Institute of Technology under the direction of Dr. W. H. Walker. The students are distributed at the various centres in the eastern states, where chemical industries are found and are thus able to obtain several weeks of practical work in the plants to which they have been assigned. The centres that have been selected to date are: Bangor, Me.; Stamford, Conn.; Northampton, Penn.; Everett, Mass.; and Niagara Falls.

The Graduate School of the University of Michigan now has seven industrial fellowships that are under the control of the Department of Chemical Engineering. These have been established by private interests, and the subjects studied are limited to matters of general interest. Publication of the results is unrestricted. Two fellowships are in gas engineering and were established by the Michigan Gas Association. One is in the manufacture of paints and varnishes and was established by the Acme White Lead and Color Works, of Detroit. One is in the pulp and paper industry, and was established by a group of Michigan producers. One was established by the Detroit Edison Company, for the investigation of materials used in the construction of central-station equipment. One was established by the Detroit Copper and Brass Rolling Mills for the promotion of better copper products. One was established by the Detroit Steel Castings Company for studies into the production of better steel castings.

Chemical Prices

The quotations below represent average prices for the quantities indicated at the time of going to press. Larger amounts, of course, may be obtained at lower figures.

Toronto, June 1, 1917

Inorganic Chemicals

Alum, lump ammonia	100 Lbs.	$6.50
Aluminium Sulphate, high grade, bags	100 Lbs.	4.00
Ammonium Carbonate	Lb.	.16
Ammonium Chloride, white	Lb.	.21
Aqua Ammonia .880	Lb.	9
Bleaching Powder, 35% drums	Lb.	7
Blue Vitriol	100 Lbs.	14.00
Borax, crystals	Lb.	.11
Boric Acid, powdered	Lb.	.16
Calcium Chloride, crystals fused	100 Lbs.	2.50
Caustic Soda, ground, Bbl	Lb.	8
Chalk, light precipitated	Lb.	.10
Cobalt Oxide, black	Lb.	1.50
Fuller's Earth, powdered	Lb.	5
Glauber's Salt, in bags	100 Lbs.	1.50
Hydrochloric Acid, carboys, 18°	Lb.	3
Lead Acetate, white crystals	Lb.	.28
Lead Nitrate	Lb.	.27
Lithium Carbonate	Lb.	2.10
Magnesium Carbonate, B.P.	Lb.	.40
Mercury	Lb.	2.60
Nitric Acid, 36° carboys	100 Lbs.	8.75
Phosphoric Acid, S.G. 1750	Lb.	.80
Potassium Bichromate	Lb.	.60
Potassium Bromide	Lb.	1.85
Potassium Carbonate	Lb.	.90
Potassium Chlorate, crystals	Lb.	.80
Potassium Hydroxide, sticks	Lb.	2.15
Potassium Iodide, bulk	Lb.	4.25
Potassium Nitrate	Lb.	.50
Potassium Permanganate, bulk	Lb.	5.00
Silver Nitrate	Oz.	.80
Soda Ash, bags	Lb.	4
Sodium Acetate	Lb.	.30
Sodium Bicarbonate	100 Lbs.	3.25
Sodium Bromide	Lb.	.80
Sodium Cyanide, bulk, 98-99 per cent	Lb.	1.25
Sodium Hyposulphite, bbls	Lb.	.2¼
Sodium Nitrate, crude	Lb.	8
Sodium Silicate	Lb.	.10
Sodium Sulphate	Lb.	4
Strontium Nitrate, com	Lb.	.55
Sulphur, ground	100 Lbs.	3.50
Sulphur, roll	100 Lbs.	4.00
Sulphuric Acid, 66°Be, carboys	100 Lbs.	3.00
Tin Chloride, crystals	Lb.	.50
Zinc Oxide	Lb.	.25
Zinc Sulphate, com	Lb.	.18

Organic Chemicals

Acetanilid, C.P.	Lb.	$ .75
Acetic Acid, 28 per cent. in bbls	Lb.	.7¼
Acetic Acid, glacial, 99½% in carboys	Lb.	.75
Acetone	Lb.	.60
Alcohol, methylated	Gal.	2.15
Alcohol, grain	Gal.	7.25
Alcohol, wood, 95 per cent.. refined	Gal.	2.25
Benzoic Acid	Lb.	7.50
Carbolic Acid, white crystals	Lb.	1.00
Carbon Bisulphide	Lb.	$ .10
Chloroform, com	Lb.	1.15
Citric Acid, domestic, crystals	Lb.	1.40
Ether, 725	Lb.	.50
Glycerine	Lb.	.80
Oxalic Acid	Lb.	.80
Salicylic Acid	Lb.	2.00
Sodium Benzoate	Lb.	7.20
Tannic Acid, commercial	Lb.	2.00
Tartaric Acid, crystals	Lb.	1.10

Metals

Aluminium	Lb.	$ .68
Antimony	Lb.	.30
Brass, yellow ingots	Lb.	.23
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Copper, electrolytic	Lb.	.37
Lead	Lb.	.14
Magnesium	Lb.	2.50
Nickel	Lb.	.47
Spelter	Lb.	.12½
Tin	Lb.	.68
Pig Iron, No. 1 Foundry	100 lbs.	....
Mild Steel	100 lbs.	5.25
Common Bar	100 lbs.	5.25

Chemical Markets

A general upward trend of prices has taken place during the month due to the difficulty of obtaining supplies. Advances particularly noticeable are the three alcohols, glycerine, ether, tannin and some potash salts. Little change is noticed in the heavy chemical market. Cyanide of soda has replaced the potash salt which is off the market. New listings during the month, in addition to the metals, are benzoic acid and its soda salt. It is expected that shipments of acetic anhydride and methyl acetate will be made for the first time during the present month.

Toronto School Contracts Given

The following tenders for scientific apparatus and supplies for the Toronto High Schools have been accepted by the Management Committee of the Board of Education:

Apparatus—McKay School Equipment, Limited, Harbord Street, $265.63; Humberside, $204.02; Jarvis Street, $95.06; Malvern, $127.10; North Toronto, $130.38; Oakwood, $375.23; Parkdale, $86.50; Riverdale, $18.82.

Chemicals—John Hargreaves, Harbord, $16.18; Humberside, $19.89; North Toronto, $42.28; McKay School Equipment, Limited, Malvern, $24.26; Parkdale, $29.17; Riverdale, $68.03; E. N. Moyer Co., Jarvis Street, $38.85; Oakwood, $40.00.

Smelter's Metallurgical Developments

The enterprise of the Consolidated Mining and Smelting Company enables British Columbia to boast of the world's greatest metallurgical plant, where five metals are electrolytically refined from hydro-electric power; of the only lead smelter and refinery which produces the whole of the lead output of Canada, amounting to about 50,000,000 pounds annually, derived from British Columbia mines; of the largest producer of gold in British Columbia; of the first equipment in Canada for the economic production of zinc by electro-chemical process; and of the first electrolytic copper refinery in Canada, says the Mining and Engineering Record.

"The arrangement entered into with the Consolidated to supply zinc at a certain figure was responsible for breaking the corner in this metal which had been established by United States producers, and in this one item alone has been responsible for the saving of at least $10,000,000 to the Imperial Munitions Board."

BOOKS

For the Chemist and Chemical Student

Practica. Inorganic Chemistry for Advanced Students. By Chapman Jones, F.I.C., F.C.S., etc. London, 1898. Latest reprint, 1906. 239 pages. Price, 60 cents.

Chemistry: An Elementary Text-book. By W. C. Morgan, Professor of Chemistry in Reed College and J. A. Lyman, Professor of Chemistry in Pomona College. New York, 1911. Twelfth reprint, 1916. 429 pages. Price, $1.25. Manual, 142 pages. Price, 40 cents. Both in one volume. Price, $1.40.

A College Text-book on Quantative Analysis. By H. R. Moody, Professor of Chemistry in the College of the City of New York. New York, 1912. Latest reprint, 1916. 165 pages. Price, $1.25.

Theoretical Organic Chemistry. By Julius B. Cohen, Ph.D., B.Sc. London, 1902. Second edition, 1912. Third reprint, 1916. 578 pages. Price, $1.60.

Practical Organic Chemistry for Advanced Students. By Julius B. Cohen, Ph.D., B.Sc., London, 1900. Second edition, 1908. Third reprint, 1915. 356 pages. Price, 90 cents.

Methods of Organic Analysis. By H. C. Sherman, Ph.D., Professor of Food Chemistry in Columbia University. New York, 1905. New and revised edition, 1912. 407 pges. Price, $2.40.

Elementary Household Chemistry. By Prof. J. F. Snell, Macdonald College, McGill University, Montreal. New York, 1914. Fifth reprint, 1916. 307 pages. Price, $1.25.

Organic Agricultural Chemistry. By J. C. Chamberlain, Ph.D., Professor of Organic and Agricultural Chemistry, Massachusetts Agricultural College. New York, 1916. 307 pages. Price, $1.60.

Outlines of Industrial Chemistry. By F. H. Thorpe, Assistant Professor of Industrial Chemistry and W. K. Lewis, Professor of Chemical Engineering, Massachusetts Institute of Technology. New York, 1905. Third edition, 1916. 65 pages. Price, $3.75.

The Elements of Physical Chemistry. By the late H. C. Jones. Fourth edition, revised and enlarged. New York, 1915. 650 pages. Price, $4.00.

Introduction to Physical Chemistry. By James Walker, D.Sc., Ph.D., F.R.S., Professor of Chemistry in the University of Edinburgh. London, 1899. Seventh edition, 1913. 421 pages. Price, $2.75.

The Manufacture of Organic Dyestuffs. By Andre Wahl, D.es Sc., Professor of Industrial Chemistry in the University of Nancy. Translated by F. W. Atack, M.Sc., M.Sc.Tech., A.I.C. of the School of Technology of the University of Manchester. London, 1914. 338 pages. Price, $2.00.

The Gases of the Atmosphere and the History of Their Discovery. By the late Sir William Ramsay, K.C.B., F.R.S. London, 1896. Fourth edition, 1916. 306 pages. Price, $2.25.

Photography for Students of Physics and Chemistry. By Louis Derr, M.A., S.B., Professor of Physics in the Massachusetts Institute of Technology. New York, 1906. Third reprint, 1916. 247 pages. Price, $1.40.

Famous Chemists. By E. Roberts, B.Sc., London, 1911. 247 pages. Price, 75 cents.

The Chemistry of Paints and Painting. By A. H. Church, F.R.S., D.Sc., Professor of Chemistry in the Royal Academy of Arts, London. Fourth edition, revised and enlarged. London, 1914. 388 pages. Price, $2.50.

Chemical Technology and Analysis of Oils, Fats and Waxes. By Dr. J. Lewkowitsch, F.I.C., late Consulting Chemist to the City and Guilds of London Institute. Complete in three volumes. London, 1895. Fifth edition, entirely rewritten and enlarged, 1913-14. Vol. I, 688 pages, price, $6.50. Vol. II, 944 pages, price, $6.50. Vol. III, 483 pages, price, $6.50.

The Plariscope in the Chemical Laboratory. By G. W. Rolfe, A.M., Instructor in Sugar Analysis in the Massachusetts Institute of Technology. New York, 1905. 320 pages. Price, $1.90.

A Treatise on Chemistry. By Sir H. E. Roscoe, F.R.S. and C. Schlorlemmer, F.R.S. Vol. I, The Non-Metallic Elements, London, 1877. Fourth edition, 1911. 931 pages, price, $5.00. Vol. II, The Metals. London, 1878. Fifth edition, 1913. 1,470 pages. Price, $7.50.

The Canadian Iron and Steel Industry. By W. J. A. Donald. Price, $2.00.

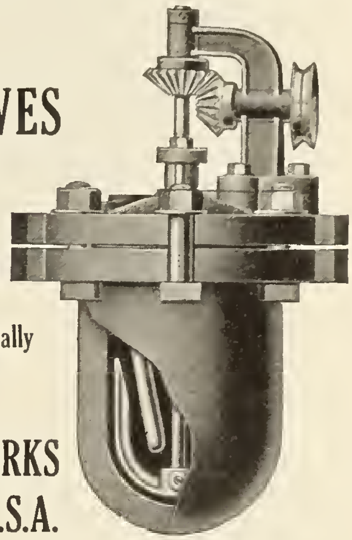
The Tin-Plate Industry. By Donald E. Dunbar. Price, $1.00.

Book Department

CANADIAN CHEMICAL JOURNAL

2 Toronto Street, Toronto

Index of Advertisements



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CANADIAN CHEMICAL JOURNAL

A Canadian Journal devoted to Metallurgy Electro-Chemistry and Industrial Chemistry.

Vol. 1, No. 3 | TORONTO, JULY, 1917 | 20c. a copy; $2 a year

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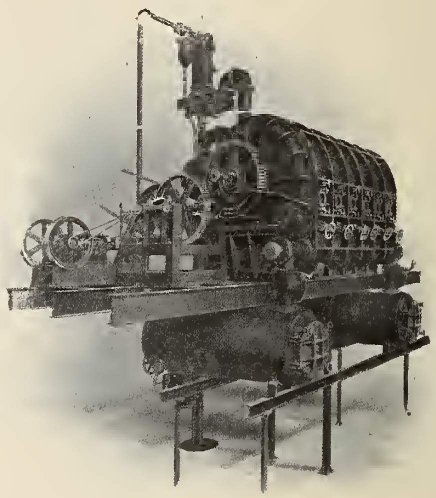
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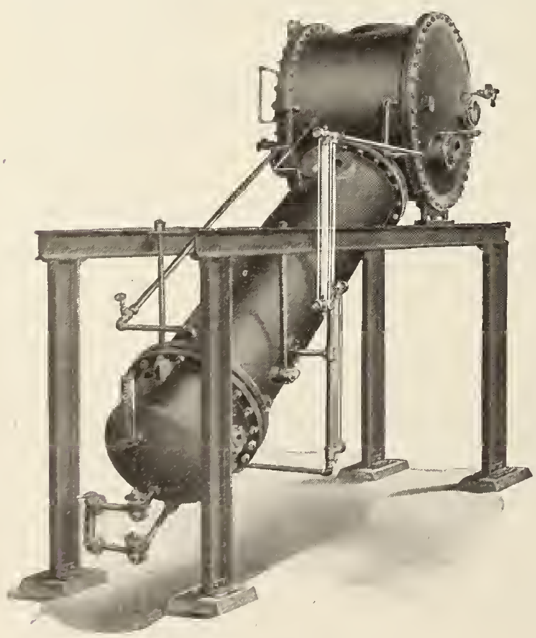
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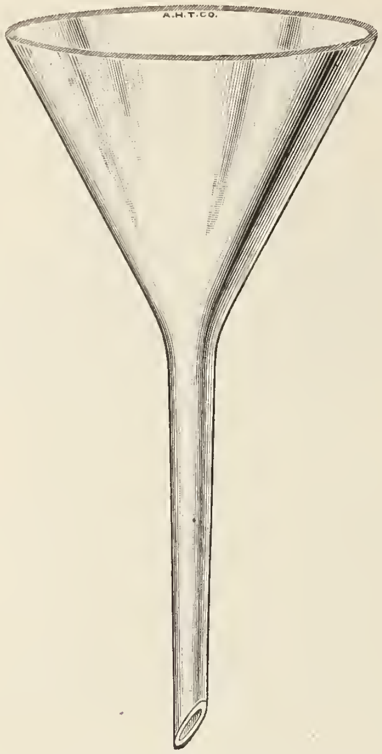

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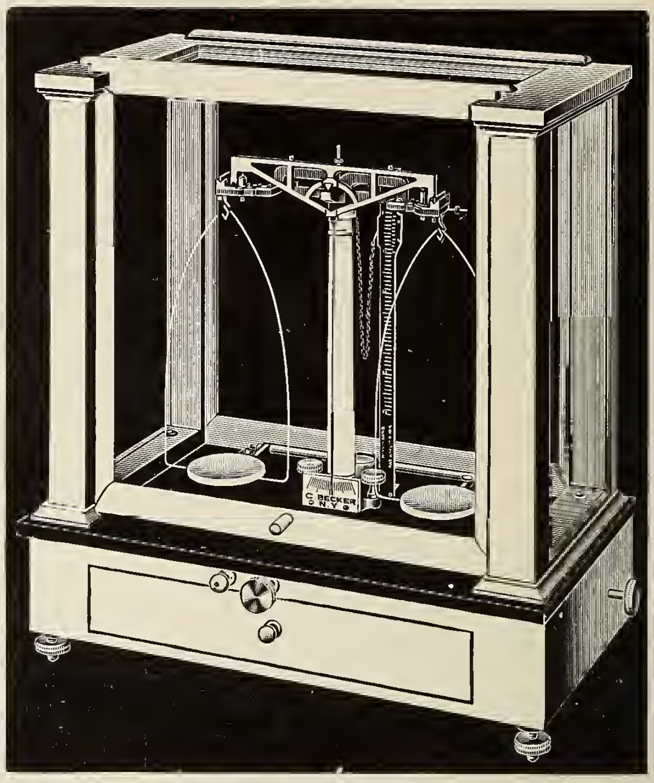

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CANADIAN CHEMICAL JOURNAL

A Canadian Journal devoted to Metallurgy Electro-Chemistry and Industrial Chemistry.

Vol. 1 TORONTO, JULY, 1917 No. 3

CANADIAN CHEMICAL JOURNAL

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Time of going to press, 25th of the month preceding date of issue. News and changes of advertisements should be in hand one week before.

The Canadian Chemical Journal announces the removal of its editorial and business departments to 36 Toronto Street where larger offices, recently occupied by the Joint Committee of Technical Organization, have been secured in the new Excelsior Life Building.

The Potash Problem

THE article on the "Potash Industry of Canada" in this issue will be a reminder to the younger generation of chemists that Canada has a historic interest in this industry. It is very interesting to learn that in the first half of the last century Canada was the world's chief source of potash. This country will in all probability again become a great producer of potash, when a successful method is discovered of extracting it from the feldspar rock which abounds in many sections. To make such work profitable the extraction of potash will have to be combined with the recovery of other saleable elements as by-products.

The National Potash Corporation in our May number made some strong claims for their method of extracting potash from feldspar as a by-product of cement manufacture. While these pages are open for information on any new method the publication of such claims does not imply our endorsement of them till proof of success is given. It may be stated that there are already over a hundred processes patented in the United States and Canada for producing potash from feldspar. Most of those that have promise of commercial success are based upon experiments made years ago by W. H. Ross, of the United States Bureau of Soils. Mr. Ross found that when one part of feldspar and three parts of calcium carbonate were ignited for about an hour at a temperature of 1400° the potash was volatilized and the clinker remaining was suitable for cement. If the lime was replaced by a quantity of calcium chloride equivalent to the alkalis in the feldspar the potash was vaporized in half the time. Hence it was concluded that potash could be set free from feldspar by substituting it for clay in the making of cement and that it might be collected from the flue dust. And as the ordinary substances used in cement making contain some potash that percentage could also be recovered by volatilization. This recovery from flue dust is sometimes effected by electrical precipitation. When powdered feldspar was digested with water and 1.7 parts of lime at a pressure of ten to fifteen atmospheres 90 per cent. of the potash passed into solution in the form of hydroxide and the residue had the composition required for cement clinker. Such pressure can safely be produced in an ordinary boiler.

We are not aware that any great advance has been made upon the experiments mentioned, and success here depends just now on good business methods combined with good location and raw materials that yield a high percentage of potash with cement or other by-products to share the cost of treating the rock.

New Arsenic Deposits

The great advance in the price of white arsenic has drawn marked attention to the mispickel deposits found in the Hastings district and it is understood that movements now on foot bid fair for the establishment of another important industry.

The high degree of purity of the arsenic produced from Hastings mispickel combined with the many advantages offered for such an industry as cheap power, excellent transportation facilities and easy access to the world's markets will make the Hastings district an important factor in the arsenic trade. Considerable attention is being given to a property north of Tweed which contains within itself all the desirable features for the establishing of a large and profitable industry with arsenic even at one-quarter the price of present quotations.

Oleomargarine And Its Food Value

On another page will be found an article by one of Canada's well known food chemists, Professor J. F. Snell, of Macdonald College, Montreal, on the Nutritive Value of Oleomargarine, which was presented before the Society of Chemical Industry recently. As will be seen, there are several points of difference between this compound and butter, some of which are beneficial and only a few which might be detrimental from the nutritive standpoint. It will be seen that oleomargarine when properly made under conditions easily attainable in any modern abattoir, is the equal of butter in most respects and has the advantage that it can be pasteurized so as to render it free from any disease germs, a process which cannot be applied to butter without making it unfit for food.

When made in an up to date plant, oleomargarine has nothing to hide and nothing to apologize for, it is a nutritious and wholesome article of diet and can be made in Canada with the raw materials which although produced here, are at present exported to the States. It is sold in Great Britain and the States today for about twenty-five ecnts a pound, which is nearly half the price of the best butter. It is not a substitute for butter but is a competitor of butter and if the government should remove the restrictions on its manufacture in Canada, the abattoirs who would naturally be called on to manufacture oleomargarine should remember this and be advised not to sell this desirable article under names that would suggest that it was an imitation of butter, for it is not. It would be a great mistake to allow the public mind to confuse these two products in thinking that butter was any superior on account of its high price.

Another Growing Industry

One of the great industries of the Dominion that has grown to an enormous extent, due to the cheap supply of electric power, in the last few years is the manufacture of calcium carbide. In the report of the department of Trade and Commerce, recently issued, it is shown that from a small beginning, a few years ago, this industry is now among the largest. Previous to the year 1915, the exports of this material did not exceed $200,000 in any one year, but in that year the exports increased from five million to thirty-six million pounds and the value from $161,026 to $1,117,118. The following year, however, showed that exports had increased to over three times the figure for 1916, being 112,974,900 pounds, valued at $3,485,670. For the year which ended on March 31, 1917 the value had increased further to $4,379,564. The demand for this material was formerly to provide acetylene lighting in remote districts and plants where electric light was then not obtainable but with the coming of electric light, the demand fell off until the newer uses of acetylene in oxy-acetylene welding and the manufacture of acetone so increased the demand that it may soon be one of Canada's monopolies.

Electricity is rapidly revolutionizing the processes of producing steel and other metals. We know that the electric smelting of metals has made remarkable advances in the last few years, but the electric treatment of steel, for example, as distinct from the electric smelting of iron and scrap iron, is being put into practice with pronounced success. A large plant is in course of construction at Gary, Indiana, where steel will be made by the Bessemer process and while still hot will be put through a treatment in an electric furnace. Steel will thus be produced which will be the equal of electric steel as made by such a process as used at Welland, Ont. The new process will produce the steel much cheaper, as the electric furnace will require to be used only a short time, and the steel will be turned out at an enormous rate, since a "blowing" in a Bessemer converter takes less than half an hour.

The Potash Industry of Canada

THE chemist of to-day who thinks of the production of potash in terms of the output of Stassfurt will be surprised to learn that at the middle of the last century between two-thirds and three-fourths of the world's product of potash came from Canada. Regarding this product as a Canadian industry it will be equally surprising to learn that for many years the export of pot-ash and pearl-ash ranked next to lumber in the shipment of forest products to other countries. In the fifties the export of potash and pearl ash from Upper and Lower Canada for several years exceeded a million dollars in value per year and a million dollars was a big sum to the Canadians of those days. It was very important to the individual settler in the first half of the last century, because it was the one product of all his varied labors that could be depended on for ready money. It was paid for in cash whereas most of his other earnings and crops were traded for groceries, drygoods and implements. His wool went to the custom woolen mill and came back in cloth or in roll cards for the settler's wife to spin; the wheat went to the grist mill and came back largely in flour and feed, and butter and home-made cheese came back in other groceries; but potash always came back in real money.

In many parts of the country the manufacture of pot and pearl ash became a specialized industry carried on all the year round. Men were employed in going through the settlements, collecting the ashes saved by the farmer who burnt his timber, not more for the sake of clearing the land than for the sake of the money obtained from the sale of the ashes. Many farmers had their own pots and converted their wood into potash, while every new settlement established an "ashery" in which both pot and pearl ash would be made, from ashes hauled in from neighboring clearings. In 1851 there were 237 asheries in Upper and Lower Canada (Ontario and Quebec). In 1871 there were 519; but by 1891 these had dwindled to 128 for the whole of Canada, and now the industry on this plan is almost extinct. However, during the last few years up to the outbreak of war the exports of potash from Canada averaged about 500 barrels per year, valued at nearly $25,000, or $50 per barrel. While during the last century Canada was the world's chief producer of potash she has now become an importer, the imports before the war averaging about 250,000 pounds, valued at about $9,000. During the first half of the last century Great Britain was the world's chief market for potash, and the pre-eminence of Canada in this industry is indicated by the fact that in 1831, for example, Great Britain imported potash and pearl ash to the amount of 228,757 cwt. of which 169,891 cwt. came from British America; 15,835 cwt. from the United States, and the balance from Russia and Poland.

Most of this output was exported direct to England, the shipments by the St. Lawrence often amounting to more than a million dollars a year. Considerable quantities went out from Upper Canada by way of Buffalo, and frequent schooner loads came down the Grand River every season for delivery here to New York and New England ports. Potash entered England free from Canada, but until free trade was adopted there was a duty on American potash of six shillings per cwt. The price in England in the thirties was about £1/5/6 for pearl ash, and £1/4/6 for potash.

A Canadian work of reference, published in 1863 and edited by Prof. Hind, the geologist, and T. C. Keefer, the well known civil engineer, described the process of manufacture in Canada as follows: "The produce of the forest of most importance next to lumber has always been pot and pearl ashes. Potashes are made from the crude ashes by dissolving the soluble portion of the ashes with water, evaporating to dryness and fusing at a red heat into a compact mass, which although gray on the outside is pink within. Pearl ash is made by calcining potashes upon a reverberatory hearth until the carbon and much of the sulphur are dissipated. Water is then added and a lye formed which, when evaporated to dryness yields the pearl ash of commerce. Canadian potashes contain on an average 60 per cent. of carbonate of potassa. Pearl ash contains generally about 50 per cent. of caustic potassa."

In the fifties the cost of manufacturing was estimated at $10 per barrel when the selling price in Montreal was $40, and, therefore, the manufactured of potash was strongly urged as an industry whose profits were certain and permanent. One advocate stated the case thus: "No one item of our available exports is of higher importance than potashes and pearl ashes. In a country where it is necessary that vast tracts of wild land should be cleared,—land covered with a heavy growth of timber, useless in the main for other purposes than the manufacture of ashes,—this needs only to be looked at to discover its utility."

To-day the forests of Ontario are worth for other industries twenty to thirty times the value of their potash and Canadian lumbermen will learn with vexation that in the tract referred to,—that is, the region lying between London and Detroit.—the timber spoken of as worthless for any use other than potash, comprised Birch, Beech, Oak, Pine, Maple, Elm, Cherry, Hickory, Ironwood, Black Walnut and many other woods which are now rare and costly.

With the clearing of the forests of Eastern Canada the potash industry declined, and this decline was hastened by the opening of the great deposits of Stassfurt, Germany. But since the war has cut off the German supply, and since Great Britain, the United States, Canada and the other British Dominions seem to have determined that they shall be self-dependent as to such products, the present problem is to discover new sources of potash and nitrates,—both essential in the field of agriculture, as well as in chemistry. While it is true that in Canada and the United States there has been throughout the last hundred years an enormous waste of material in almost every industry, and none of greater enormity than in wood, yet all that can now be saved of the remnants of our forests will never restore the potash industry on the old basis. It will be interesting to note that the Town of New Toronto is now installing under the supervision of its engineers, Messrs. James, Loudon & Hertzberg, a system of incineration for the treatment of garbage, by which potash is recovered to the value of $7 to $10 per ton. The incinerator is designed by the Reid Products Company of Toronto, who have installed plants in several towns and have designed a small type for private works. Of the latter, thirty-eight were installed at the military grounds at Camp Borden. Such endeavors to utilize the waste of cities should be encouraged, but, at best, they can only yield a fraction of the potash required.

There is still, however, a source of potash in the feldspar rocks of America, vaster than has ever been exploited from wood, and without doubt chemistry will sooner or later solve the problem of profitably extracting it. There are millions of tons of feldspar rock in Canada and in some sections the potash contents run from 10 to 14 per cent.

The cost of extracting the potash must be reduced by using other elements of the rock as by-products, and aluminum compounds, porcelain and Portland cement can do this in some districts. The making of potash as a by-product of the cement industry is now much talked of in Canada, but the claims made for the processes have not yet been demonstrated on a commercial scale; and, in any case, the output in this class is necessarily restricted to the market obtainable for the cement.

Generally speaking, the areas of feldspar rock in the northern half of this continent yield a porcelain that is whiter and freer from iron, and for this reason large quantities of Canadian feldspar are shipped to the United States, ranging from 11,000 to 18,000 tons per year,—to be used in the pottery and porcelain industries, and for the manufacture of artificial teeth, etc., and there would seem to be room for further develpment of such industries and for aluminum in both countries in combination with potash production. When the nickel areas of Sudbury were opened up, the peculiar combinations of the ore presented a knotty problem to be worked out, but patience, skill and money solved every difficulty, with the result that to-day the Sudbury district now supplies 80 per cent. of the nickel output of the world. There is every reason why all obstacles will be overcome likewise in the production of potash, and if so, the primacy in the manufacture of this most essential material will be restored to America.

NICKEL

Canada's Share in the World's Supply—The Future of Nickel Refining in Canada

By E. B. Biggar

ARTICLE 3

THE present dominant position of Canada in the world's nickel market was not realized when costly experiments were being made by chemists connected with the big nickel corporations to overcome the difficulties of smelting the ores of the Sudbury district. The chief source of the world's supply then was Europe, and even the United States surpassed Canada. From 1840 to 1860 the production of the whole world only averaged from 100 to 200 tons a year, and its use was chiefly for cheap jewelry and utensils that could be produced from the alloy known as German silver. Its price averaged $2 to $3 a pound, but this increased by the growing demand and the uncertain supply till in the seventies, when it averaged $6 to $7 a pound. This rise was largely caused by the adoption by Germany, the United States and some other countries, of a nickel alloy for coinage, which used up more nickel than could be replaced by the annual supply.

As the technical problems of working the metal and making alloys were solved, and its new qualities became known, the demand and the supply both increased, but improved processes enabled the smelters and refiners to cheapen the product and still make more profits than before. The nickel refining corporations have been making prices ranging from 30 cents to 45 cents per pound, according to the size of the order.

As mining and exploration have proceeded in Canada the extent and richness of the Canadian nickel ores appear to be more clearly demonstrated, while the supplies from other sources have become more fitful by reason of the pockety nature of the deposits and their limited area.

No one knows what nickel deposits remain to be discovered, but the present situation is that there are no known mines that seriously compete with Canada in extent. It was in 1889 that nickel first appeared as a separate article of Canada's exports with over a third of the estimated production of the world.

For example, the most promising nickel mine of the United States, the Gap Mine of Pennsylvania, has been practically out of production for twenty years, and of the several States having deposits not one has been producing nickel ore for the past three years. The only nickel produced in the United States is that recovered as a by-product of "blister" copper ores, amounting to about 250 tons of metal a year. The Swedish mines were closed when the war broke out, though they are now operating on a small scale, no doubt helping to make up the shortage in Germany. The output of Norway averaged less than 70 tons a year of refined metal before the war, and the Norwegian ores only average two per cent. of metal. The Norwegians are successful smelters, but they use imported ore largely much of it from New Caledonia. The deposits of Norway, which were out of business when war was declared, have produced from 240 to 690 tons annually since the war. There are deposits in the Ural mountains in Russia, which are said to be producing 600 tons a year, and there are deposits in Australia and South Africa producing a few tons each in 1916.

The output and export from New Caledonia are very jumpy quantities, varying from 70,000 to 125,000 tons of ore and matte per year, producing 2,000 to 4,000 tons of pure metal. Out of 800 nickel mining concessions granted in New Caledonia only 40 are actually exploited, and the exports of ore during the last half dozen years have decreased; but whether this is altogether due to mining conditions or to the policy of the International Nickel Company of the United States, which has acquired large interests in these mines, and to whom much of that ore goes for refining in New Jersey, is not clear. One reason why the New Caledonia mines may not be able to maintain production in competition with Canada is that all the materials for smelting and refining—such as coal, soda ash, gypsum, and sulphur—have to be imported, while the long sea voyages both for materials and the shipments of ore or metal are a drawback. At all events M. du Paizat, a French authority, estimated the output of the three smelters of New Caledonia to be equivalent to 2,263 tons in 1912, and the annual average production has remained at about that since 1891. Compare this with an output equivalent to 42,500 tons of pure nickel by Canada in 1916.

The following table shows the eminence Canada has achieved as a nickel-producing country.

Nickel Production in Canada and the World

	Production of Canada Tons	Production All other Countries Tons	World's Production Tons
1840-60....	....	....	An average of 200
1860-70....	....	....	" " 600 to 700
1889.......	415	1,085	1,500
1890.......	713	1,287	2,000
1894.......	2,453	2,547	5,000
1902.......	5,346	3,254	8,600
1906.......	10,776	3,524	14,300
1910.......	18,636	2,364	21,000
1914.......	22,759	7,241*	30,000
1915.......	34,039	4,000	38,039
1916.......	42,000	4,000	46,000

*Est.

The significance of these figures consists not so much in the fact of the extraordinary increase in the output of the Canadian mines, as in the fact that all the increase in the world's supply in recent years has been contributed by Canada alone. The rest of the world has indeed decreased its output during the past three years.

With the exception of a small quantity refined at Thorold, all the nickel mined in Ontario is shipped abroad as "matte" containing the copper with the nickel, and the next stage in the industry will be the establishment of refineries in Canada which will carry the processes of manufacturing in all their ramifications to the finished articles. The most interesting development in this branch is the acquisition of the properties of the Canadian Nickel Corporation, including the Murray mine, by the British American Nickel Company, which will establish both smelters and refineries in Ontario. The new company has a ten-year contract from the Imperial Government for a large quantity of nickel, but the important feature of their operations will be the use in Canada of the refining process worked out by V. Hybinette, and in successful use at Kristiansand, Norway, for the last six years. By this, nickel is refined to a purity of 98.70 per cent., and at a cost of about 13 cents a pound, the metal selling at 40 cents to 45 cents per pound. It is expected that these works, which are located on the celebrated Murray mine, four miles from Sudbury, will be in operation within a year, and the effect will be to establish the nickel industry for the first time on a Canadian foundation.

The International Nickel Company, of the United States, are also erecting refineries in Canada at Port Colborne, Ont., where new works planned to cover 350 acres are now in progress.

The largest share of the nickel mined in Canada—and consequently the largest share of the world's supply—has hitherto been smelted by the Canadian Copper Company, which is owned by the International Nickel Company. The Canadian Copper Company at its works in Sudbury, smelts the ore into a matte (a French word meaning dull, or without gloss), comprising chiefly the copper, nickel, and silver contents, but separated from its coarser metals. The matte is then shipped to the International Nickel Company's works at Constable Hook, N.J., where it is refined, and this refining work employs a large number of skilled hands, and involves the chief industrial processes connected with the nickel trade. This corporation controls not only the Canadian material and the extraction of nickel from United States copper, but it owns the Nickel Corporation, Limited, and the Societe Miniere Caledonienne, both of New Caledonia, which two companies now own 9,217 hectares of mineral land and 3,848 hectares of other land in that island, and hence the peculiar fact of so large a part of the New Caledonia ores being shipped all the way around the world to New Jersey for refinement. The matte product from the Canadian Copper Company and the product of refined nickel from the New Jersey works of the parent company make about two-thirds of all the nickel output of the world. The capital of the International Nickel Company is $62,000,000, and its net profits range between four and five million dollars a year—the figures for 1915 were $5,598,071, and for 1916—over seven millions—besides reserve sums and funds laid by for further exploitations. Its wholesale customers are the chief governments of the world, and needless to say that fact gave it control of the world's market prices and the world's supply.

The International Nickel Company has control, but it has not an absolute monopoly of the world's nickel industry. The Mond Nickel Company, operating by another process worked out by Dr. Ludwig Mond, a British member of Parliament, owns considerable nickel areas in the Sudbury district, has a smelter at Coulson in that district, and ships its matte to Clydach, near Swansea, Wales, for refining. Its chief customers are the British and allied Governments. Its capital is £2,410,000, and on some classes of stock it has paid dividends ranging from 48 to 55 per cent. Then there is the Alexo Mine, on the Porcupine branch of the T. & N.O.R., Temiskaming district, which ships some ore to the Mond smelter, and there are a dozen other companies which own nickel lands but are not yet smelters or refiners.

Industrial Wastes Disposal

By Harrison P. Eddy*

While there are various waste materials resulting from the industries, the term "industrial waste" has come to mean the liquid wastes from the processes employed in industrial establishments. In England they are called "trade wastes"—a term not quite applicable in this country, although occasionally used.

Origin of Industrial Wastes

Many industries employ great quantities of water for various purposes such as condensing, washing of raw stock, dilution of chemicals, transportation and application of materials, and the washing and rinsing of finished products. Some of these uses do not defile the water and it can discharged at will, as for example many condenser waters. Other uses result in a very great change in the character of the water and render it unsuitable for discharge into some waterways.

In paper mills after the digestion of the raw stock with strong chemicals, there remain liquors, highly charged with mineral and organic substances for which the manufacturer has no further use. He therefore seeks to get rid of them in the most expeditious and least expensive manner. The fibrous stock is washed and large quantities of wastes are discharged from the washers, more or less highly charged with substances like those already mentioned. From the paper machines come great quantities of water carrying fine fiber, clay, coloring matter, and other substances depending upon the character of paper made and the processes employed.

*Paper read at the Buffalo Meeting, American Institute of Chemical Engineers, June 20-22.

In tanneries pure water is indispensable, but after use it is highly colored, charged with spent chemicals, and loaded with organic matter. Its burden of impurity is partly in suspension and partly in solution. Wastes from different processes within the same tannery often react upon one another, throwing out of solution substances which in their new physical condition may be deposited in waterways to their detriment. Some tannery wastes of themselves are so resistant to bacterial action that they do not readily putrefy, yet when diluted with the waters of a natural stream, they may become most offensive.

The wastes of woollen mills vary radically from those of paper mills and tanneries, yet they may be the cause of just as serious complaints. The grease and soaps from the scouring of the wool, the spent dye liquors, the soaps from the clothing and the rinse waters in the aggregate, are of great quantity, highly colored, turbid, charged with suspended matter and quite capable of transforming an attractive stream into an unsightly, foul-smelling, and quite unattractive waterway.

Instances like the foregoing might be multiplied almost without end. Some of the other industries which have encountered difficulties in the disposal of wastes are wire-drawing and galvanizing works, carpet mills, dyeing and leaching works, strawboard factories, slaughtering and packing houses, breweries, distilleries, gas works, chemical and explosive works, and mines and coal washing plants.

Effects of Wastes Upon Waterways

The ingredients of industrial wastes may be grouped in three main classes:

Floating and suspended matter.

Substances in solution, in colloidal condition, and in an extremely fine state of suspension.

Bacteria.

Floating and suspended substances may render the waters into which they are discharged, unsightly, and cause deposits. Such deposits, if of organic matter, often deprive the overlying water of a large proportion of its natural content of dissolved oxygen which is necessary for the maintenance of biological equilibrium and the prevention of putrefaction. Decomposition is accompanied by the generation of large quantities of gas, some of which is entrained in the mud until it has accumulated sufficiently to enable it to buoy up large masses, which may be seen floating for a time upon the surface of the water, only to be broken up and redeposited upon the liberation of the gases.

Dissolved substances almost always accompany the suspended matter in industrial wastes. Sometimes they are much more troublesome. They, too, cause the depletion of the oxygen supply, usually through the action of the bacteria of decomposition. Particularly objectionable and difficult to treat are those wastes containing large quantities of very finely divided suspended matter, and colloidal substances. Usually impurities of this class pass along with the waters of the stream into which they are discharged and do not form deposits. However, under some circumstances such ingredients are coagulated and thrown down, sometimes by the reaction of wastes of one process with those of another, and at others by natural physical, chemical, and biological processes going on in the waters.

Most industrial wastes contain bacteria. These may not be pathogenic germs. In fact, they may be decidedly helpful in the problem of disposal, rather than harmful. There are abundant opportunities in some of the industries, however, for the pathogenic organisms to escape in the liquid wastes and thus contaminate the waters into which such wastes are discharged. One of the most dreaded organisms which may be spread about in this manner is the anthrax bacillus, sometimes present in hides, skins and wool. This organism is very hardy and appears to maintain its virility through its spores for many years.

It might appear that, as the industries are the offenders in this field of activity, there would be few complaints from them of the conditions produced by the discharge of industrial wastes.

Just the contrary is true. One of the most common complaints comes from the manufacturer to the effect that an upper riparian industry is rendering the water unfit for use in his plant.

Selection of Factory Sites

Enough has been stated to show how widespread is the trouble in disposing of industrial wastes. When about to establish a new industry or plant, the proprietors usually make thorough investigation of the quality of the water available for their use. The extent of the supply is also generally investigated and often such collateral questions as the amount of power derivable from the passing stream. But how infrequently do they make even a superficial study of the problem of wastes disposal. Yet this may be a greater and more difficult problem than that of water supply.

Expenditures of $100,000 or $200,000 for wastes treatment plants and of $25,000 to $40,000 annually for the operation of such plants are becoming more and more frequent. Capitalizing the annual expenditure of $25,000 at 5 per cent. and adding $100,000 for construction cost, making no allowance for depreciation, it appears that the industry might have expended as much as $600,000 in procuring a site which would not have entailed the necessity of wastes treatment.

The selection of a suitable site for an industry producing large quantities of wastes is a matter of much importance. Even though conditions at the outset appear to be favorable, they may be materially altered by establishment of new industries down stream or by an increase of riparian population below the plant.

Treatment of Wastes

When it is impracticable to afford the wastes sufficient dilution to prevent the production of unsatisfactory conditions, it becomes necessary to so modify the character of the wastes that they will not cause complaint.

One often hears that wastes cannot be so treated; that if a way were known the manufacturer would gladly adopt it. This impression that the wastes cannot be successfully treated is in many cases not true and it may be accepted that they can be so treated as to remove their objectionable and deleterious properties before their discharge into natural waterways.

On the other hand, such treatment may be and often is a very expensive undertaking and one from which the manufacturer naturally shrinks on this account and also because he personally is not familiar with the process or processes necessary to the accomplishment of the object.

Perhaps the most important step in the solution of this problem is the determination of the extent of treatment necessary to meet the requirements of the case. To answer this question intelligently it is necessary to know the character and quantity of the wastes produced, the character of and conditions surrounding the waterway into which they are being discharged, and their effect upon the waters in question.

The next step is to determine how best to treat the wastes to accomplish the necessary results at a minimum cost and, in any event, one which is not prohibitive. There have been instances when the plant proposed for such treatment would have cost a sum about equal to the value of the entire industrial plant of which it was to become a minor part. Such a suggestion is absurd and tends to reduce or extinguish the respect of the manufacturer for the party making the suggestion, for the officials trying to enforce the laws, and even for the laws themselves.

The impurities may be classified again as suspended and dissolved matter and bacteria. For the removal of the suspended matter screening may suffice under some conditions, while others may require the more complete removal by sedimentation. When the substances in suspension are of very light specific gravtiy and finely divided, it may be necessary to resort to chemical precipitation.

Some dissolved matters may be removed by chemical precipitation, while others can be modified in character by chemical treatment without actual removal. If they are organic and subject to putrefaction, bacterial action may be required for their oxidation as in sewage treatment.

Certain wastes are bacterially dangerous and it may be necessary to destroy the pathogens even where the suspended and dissolved matters would cause no harm. In such cases the treatment of the wastes may be all that is essential, while in others it may be necessary even to treat the raw material, as has been suggested in the case of anthrax-infected hides.

It should not be inferred from this discussion that a single process can be selected for each case, for it often requires several to accomplish the desired result.

At one plant where the author's firm has supervisory charge of the wastes disposal department, no less than seven steps have been employed at one time. These are degreasing of a portion of the wastes, sedimentation of the wastes, chemical treatment of the settled effluent, filtration of a portion and dilution of the remainder of the chemical effluent, and finally the introduction of chemicals to prevent the exhaustion of the supply of oxygen in the river.

Advisability of Anticipating Complaint

In many cases industrial establishments which are now of great size have grown from very modest beginnings, often merely a room or two adjacent to a water privilege, which was the primary reason for the selection of the site. As the business has grown through the decades, conditions have entirely changed. What was an abundant supply of water not only for industrial purposes, but also for the dilution of the wastes, has now become barely adequate for industrial purposes alone and the entire flow now passes through the plant and perhaps through several plants more recently built. Thus the entire stream has become a river of industrial wastes rather than, as orginally, a natural river into which a minor quantity of industrial wastes were discharged.

Under some conditions a proscriptive right may be acquired to make certain uses of the water of the river, even though they be more or less hostile to the enjoyment of some privileges of lower riparian owners. The proscriptive right is often advanced in defense of the practice of discharging untreated industrial wastes into waterways and their consequent pollution. Many of the industries, particularly in the eastern part of the country, are of very long standing. The continuous operation of an industrial plant devoted to the same general kind of work for more than a century, can be cited in numerous instances. In comparatively few cases, however, can it be shown that such industries are operating under conditions substantially identical with those of prior decades. Either the character of the business has changed so that processes are different and industrial wastes are greater, or less in quantity and decidedly altered in character, or the business as a whole has become much greater with a corresponding increase in the quantity of industrial wastes. These changes make it exceedingly difficult in most cases to establish a proscriptive right to the acts of which complaint is made.

It should be borne in mind that in no case can one acquire a right, by proscription or otherwise, to create a nuisance. This fact has been the stumbling block upon which many an effort to secure or maintain privileges, through court decisions, has been defeated.

The paramount lesson to be gained from experience in these matters is that it is wise to anticipate complaint of objectionable conditions whether from lower riparian manufacturers influenced by difficulties caused by the character of the water, from a community complaining because of odors and objectionable appearance of the stream, or from the farmer whose cattle will not drink the water, whose crops are killed because of inundation by polluted waters, or whose ditches and natural brooks have become so overgrown with vegetation due to the fertilizing ingredients of the water having their origin in industrial wastes, that they will no longer serve their purpose.

The prudent manufacturer will make it a part of his routine business to carefully observe the effect of the discharges from his plant, upon the character of the water in the river, not alone in his immediate vicinity, but for a considerable distance down-stream. When conditions become noticeably objectionable, he will take measures to remedy them, at the same time maintaining the valuable privilege of utilizing the stream for the disposal of his wastes, to as great an extent as is compatible with the public good and the reasonable use of the waters by lower riparian manufacturers. Such a policy, if intelligently pursued, in many cases will result in avoiding expensive litigation. More important than this, however, is the fact that by maintaining the waterway in a reasonably satisfactory condition, the hostility of lower riparian dwellers may be avoided. Where such a feeling is aroused by objectionable conditions, it may exert itself through legislation or through litigation in such a manner as to require the establishment of exceedingly rigid restrictions as to the use of the river or even drive the industries away. Numerous instances of the latter can be cited.

Program for Solution of Problem

In many cases where manufacturers have been confronted with a serious problem in connection with the disposal of their industrial wastes, they have been inclined to attempt its solution without first acquiring a clear understanding of the scientific principles involved, either in the production of the conditions which caused the trouble or in the processes available for the treatment of the wastes to render them less objectionable. The treatment of industrial wastes usually is a subject entirely different from that with which the manufacturers have to deal in their usual business and in which they are primarily interested, all other matters such as the treatment of their waste liquors being of only secondary interest and importance from their point of view. They have, therefore, often adopted a plant poorly adapted to the use they desired to make of it. Sedimentation tanks, for example, are often found which are entirely inadequate for the purpose, although this process is most simple. All sorts of filters have been designed and constructed, but usually without the remotest conception of the scientific principles involved in the treatment which they were intended to accomplish.

Another fruitful source of misdirected energy has been the desire to recover from the wastes ingredients of value such, for example, as the grease and fertilizing ingredients in municipal sewage. Industrial wastes, like sewage, often contain ingredients which have a market value, and every encouragement should be afforded to the recovery of such products. As economic conditions change in the future there will be a greater need of economizing in this direction, and it is to be expected that processes will be devised for the profitable recovery of such ingredients. The fact that such processes may not be available at the time the problem first presents itself, but will probably be available at some future time, is not a justifiable reason for making no effort for its solution.

Whenever an industry is confronted with a problem of this kind a program for its solution should be carefully worked out before making expenditures upon construction. In fact, the studies necessary to the preparation of such a program may disclose other means of solution, involving relatively small cost.

First a study should be made of the waterway, to note its condition and physical characteristics, such as size, velocity of flow, depth and temperature, and a similar study of wastes to determine their quantity and character. With the information gained in this manner it will be possible to form an opinion as to the extent of treatment required to meet existing conditions.

Next, the kind of treatment and the plant required to provide such treatment, should be determined. The methods selected should be those required to give the results which may be desired within a reasonable period of time in the future when perhaps conditions have become decidedly different from those obtaining at the time the investigation is made. Such methods should always be selected and reported with the clear reservation that new and better processes may subsequently be devised.

Following the selection of methods should be the construction of plant. Here it may be wise to proceed progressively, building first the system of drains required for the collection of the wastes and for their discharge at a single point. After this has been done further investigations based upon the measurement and analyses of the combined wastes, may be desirable. When the collecting system shall have been completed, it will be possible to provide the first part of the treatment process, such, for example, as screening or sedimentation. After this has been accomplished still further investigations may be desirable to determine, first, the efficiency of the plant already installed and, second, the next process of treatment which should be provided and the probable results to be obtained.

However much or little may be required, it is important to build in accordance with an intelligently devised plan and in harmony with such additional processes as may follow. Thus many expensive mistakes will be avoided and advantage taken of all opportunities to provide an economical arrangement of plant. The following of such a course will often result in avoiding expensive pumping of the wastes, or the treatment of excessive quantities due to the inclusion of relatively clean waters which may not require treatment under the local conditions.

The final step, and undoubtedly the most important, is the intelligent operation of the plant. Whether the processes involved are simple or complex, the supervision and control of operation should be based upon a knowledge of the conditions in the river, the character of the wastes and the scientific principles involved in their treatment. The object to be attained and extent of treatment necessary at the time of its accomplishment should be kept constantly in mind. Many thousands of dollars in the cost of operation may be saved in this manner

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Iron Pyrites Deposits in Southeastern Ontario*

By P. E. Hopkins

The earliest mining of iron pyrites in Ontario was done in 1868 on the Billings property near Brockville. The mines were closed down in 1879 under the assumption that they were exhausted. Many other pyrite deposits have been worked for gold, iron or copper at some time. The steady pyrite industry of the Province began in 1900 when ore from the Bannockburn mine was produced. Mines in Hastings county have been steady producers since that time. An acid-making plant has been in operation at Sulphide since 1907 by the Nichols Chemical Company for the treatment of its ore at Sulphide. The company also buys the ore mined from other properties in the neighborhood. Another plant for treating custom ore is operated by the Grasselli Chemical Company at Hamilton. These two plants treat the bulk of the eastern Ontario production, the remainder being shipped to the United States.

Recently a large percentage of the production has been coming from the Vermilion Lake deposits in northwestern Ontario, the ore being shipped to United States ports on the great lakes. Another property, the Goudreau lake deposits, has been recently developed and expects to commence at once supplying large tonnages. The Helen mine, operated by the Algoma Steel Corporation, produces some pyrite which is treated in its plant at Sault Ste. Marie.

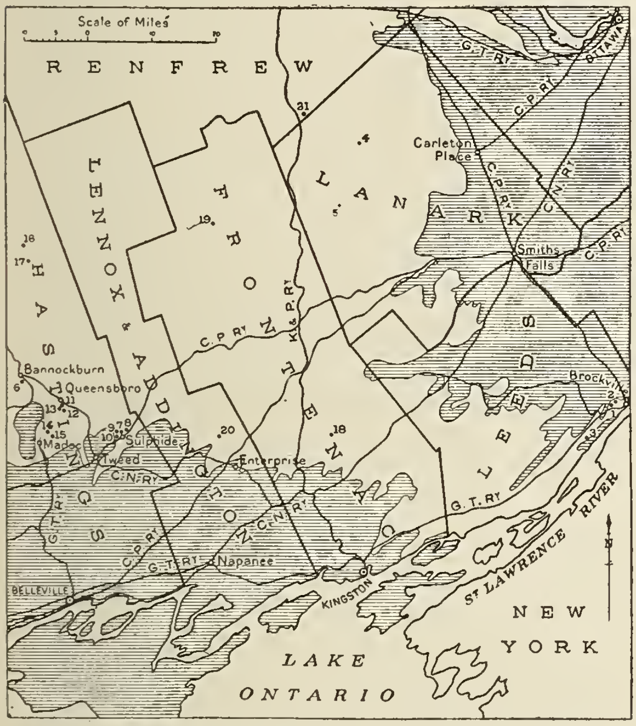
The iron pyrites resources of Ontario are of considerable extent and value. In the last fifteen years 538,755 tons, worth $1,438,122, have been produced, the greater part coming from southeastern Ontario. During the coming years there will undoubtedly be a steady increase in production. The war has had a stimulating effect on the demand of the United States for pyrite from Ontario.

* [illegible] Bureau of Mines Report.

Brockville Section

The Brockville Chemical Company, No. 1, began mining for pyrite on the Billings property in 1868. The ore occurred in a series of lenses conformable to the lamination of a highly foliated pink granite gneiss. The lenses which consist of pyrite and calcite in parallel lines, strike northeast, and dip to the southeast The richer shoots of ore were gouged out and no timbering was done. The main pit was sunk 250 feet. The ore was used for making acids in Brockville, the sulphuric and mixed acids being used at the fertilizer and dynamite works in and near Brockville. Operations of all kinds ceased in 1880. The evidence of the men who worked in the old pits is to the effect that they were never competely exhausted.

Sloan Prospect, No. 2.—A band of gossan strikes in a northeast direction across the property and dips to the southeast. The 20-ft. inclined shaft passes through 6 or 8 feet of gossan. There is a width of 3 feet of solid pyrites on the foot wall, the remainder of the shaft being in alternating bands of pyrite and crystallized calcite in equal amounts. Eighty tons of ore, running 40 per cent. sulphur, were shipped to Buffalo and Capelton.



Map of a portion of southeastern Ontario. The hatched area is Paleozoic, and the numbers indicate the relative positions of the iron pyrites deposits mentioned in the Pre-Cambrian.

The Buffalo-Brockville Mining Company shipped a small tonnage from this lot during 1911 and 1912.

Shipman Prospect, No. 3.—The pyrite, which is much intermixed with pyrrhotite and country rock (gneiss), has been mined from an irregular pit 40 feet long and 30 feet wide.

Lanark County

McIlwraith Mine, No. 4.—The deposit, which is covered by 14 feet of gossan, strikes north of east along a contract between diorite on the south and crystalline limestone on the north, and dips 60° to the south. It was first opened for gold. In 1899 and 1900 the shaft was deepened to 75 feet and a 150 ft. tunnel run along the strike of the deposit, disclosing a length of over 90 feet of clean high-grade pyrite inclosing lenses of quartz. A 12-ft. crosscut to the south did not pierce the width of the deposit. Three carloads of ore were shipped. Samples from the dump and tunnel, by E. L. Fraleck, gave 38.86 and 42.60 per cent. of sulphur respectively.

Ladore Prospect, No. 5. A heavy fahlband strikes north of east along the contact of a coarse amphibolite and a fine-grained gray granite. The trenches and shallow pits expose a gossan in the form of bog iron ore, but pyrite in quantity was not located. The fahlband continues into the adjoining lot to the east along a contact of crystalline limestone and granite.

Hastings Section

Bannockburn Mine, No. 6. in 1898, the property was opened as an iron mine, 11 carloads of limonite, running about 38 per cent. in iron and low in sulphur, having been shipped. This ore was merely a gossan 8 to 15 feet deep which capped iron pyrite deposits. The pyrites occurred as two lenses at right angles to each other, but conforming in strike and dip with the inclosing rock, a chloritic schist. Limestone covers the apex of the fold of the lenses. The south lens, which is 160 feet long and 8 to 15 feet wide, was mined to a depth of 275 feet. During the six years of operation about 580 tons of pyrite per month were shipped, all of which went to the General Chemical Company at Buffalo. The ore did not fall off either in grade or quantity with depth, but, owing to the hazard of open-pit mining, operations were abandoned in August, 1905.

Hungerford Mine. No. 7. This property was opened forty years ago as a gold property, and a smelter was erected to extract gold from the barren pyrite. The Nichols Chemical Company re-opened the mine in June, 1903. Owing to some difficulty about the title the mine was closed down in August, 1904, but operations were resumed in August, 1905, and have since been continuous. Since 1907 acid works have been in operation for the treatment of company ores, and other ores in the vicinity.

Passing through this property, and extending beyond, is a large fahlband striking 25° north of east and traceable for two miles. Level farm land to the south is underlain by garnetiferous crystalline schist cut by massive diorite, into which, 500 yards north of the deposits, has been intruded a pink hornblende granite that rises above the country in a series of rugged hills, locally called the Bald Mountains. The granite has protected the deposits from denudation. The deposits are strung along the contact of the diorite and the schist, the strike of lenses, contact, fahlband, and schist being identical.

The pyrite occurs in three parallel deposits striking with the schist and dipping 60° to the south. The middle one, which does not outcrop on the surface, lies 85 feet from the south vein and 45 feet from the north deposit. The north deposit, upon which most of the work has been done, varies in width from 6 to 22 feet. It has been exploited to a length of 620 feet, and to a depth of 575 feet, and the ore still continues. The length as indicated on the surface is about 500 feet. There are now two shafts on the property and about 3,500 feet of drifting has been done on the ore bodies on the six levels. During 1915 work was confined to stoping on the north vein and drifting on the south vein.

The ore is coarsely granular and makes a large percentage of fines. The main impurity is calcite, although there is also some quartz present. A small quantity of pyrrhotite occasionally occurs, mainly in the north lode next the foot wall. The average percentage of run of mine ore is about 35 per cent., the fines being much higher.

The acid works have been successfully operated since their completion in July, 1907, and machinery has been installed at various times to increase the capacity and to make new acids At present sulphuric, hydrochloric, nitric and mixed acids are made by the contact process and shipped in the company's tank cars to various parts of Ontario and Quebec.

Electric power supplied by the Seymour Power and Electric Company is used throughout the mine and acid works.

The Canada Mine, No. 8, which was formerly the Oliver prospect, adjoins the mine operated by the Nichols Copper Company on the east, and is located on the same fahlband. The lode strikes east and west and dips 50° to the south. During part of 1907, the Canadian Pyrites Company sank an inclined shaft on the deposit to a depth of 110 feet and did some drifting on the 85 ft. level, together with some diamond drilling. The deposit varies from 4 to 7 feet in width. The ore on the dump is pyrite with a little pyrite and pyrrhotite, which will grade upward of 40 per cent. in sulphur.

The Hungerford Western Extension, No. 9, was fairly well prospected in 1906 by means of surface trenches at regular intervals along the strike of the fahlband. The western lens had been exploited by surface trenches to a length of 500 feet exhibiting, near the line between the lots, a width varying from 16 to 18 feet of ore, which will grade from 42 to 44 per cent. sulphur. The only impurity consists of small included lenses of calcite.

The Ontario Sulphur Mines, Limited, No. 10, commenced work in March, 1908, and continued until the end of 1911. The pyrite deposit on which work has been done is located about one-half mile west of the Hungerford mine. It appears to be a lens pitching towards the south-east. A shaft has been sunk 300 feet, with 225 feet of drifting on the 100 ft. level and 250 feet on the 200 ft. level. According to A. W. G. Wilson, "The total shipments from the property up to the first of May, 1911, have been 4,821 long tons of ore averaging 36½ per cent. sulphur." In one place the deposit is 30 feet wide.

The Sulphide Chemical Company operated the property from the spring of 1913 until the following November, during which time the mine was dewatered and considerable ore was raised and shipped. No work has been done since.

The Queensboro Mine (Blakely), No. 11, up to the autumn of 1906 shipped 65 carloads of pyrites running about 45 per cent. sulphur. Mine operations ceased in 1908. The pyrite occurs as a series of lenses up to 15 and 20 feet wide along the contact of a garnetiferous schist (Grenville in age) and an intrusive pink felsite (post-Hastings in age). The ore is dense, the only impurity being thin veinlets of quartz. In another place some zinc blende is interbanded with the pyrite. The main shaft is 135 feet deep with about 175 feet of drifting on the 50- and 85-ft. levels.

The Canadian Sulphur Ore Company's Pyrites Mine, No. 12, was discovered in 1906 by Stephen Wellington while prospecting for iron. Under the gossan, merchantable iron pyrites was discovered, from which a car load of iron pyrites was shipped in 1908. Later, the Canadian Pyrites Syndicate bought the property, installed a small plant and shipped a few hundred tons of pyrite. In the spring of 1910 the property was handed over to the present company, which began shipping ore three months later, and has continued to the present. The mine is equipped to produce 100 tons of iron pyrites per day, yielding 40 per cent. of sulphur. Since December 11, 1912, the mine has been run by electricity supplied by the Seymour Power Company. A branch line two and a half miles in length from the Bay of Quinte Railway near Queensboro to the mine was completed in 1913. The ore is shipped to the Nichols Chemical Company's acid plant at Sulphide, eleven miles southeast, and to the chemical companies at Hamilton and Detroit.

The pyrite is mined by underground and open-pit methods. The development work consists of three shafts and two open cuts, with some diamond-drill borings. Nos. 1 and 2 shafts, which are 75 and 100 feet deep, respectively, have been abandoned for some time. The work of late years has been confined to shaft No. 3, and the two open pits. The vertical shaft, No. 3, is 250 feet deep with about 800 feet of drifting on the 60-, 120-, and 200-ft. levels. The pyrite deposits are marked by gossan outcrops from 2 to 30 feet in depth. Beneath are the pyrite deposits, which occur as lenses in contact with rusty schist to the south and white quartzite to the north (both Grenville in age) near an irregular post-Hastings intrusion of gray felsite. The strike of the deposits is slightly north of east, while the dip is almost vertical, inclining slightly to the south. Lenses vary in width up to 25 feet, but horses of country rock are frequently inclosed in the pyrites.

The ore is high grade, very little cobbing, if any, having to be done. Ores have been shipped running 40 to 48 per cent. sulphur.

The deposits are free from impurities such as arsenic, zinc, lead, copper and calcium. The pyrite burns satisfactorily, and is in good demand by sulphuric acid makers.

The Davis or Palmer Deposit, No. 13, is in the Grenville limestone. On the surface the pyrite is 2 feet in width; 9 feet down there is said to be a deposit 15 feet wide. A few carloads of pyrites were shipped from a pit sunk on the property.

The Farrell Deposit, No. 14, lies in and conforms with the schist which strikes northwest. Test pits for a distance of 200 feet show either gossan or pyrite. A shaft has been sunk to a depth of about 25 feet. A sample collected by E. L. Fraleck, representing an average of 75 per cent. of the dump (which consists of about 40 tons), yielded 40.64 per cent. of sulphur. The deposit maintains a uniform width of 5 feet, the only impurity being crystalline limestone.

The McKenty Prospect, No. 15, shipped hematite forty years ago. A pit at one time 60 feet deep has caved in. An examination of the cull dump reveals the fact that all large lumps of apparent hematite have, when broken, a core of pyrites. In E. L. Fraleck's opinion, this is one of many instances throughout eastern Ontario where hematite constitutes the gossan capping of a sulphide orebody.

The Little Salmon Lake Deposit, No. 16, occurs in a chlorite schist which strikes east and west, the main rock in the area being a white crystallized limestone, probably of Grenville age. A trench, 40 feet long, uncovered pyrite 15 feet in width. An average of 75 per cent. of the pyritiferous material yielded 38.83 per cent. of sulphur.

On the Gunter Property, No. 17, a shaft, 20 feet deep, has been sunk on a deposit consisting of alternating bands of quartz and pyrite 5 feet wide. A sample representing two-thirds of the dump yielded 39.50 per cent. of sulphur.

Snooks Prospect, No. 18.—A fahlband strikes northeast through a coarse, impure crystalline limestone, and can be traced across the adjoining lot 6 to Desert Lake. On the road allowance, 7 feet of massive pyrite and 25 feet of pyrite mixed with crystalline limestone were uncovered in obtaining material for the road.

On the Stalker Prospect, No. 19, is a well-defined fahlband, containing some hematite, and striking east and west. A small test pit has been sunk on a lens of pyrite which shows at that point a width of 6 feet.

The Foley Deposit, No. 20, occurs in an outlier of crystalline limestones surrounded on all sides at short distances by granite. The irregular deposit consists of small masses of pyrite and pyrrhotite in about equal proportions. The work consists of a pit, 80 feet long, 40 feet wide, and 10 to 15 feet deep, sunk on pyrite and pyrrhotite in about equal proportions intermixed with pyroxene, calcite, mica and molybdenite.

The Caldwell Prospect, No. 21, was opened in the fall of 1915 by Thomas B. Caldwell of Lanark. About 500 tons of ore have been mined, but the sulphur contents are not known.

Electric Melting of Brass and Ferro-uranium

By an agreement with Cornell University representatives of the United States Bureau of Mines have been investigating the electric melting of brass. The furnaces now used in the brass industry cause a large loss of metal by volatization, and require crucibles, which have become very costly since the outbreak of the war. Long series of experiments have indicated that the use of a suitable electric furnace might materially reduce the metal losses and avoid the use of crucibles. The Bureau of Mines is now testing an electric furnace built on the design worked out in the laboratory tests. This furnace is of commercial size, is installed in a brass foundry, and is being tested with special attention to its suitability for use on such brasses as are used for cartridges and shrapnel cases.

Another electric furnace problem studied by the Bureau has been the production of ferro-uranium from the uranium oxide obtained as a by-product in the extraction of radium from its ores. Ferro-uranium is used in making uranium steel, which is said to be used by Germany for the liners of big guns which will stand up at a rate of fire so rapid that other steels fail.

As soon as the test on the large brass furnace is completed, work will be begun on the production of sample lots of uranium steel and other special steels, for test by the Bureau of Ordnance of the War Department as to their suitability for use in guns. The work on gun steel will also require the use of electric furnaces. It has not yet been decided whether this work will be done at Cornell or at one of the other Universities which have offered facilities for this work.

New Motor Fuel From Kerosene

William Augustus Hall, a London chemist, has invented and patented a process for making a motor fuel from kerosene that is claimed to be suitable for use in high speed internal combustion engines.

The process consists in taking the fraction of kerosene boiling up to about 220° C., and passing this fraction, which constitutes the spirit or drying portion of the oil, between very small interstices under a very high pressure, which may be from 1,000 pounds per square inch to even 3,000 pounds per square inch or more, in the presence of a gas containing hydrogen or a hydrocarbon gas at a temperature not above that of the lowest boiling point of the liquid, say 100 deg. to 120 deg. C.

By this means there results a combination of the gas and the liquid hydrocarbon, causing a certain amount of hydrogenation of the latter, the result being a considerable lowering of the flash point of the liquid hydrocarbon and an alteration of the odor.

Description of Apparatus

Apparatus for producing this combination of the gas and oil may consist of a form of homogenizer of the kind used in homogenizing milk, consisting of a series of metal disks or plugs between or through which the liquid is forced in the presence of the gas. The metal disks or plugs are preferably made of nickel and may be very finely grooved, i.e., may be provided with mere scractch marks. The gas employed may be hydrogen, or any coal gas containing hydrogen, or hydrocarbon gas such as oil gas or acetylene.

The product obtained is distinguished by its much lower flash point than the fraction of kerosene having this boiling range, as also by the loss of the kerosene odor and the production of a new odor and a liveliness of the fuel not possessed by kerosene when used in a high-speed internal combustion engine.

The Manufacture of Pure Molybdenum

At the meeting of the New York section of the American Chemical Society, held at the Chemists Club, on June 8th, C. H. Humprhies of the Commercial Research Company, Long Island City, read a paper on "Molybdenum," confining himself to the manufacture of the purer grades of that metal. He reviewed briefly the geology of molybdenum ores and showed samples of molybdenite and wulfenite. Molybdenite, M(S), is the principal source of metallic molybdenum. It is reduced by carbon in an electric furnace. The ordinary methods, however, produce a metal which contains some carbide, and in order to obtain pure molybdenum the trioxide or ammonium molybdate has generally been used, as the starting point. The molybdate is made from the sulphide and this is reduced in an atmosphere of hydrogen in an electric furnace, producing a crystalline material which passes through several more stages of purification. The process is analagous to the well known General Electric tunsten reduction process.

This crystalline product is placed in a nickel or nickel-plated boat in a gas furnace and heated to 900 to 1,000 deg. C. It is then rushed and screened and reduced again for several hours at 1,200 deg. C. It is then examined for oxide by inspection. It appears streaky if oxike is present. If a blue tint is observed on shaking in water oxide is present.

After the final reduction the metal is powdered, then pressed in a steel mold and heated in an electric furnace for about a half hour at 1200-1300 deg. The metal sinters and becomes hard, but is not yet suitable for working. It is then placed in a furnace, the air displaced and a current of about 100 amperes is passed through the metal. It shrinks and forms a true molybdenum rod. It is then swaged and made into smaller rods, wire, foil, etc. The swagging is done hot from the electric furnace at about 1400 deg. The metal runs through dies of high speed steel down to 0.001 in. The smallest size for practical purposes is 0.005 to 0.01 in.

If the pure metal is heated to 1200 deg. several times and quenched the surface can be made glass hard.

In discussing the effect of alkalies, the author said that some molybdenite contains calcium and barium, and that these are hard to keep out of the metal. They prevent working of the metal when present even in the hundredths of a per cent.

The author mentioned an interesting possible use of pure molybdenum, i.e., as a substitute for platinum in jewelry. tI is just as beautiful and is permanent and can be produced at present for 25 cents per gram. The main drawback is the difficulty of soldering. It can be welded in an atmosphere of hydrogen, but the method is cumbersome. Another possible use is in X-ray targets. The oxide is used with tannic acid in coloring shoes.

Bounties

Canada's expenditure in the nature of direct appropriation for the encouragement of certain industries amounted to over twenty-one and a half million dollars for the twenty years ended March 31st last, according to the official statistical report. This amount was handed over to seven industries in lieu of protection otherwise afforded by the custom tax. The amount paid to producers of pig iron was $7,097,041, on a production of 5,431,547 tons, or at the rate of $2.65 per ton. Steel, 48,448,780 tons, at the rate of $1.28 per ton. Manufactures of steel $2,868,122 for 499,312 tons, or $5.74 per ton. Lead $1,979,164 for 1,187,083,350 pounds, or approximately 3 cents a pound. Binder twine, $367,962 for 108,048,641 pounds, or approximately 3 cents a pound, and crude petroleum $2,537,012 for 169,134,123 gallons, or 15 cents a gallon. These figures are illuminative in that they indicate the approximate rate paid by Canada directly and indirectly in developing the industrial and commercial interests. Reduced to such cold figures the bill appears tremendous, but the importance of these industries in the development of this country more than justifies the means. We are now faced with the problem of encouraging the building of ships in the Dominion. For the moment, the question of price is scarcely considered, because of the urgent need for ocean going vessels, but consideration of after-the-war conditions is necessary, and it is recognized that Canadian shipbuilders will require some assistance in their competition with other countries. The principle of paying bounties on the ships built in Canada appears to be the only feasible way in which such assistance can be granted.

The bounties on iron and steel, which were the heavy items, expired several years ago. The bounties paid in the fiscal year 1915-16, amounted to only $109,236.68, of which $109,176.80 was on crude petroleum, and $59.88 on lead. For the last fiscal year, 1916-17, the bounties paid were on crude petroleum, amounting to $101,428.28.

The Great White Coal of British Columbia

By G. R. G. Conway, M.Inst., C.E., M. Can. Soc. C.E.

British Columbia, owing to its wonderful topography, can claim to be one of the greatest water power countries in the world. The great mountain ranges, rising high above the limits of perpetual snow, form inexhaustible storehouses of power, and on the Pacific coast slope the abundant rainfall and magnificent lakes and rivers have created opportunities for developing those vast natural sources of power for the use and convenience of man, in boundless fashion.

The Province, according to the latest estimate of the Surveyor-General, comprises 372,640 square miles, and the population is still short of the half-million mark, but even in these early days of her hstory the most indifferent observer realizes that British Columbia's destiny is bound to be a great one. The possession of these water-powers gives her people untold potential wealth, and the knowledge of this ownership should be a stimulating influence in the development of the many other natural resources which Nature has so lavishly bestowed upon the great coast province. Her climate, which British Columbians do not advertise as they should advertise, that is to say, year in and year out, in the convincing manner of the "sunny" Californians —is one of her greatest assets, in spite of the heavy rainfall which yields in some of the coast regions as much as 120 inches of rain per annum, and in other parts no more than 15 inches. The heavy rainfall though is distributed very evenly, so that no prolonged periods of drought cause anxiety, and the estimates of a river's flow are wonderfully uniform if based upon a number of years' observations.

Only those who have studied water power problems in Canada realize that already there have been installed near the lower mainland in proximity to Vancouver and Victoria hydro-electric plants capable of producing 1 horse power for every two persons now resident in the province. These plants have made Vancouver, Victoria and New Westminster among the best electrically served cities in the world, giving them an abundance of cheap electrical energy available for manufacturing and other purposes at a day's notice.

The application of electrical power in the province, in addition to the well-known uses in the cities for electric light, electric street and interurban railways, and for industrial purposes, is largely used for mining, smelting and the manufacture of wood pulp and newspaper, the manufacture of lumber, in the canning industry, and for the smelting and reduction of copper ores.

The accompanying table recently compiled is from a little book entitled, "The Water Powers of British Columbia," which the writer has prepared for the water power branch of the Dominion Department of the Interior:

In addition to the above, many other schemes of development have been designed which will bring the total of developed powers up to nearly 500,000 horse power—schemes that will be prosecuted with energy when the improvement takes place in the financial conditions that will follow a triumphant peace.

An approximate estimate of the available power even at a conservative figure cannot be placed at much less than three million horse power. It will therefore be seen that the actual horse power utilized at the present time comprises only eight per cent. of this great total. The whole of these plants have been constructed during the past nineteen years, and about half the total of existing powers has been placed in service during the past six years.

The Kootenay's Light & Power Company's plants at Bonnington Falls, on the Kootenay River and Kettle River, which have at the present time a capacity of 23,000 horse power, can justly claim to have been the first plant of any magnitude in the province. The original hydraulic and generating units were placed in operation early in the year 1898. The Goldstream plant of 3,000 horse power, forming part of the British Columbia Electric Railway Company's system to supply the City of Victoria with light and power, although under construction simultaneously with the Bonnington Falls plant, was placed in operation a few months later during the same year.

Capacity of the Principal Water Powers as at Present Developed in the Province of British Columbia

Owner	Situation	Present Capacity Installed Horse Power	Purpose for Which Energy is Utilized
West Kootenay Power & Light Co., Ltd.	Kootenay River & Kettle River, near Nelson	23,000	Mining, smelting, light and industrial power.
British Columbia Electric Ry. Co., Ltd.	Goldstream, near Victoria	3,000	Light, industrial power and street railways.
British Columbia Electric Ry. Co., Ltd.	Lake Buntzen, Burrard Inlet	84,500	do.
Western Canada Power Co., Ltd	Stave Lake, near Ruskin	26,000	Indutrrial power: (26,000 h.p. now being added).
British Columbia Electric Ry. Co., Ltd.	Jordan River, Vancouver Island	25,000	Light, industrial power and street railways.
Ocean Falls Company, Ltd	Link River, Ocean Falls	11,200	Wood pulp and lumber manufacture.
Canadian Collieries (Dunsmuir), Ltd.	Puntledge River, near Nanaimo	9,400	Coal mining.
Powell River Company, Ltd	Powell River	24,000	News print manufacture.
Granby Consolidated Mining, Smelting & Power Company, Ltd	Falls Creek, Granby Bay	7,325	Copper mining and smelting.
City of Nelson	Kootenay River, near Nelson	4,000	Mining, industrial power and light.
City of Kamloops	Barrier River, near Kamloops	2,800	Light and industrial power.
Britannia Mining & Smelting Co., Ltd.	Britannia Creek, Howe Sound	2,735	Copper mining and reduction.
Hedley Gold Mining Company	Similkameen River, near Hedley	2,650	Gold mining.
City of Prince Rupert	Woodworth Lake, near Prince Rupert	1,650	Light and industrial power.
Swanson Bay Forests Wood Pulp & Lumber Mills, Ltd	Swanson Bay	1,250	Wood pulp and lumber manufacture
City of Revelstoke	Illicilliwaet River near Revelstoke	600	Light and industrial power
Other small developments described below		890	Mining, municipal and hotel lighting, salmon canning.
Total horse power at present installed		230,000	

Lower Bonnington Falls, Kooteney River Development

The Lake Buntzen plant of the Vancouver Power Company—a subsidiary company of the British Columbia Electric Railway Company—which supplies power to the City of Vancouver, and the adjoining municipalities, was first placed in operation in 1905. This plant was originally designed for 12,000 horse power, and was at that time considered of sufficient magnitude to meet the needs of the district for many, many years. Owing to the enormous expansion of Vancouver and the surrounding territory, the Lake Buntzen plant has now grown to 85,000 horse power, while the City of Victoria is now supplied from Jordan River, forty miles east of the city, and together with the Goldstream plant has power available up to 28,000 horse power installed to meet the industrial needs of the community.

It is estimated that within reasonable distance of the cities of Vancouver and Victoria, without going beyond the present day limits of long distance electrical transmission, 750,000 horse power can be economically developed—a possibility that will place these cities among the most favored for the expansion of many existing and future industries.

Among other notable powers of the province is that at Powell River, where 24,000 horse power is utilized in the manufacture of pulp and newspaper. At Ocean Falls 11,000 horse power is utilized for the same purpose.

At the plants of the Granby Consolidated Mining Smelting & Power Company, Falls Creek, and the Britannia Mining & Smelting Company at Howe Sound, copper smelting is a large and thriving industry.

The Dunsmuir Collieries, which may be said to produce a commodity used in composition with the electrical energy created by the Great White Coal, utilize nearly 10,000 horse power at their mines near Nanaimo.

In the construction of many of the larger hydro-electric plants big engineering problems had often to be solved, e.g., in the construction of the Lake Buntzen plant a tunnel two-and-a-half miles long through granite mountains 4,000 feet high, connecting Lake Coquitlam and Lake Buntzen, was necessary to convey the stored water from the Coquitlam watershed to Lake Buntzen—this tunnel being the longest of its kind in the world. To store water in Lake Coquitlam to feed the thirsty water wheels an earth dam 100 feet high was necessary. This dam, constructed by means of clay sluiced between huge toes of granite rocks by hydraulic giants, is as massive and secure as the adjoining hills.

On Vancouver Island, for the purpose of obtaining sufficient storage of water for the Jordan River plant supplying the City of Victoria with light and power, a reinforced concrete dam of the Ambursen type, 130 feet high, was necessary. This dam has the distinction of being the highest of its type in Canada, being exceeded in height by only one other reinforced concrete dam, viz.: the La Prele Dam in Wyoming, and it can further claim to be the highest steel concrete dam in the British Empire.

Ocean Falls, Ocean Falls Company, Limited

The Stave Falls plant of the Western Canada Power Company has had to deal with the difficult problem of controlling the heavy floods that flow during the early summer when the snows being to melt. At this plant, where 26,000 horse power has already been installed, two large turbines of 13,000 horse power each are being added to the plant at the present time, and further additions ultimately will bring its capacity up to not less than 80,000 horse power.

Many of the available water powers in British Columbia are capable of being developed under a high "head"—that is to say, the maximum available fall of water that can be obtained is being used. For example, at the Britannia mines 1915 feet has been utilized, and at Jordan River 1,145 feet, making these two water powers the highest head plants in Canada.

Coquitlam Lake with dam in background, Coquitlam-Buntzer Development

Among the chief undeveloped powers of the province are the Campbell River Falls on Vancouver Island where, with proper conservation of water in Buttle's and Upper and Lower Campbell Lakes, as much as 200,000 horse power can be utilized on a peak load. These lakes are in the heart of the great Strathcona Park which the Provincial Government is now opening up with excellent roads, and with careful designing the necessary dams could be made an attractive feature of the park, enhancing—if that were possible—the scenic value of the beautiful surroundings.

Another interesting development which has been designed for supplementing the power supply in Vancouver is that known as Jones Lake, ninety miles east of the city, where 35,000 horse power can be obtained by harnessing the waters of the lake so that a fall of over 2,000 feet can be utilized.

The Fraser River too has unlimited possibilities for the development of water power—in fact the whole province is an exhaustive field for the study and utilization of that power, a field which is now being investigated by the Water Power Branches of the Provincial and Dominion Governments, and also by the Commission of Conservation.

It is, however, impossible here to refer to these powers in detail. It is sufficient to say that there is probably no part of the province within range of any possible industry that cannot be served economically by hydro-electric power.

With these opportunities it is obvious that British Columbia is a fertile field for the establishment of immense industries. Take for, example, what Norway and Sweden have done to use their water powers, particularly in one industry alone, viz.: the fixation of atmospheric nitrogen for the production of nitric acid and nitrates. A small plant, established in Norway in the year 1903, utilizing only 25 horse power for this purpose, has grown so rapidly that now hydro-electric power amounting to 400,000 horse power is used in its production alone.

The world's consumption of nitrogen in various forms is about 750,000 tons annually, representing a value of about two hundred and fifty million dollars, and the demand is yearly increasing by about five or six per cent. Four-fifths of this supply has hitherto come from Chile, but within the new trade routes opened by the Panama Canal there is no reason why British Columbia cannot seriously compete on the most favorable terms in the European market with the natural salt petre of Chile. These Chilean fields are not unlimited. They are yielding now over three million tons annually, and in a few years' time the supply must be exhausted and, in consequence, the fixation of atmospheric nitrogen, begun at Niagara Falls in 1902, is now a great national duty for Canadians to undertake so that our vast water powers may produce fertilizers to assist the agricultural progress of the Dominion.

Great possibilities, too, are being utilized in the province for the smelting and reduction of ores, and in the electrolytic refining of British Columbia copper, which was formerly done in the States. In the production of calcium carbide—a great Canadian industry requiring further development—the possibilities are equally advantageous.

British Columbia, with its excellent harbors and its many navigable rivers, assisted by the great transcontinental railways, requires many new industries, and the example of rugged Norway in embracing every opportunity to develop industries that require economical water power should be emulated. She has within her borders all that is of material necessity to make a great province supporting in time to come in prosperity eight or ten millions of people, people who will, we hope, be strong, self-reliant and happy representatives of all that is best in the Dominion.

Norton Company Erects Another Unit

Chippawa, May 31—Water was turned on in the new Norton Company water works system during the month, water being available in all the company houses and plant.

Three Contmetal Jewel Filters have been installed, a sand and lum process being used. This removes all sediments, leaving the water absolutely clear. The water then goes through a chlormation process and is completely sterilized. Three electrically-driven verticle centrifugal pumps force the water through the system and being instaled below water level they never lose their priming.

Last year the Norton Co. erected three units for the production of crude abrasive, and this year will erect another unit. In fact forms are already well up, but no concrete has been poured. The plant, when this unit is complete, will be a huge one.

The Nutritive Value of Oleomargarine*

By Prof. J. F. Snell, Macdonald College

The purpose of the inventor of Oleomargarine was to prepare a cheap and wholesome substitute for butter for the use of sailors and other poor people in France. That in cost and wholesomeness the product as now manufactured and sold in most civilized countries fulfils the aspirations of the inventor is admitted, so far as I have been able to discover by all competent authorities on foods. The necessity of using as raw materials fats free of all odor and taste so that the odor and taste of the finished product may be identical with that of the milk, cream or butter with which these fats are churned, precludes the use of any raw materials which are not clean and fresh.

The merits of modern oleomargarine from the sanitary standpoint cannot therefore be disputed. Examination of the following British and American works reveals no divergence from this opinion.

Blyth, Foods, London, 1903.

Gilman Thompson, Practical Dietetics, New York, 1906.

Wiley, Foods and their Adulteration, New York, 1911.

Tibbles, Foods, London, 1912.

Sherman, Food Products, New York, 1914.

Bailey, Source, Chemistry and use of Food Products, Philadelphia, 1914.

Hutchison, Food and Dietetics, London, 1916.

Of these authorities I shall quote only Wiley and Hutchison. Dr. Wiley, whose sympathies are certainly not always with the manufacturer says:

"There has been a constant disposition on the part of dishonest manufacturers and dealers, since the time when oleomargarine became a commercial commodity, to sell it as butter. With a more rigid national and state inspection, it is reasonable to hope that this fraudulent use of oleomargarine can be avoided, and the pure, unadultered article under its own name be supplied to those who prefer it either on account of its properties or its price. The components used in the manufacture of oleomargarine when properly made, are all wholesome and digestible materials such as are consumed in eating various food products. It does not appear therefore, that any valid objection can be made against the use of oleomargarine from a physiological or hygienic standpoint."

Dr. Hutchison, whose comment is perhaps the most comprehensive of those I have examined, says:

"Margarine owes its orgin to the ingenuity of the French chemist Meges-Mouries, and was first manufactured under his directions for use in the French Navy in the year 1870.

It has the following composition:—

Water	9.3	per cent.
Proteid	1.3	"
Fat	82.7	"
Ash	6.7	"

"It will be observed that the proportion of fat is exactly the same as in an average specimen of butter, and the only point in which the two differ is that butter has a much higher proportion of the soluble and volatile fatty acids. There is no reason to believe that this is in any way to the disadvantage of margarine as a food. The fat of our bodies contain no soluble fatty acids, and human milk fat is almost destitute of them too. Indeed, one might almost regard the absence of butyrin as a point in favor of margarine, for when butter becomes at all rancid butyric acid is liberated from the butyrin, and butyrin acid is an exceedingly irritating substance. The comparative absence of casin in margarine is also a good point, for casein, as we have seen, tends to promote the decomposition of butter."

"So much for the chemical side. From a physiological point of view margarine is equally deserving of recommendation. It is absorbed almost as completely as butter, the difference being only about 2 per cent. In other words, 102 pounds of margarine are equal in nutritive value to 100 pounds of butter. Whatever may have been the case, margarine is now made only from pure animals fats, and the processes to which it is subjected in manufacture insure its further purification. As its flavor is equal to that of an average specimen of butter, and as it has the advantage of being very much cheaper, there is every reason to wish that the prejudice against it, which it still rather widespread, should quickly disappear, and that is should be welcomed as an admirable and cheap substitute for a rather expensive, but necessary food."

The above paragraphs stand unchanged in the 1906, 1910 and 1916 editions of Hutchison's work. In the 1916 edition he adds the following:—

"It has been objected to margarine that it may be deficient in vitamines; which are present in butter. To this it may be replied that there is no proof that butter contains vitamines, and in any case, in a mixed diet, the matter is one of no importance. The further objection that fats of vegetable origin may not play the same part in metabolism as animal fats is purely speculative."

Before passing on to consider the phase of the subject alluded to in this new paragraph of Hutchisons I wish to quote from Bolton and Devis's recent but undated book, "Fatty Foods", a few sentences which indicate that in the old world the range of materials used in the margarine industry is much wider than Hutchison realized when in revising his book in 1916 he allowed his statement that "only pure animal fats are used" to stand unaltered, and that there is after all some alight possibility of unwholesome fats being employed.

These analysts, specialists in the analysis of fats and oils, take the responsibility of stating that at the present day there is scarcely an animal or vegetable fat (which can be procured in sufficient quantity) that has not been tried, or actually used, in margarine, and even fish oils are being pressed into the service of the manufacturer. The consequence of this unfortunate idea that any oils or fat, if sufficiently refined, is suitable for the purpose has led on occasion to the use of consignments of oils having poisonous properties, with disastrous results." This warning is, of course, addressed to the analyst advising the manufacturer and must not be understood as implying any but a very remote danger to the consumer—a danger, moreover, that would be even more remote in this country than in such a centre of importation as England.

Hutchisons' slightly reference to vitamines and to the different parts played in metabolism by different fats does not in my humble opinion do justice to the new discoveries in the science of nutrition nor to their bearing upon the relative merits of butter and oleomargarine. The term vitamine is applied by Funk and his followers to a class of substances whose presence or absence in foods is inferred from the effects of the foods upon the normal maintenance and especially upon the growth of the animals consuming them. Exception has been taken to the word "vitamine" on the grounds: (1) that the root vita, connotes an importance in biological processes superior to that of other substances which are in fact no less absolutely indispensable and (2) that the termination amine assumes an amino constitution for substances which have not yet been even isolated. F. G. Hopkins of Cambridge prefers to call them "accessory factors of uncertain nature" while some have extended to these substances the term hormone, originated by Starling in 1905 to designate any substance which, produced in one organ of an animal is transported in a dissolved state to another organ whose activity it arouses or stimulates (for example (1) adrenalin produced in the suprarenal glands and affecting the sympathetic nerves causing constriction of the blood vessels, (2) secretin produced in the cells of the intestinal walls and stimulating the flow of pancreatic juice, (3) carbonic acid produced in the muscles and affecting the respitatory centre). With our present meagre knowledge it is of course impossible to select any name for these elusive nutritional factors which will satisfy everybody. Call them "vitamines," "hormones,"

*Presented before the Canadian Section of the Society of Chemical Industry, March 30, 1917.

"accessory factors" or what we will, however, they are not to be despised.

As presented by Prof. E. V. McCollum of the University of Wisconsin, one of the prominent investigators in this field, the facts about these newly recognized food factors are substantially as follows:

When a growing animal is put upon a diet of carefully purified proteins, fats, carbonydrates and salts, he ceases to grow, begins to decline and dies a premature death. A little egg-yolk added to his diet saves the situation complctly. He not only lives but grows. Egg-yolk which has been extracted either with a fat solvent or with water fails in its effect but in either case the restoration of the extract makes good the deficency. There appear, therefore, to be two substances or classes of substances in egg-yolk which are essential to normal nutrition, a fat-soluble A and a water-soluble B. Aside from egg-yolk there are other sources of each of these materials. The water-soluble B is obtainable from oats, wheat, corn, milk and many other food stuffs. It is absent from starch, sugar, polished rice and the fats and is less abundant in the meats than in the grains. It is the absence of this water-soluble hormone or vitamine from the diet which caused the disease known as beri-beri, the most prominent symptom of which is a general paralysis due to degeneration of the nerve cells. This disease is prevalent in Japan, China and the Philippines among people whose diet consists of polished rice and fish. The substitution of unpolished rice for the polished grain effects a cure, water-soluble A being present in rice bran and especially in the germ of the grain, which is removed with the bran in the polishing process. It was this water-soluble B which Funk had in mind when he orginated the term vitamine.

But fat-soluble A is no less essential, and it is fat-soluble A which is present in butter, and far more abundantly present in butter than in oleomargarine. If to our ration of purified food stuffs we add a material rich in the water-soluble substance B—say fat-extracted egg-yolk—we have a diet which is deficient in nothing but fat-soluble A. Now we can get just as good results by supplementing this ration with butterfat as with the fat of egg-yolk. But neither olive oil, nor cottonseed oil, not peanut oil, nor almond oil, nor lard, nor tallow will serve the purpose. The only fats other than those of milk and eggs which have been found to have the requisite supply of fat-soluble A are the fats extracted from certain internal organs such as the kidney and liver—hence perhaps the medicinal value of cod-liver-oil—and possibly the fats of the germs of some cereal grains, for instance wheat germ. Green forage crops appear to contain fat-soluble A, although, curiously, it does not come out with the fats of plant tissues. "Alfalfa leaves", says McCollum, "are the best source of this unknown dietary constituent we have found" and he suggests that the large proportion of forage material in the diet of the cow may account for her phenomenal milk-producing capacity. She is, so to speak, a concentrator of fat-soluble A. He is also inclined to believe as the result of a considerabe number of experiments that by selecting the feeding stuffs appropriately the quality of the milk-fat may be modified as respects its contents of this growth-promoting ingredient and that it is even possible so to feed a cow that her milk, although normal in its general chemical composition, will be useless for the nutrition of the young. No ordinary ration, however, would result in the production of such milk.

In the light of these facts it can no longer be maintained that oleomargarine, wholesome food as it is, is a complete substitute for butter. Prof. McCollum's own views on this question have been expressed as follows:

"I have been repeatedly asked if this story of the peculiar food properties of butterfat as contrasted with the body fats of animals is not to be construed as the funeral oration of the butter substitute. In the past the butter substitute man has argued that one fat yields as much energy as does any other, and all fats are about equally well digested and absorbed, and that when he makes a product which is as palatable as butter, he has something just as good as butter in every respect and at a great saving in expense.

"My answer to this question is as follows: The butter substitute, containing a considerable mixture of the body fats of the animals, is not equal in its physiological properties to an equal amount of butter, although it may possess as much energy and equal digestibility. As an energy food it may be just as good as butter, but in the peculiar growth-promoting power we have been discussing, butter is lowered in value in so far as it diluted with animal or vegetable fats. Among the ordinary human foodstuffs the sources of the unknown substance indispensable for growth are eggs, milk, and meats. Meats do not furnish so much as do either eggs or milk. All other human food seither do not further this substance at all or contain entirely inadequate amounts of it. It is easily possible and practicable to give the young child what he needs of this substance in the form of milk and eggs, and still allow him to eat a butter substitute on his bread. At least I believe there is no doubt that this can be done. There are no substitutes, however, for these two kinds of foods for the growing young.

"The experience I have had up to the present time in trying to determine the relative amount of the unknown substance contained in butterfat, which is necessary to maintain a grown animal as compared with the amount necessary to induce growth in the young, is still entirely too small to warrant drawing satisfactory conclusions, and I can only say tentatively that the amount required to maintain a grown animal is quite small in comparison."

The correct inference from these new discoveries in the science of nutrition is, of course, not that the manufacture and sale of oleomargarine should be prohibited, but that, in the interest of the consumer as well as obviously in the interest of the dairy industry, such manufacture and sale should be so regulated by government supervision as effectually to prevent the palming off of this good food for its superior, good Canadian butter.

South African Asbestos Industry

The South African Mining Journal regards the output of asbestos at the Cape as a possible rival to that of Canada. It is admitted that the Canadian product is superior in heat-resisting qualities, but as against them the South African product is longer in fibre, is more elastic, and meets practically all the requirements of industry. Reviewing the position of the asbestos industry generally, that journal says:

Admittedly—as things now stand, and however hopeful prospects may be for the future—the position occupied by blue asbestos in the world's industry is still but small. It appears that of the world's production for the years 1910 and 1911, approximately 80 per cent. was produced by Canada, 13½ per cent. by Russia, and only ½ per cent. by the Cape. As blue asbestos is almost entirely confined to the Cape, the last figure may be taken as representing the total proportion of blue to white produced in these years. The output from the Cape for the year 1915 shows a remarkable increase, and appears to mark a new epoch. From all that one can learn, the improvement is mainly due to an increasing all-round demand from the English manufacturers. Some portion of the increase should be attributed, no doubt, to the special demands for war purposes, but it has to be pointed out, on the other hand, first, that there is nothing like the same proportionate increase in the Canadian output, and, in the second place, that we have in the meantime lost the German market, which has been a large buyer hitherto. To the general result, the entry of the Kuruman production on to the market may have been a factor of some consequence, bringing in new buyers and widening the field generally.

Position of Canadian Industry

The rise of the asbestos industry has been phenomenally rapid. In 1903 the whole Canadian output was only 29,261 tons, as against 136,609 tons in 1913. New purposes are continually being discovered to which the mineral may be advantageously put, and it is impossible to estimate the probable demands for the future. Some purposes to which it is now being adapted—for instance, the manufacture of a composite roofing material—are capable of almost indefinite expansion. The question that interests us, in view of these considerations, is what share is the blue variety going to have in the future expansion of the industry. With a few remarks bearing on this important point I may fitly conclude. One consideration bearing on the future of blue asbestos is that it was late in entering the field, and has had a very uphill fight hitherto, so that its intrinsic merits may well have been slow in obtaining due appreciation. With the assurance of a widening market its future progress in popularity is likely to be much more rapid. If our product is to take any great place in the markets of the future it will be mainly as a rival to Canadian asbestos, which is the finest white variety in the world. The quality of the United States output is not such as to bring it into active competition with either the blue or the Canadian. The Russian competition is likely to be more formidable, but the fibre is not of so high a quality as the Canadian, and, in spite of cheap labor, the working conditions are bad generally. In Canada, apart from the very fine quality of its product, we find a very highly developed industry, with a magnificent market in the United States—at its doors, so to speak—taking sixty per cent. of its output right away. But, on the other hand, the production of crudes (or best qualities) by no means keeps apace with mill stock, and has, in fact, increased little in the past ten years. Further, the working margin of profit must even now be small: the tolal value of the asbestos mined for the past three years has averaged just over 6s. per ton of rock quarried. This sum apart from providing profits, has to meet all expenses of mining, milling, grading, and bagging the fibre. Looking at these facts, the Canadian industry, in spite of its very high organization, does not appear to be in a very strong position to meet increasing competition, especially in the production of the best qualities of fibre. As regards the Cape, it would be altogether too dangerous at the present stage to offer any estimate of the value of asbestos that may be expected per ton of rock mined. It must suffice to say that the figure considerably exceeds the Canadian. Two facts, however, to which allusion has already been made, stand out: first, that under the most disadvantageous conditions there appears to be no great difficulty in marketing our asbestos at a profit; and, secondly, that with good management a one-inch seam can be worked underground at a profit. No opportunity has presented itself so far for referring to the enormous disadvantages the Cape field has to place against the one favorable feature of a good labor supply. The characteristics of the country generally are absence of water and superfluity of sand. The roads are almost the worst possible. With the exception of the workings at Koegas, which have recently been brought within eighteen miles, the producing properties are seldom less than one hundred miles from rail. The future of this important minor industry seems to depend mainly on an increasing appreciation of the intrinsic merits of the fibre in the general market and in improvements in working facilities locally. Prospects in the first direction appear good; no doubt improvement will be attained in the latter in good time.

British Iron and Steel Institute

The annual meeting of the British Iron and Steel Institute was held in London, May 3 and May 4, 1917. An attractive programme of technical papers was presented and several interesting announcements were made.

The new president of the Institute is Sir William Beardmore. Professor Henry M. Howe was elected an honorary vice-president.

The Bessemer Medal for 1917 was presented to Mr. Andrew Lamberton, in recognition of his work in mechanical engineering appliances in the iron and steel industry.

Following is a list of the papers read at the meeting:

Properties of the Refractory Materials Used in the Iron and Steel Industry. By Cosmo Johns (Sheffield).

The Determination of the Line SE in the Iron-Carbon Diagram by Etching Sections at High Temperature in Vacuo. By Professor Tschischewsky and N. Schulgin (Tomsk, Russia).

The Influence of Surface Tension Upon the Properties of Metals, Especially of Iron and Steel. By F. C. Thompson (Sheffield).

Cementation by Gas Under Pressure. By F. C. Langenberg (Cambridge, Mass.).

The Penetration of the Hardening Effect in Chromium and Copper Steels. By L. Grenet (Firminy).

The Case-Hardening of Iron by Boron. By Professor Tschischewsky.

Steel Ingot Defects. By J. N. Kilby (Sheffield).

Notes on Some Quenching Experiments. By L. H. Fry (Burnham, Pa.).

Origin and Dvelopment of the Railway Rail in England and America. By G. P. Raidabough (Sparrow's Point, Md.).

Refractory Materials Used in the Iron and Steel Industry

The author of this paper, Cosmo Johns, discussed the sources and properties of the various refractory materials used by the iron and steel industry. He said that the art has been so long in front of the science of the refractory industry, that the most urgent need at present is for an expression, in terms of scientific precision, of the most successful practice in manufacturing the refractory product and of the physico-chemical changes which take place when they are used.

"Tenacity and compressive strength at ordinary temperatures are valuable only in so far as they permit the refractory products to be transported and enable them to withstand the structural stresses to which they are exposed when used. This is not difficult to attain. It is when the material is exposed to high temperatures that the value of these properties becomes most important. The abrasion caused by the movement of solid substances wh le n contact with their heated surfaces is important, whi e the erosion caused by the passage of dust-laden gases at h gh velocities become serious in time. Litt e or nothing is known of the conditions that favor or retard abrasion and erosion. High tenacity, wh ch in most cases wou d mean that of the bonding or of the most fusible constituents, is most probably the desired property. It is the surface exposed to the highest temperature which suffers, for it is the one that is in contact with the moving solids, liquids, or gases. Compressive strength is rarely a cause of failure, for the bulk of the refractory material is at a lower temperature than the face and therefore less affected. There is, however, urgent need for accurate determination of the two properties under discussion at wide ranges of temperature for the more important materials under both oxidizing and reducing conditions.

"Not less important than resistance to high temperature with concurrent abrasion and erosion is resistance to the corrosion caused by slags gases. The effect of acid slags on basic refractories and of basic slags on acid refractories are familiar, while a most striking example might be indicated on the marked corrosion of the silica bricks in the gas ports and uptakes in open-hearth furnaces, due to the alternating passage of oxidizing and reducing gases with the resulting formation of fusible silicates. A factor conducive to rapid corrosion in the last case is the absence of large articles of silica in the bricks employed and the presence of excessive pore spaces. Here again little has been published and few observations recorded. The effect of the alkalies found in certain coals on the refractories used in coke-oven construction is serious, and here too little is known as to the real nature of the destructive influences at work.

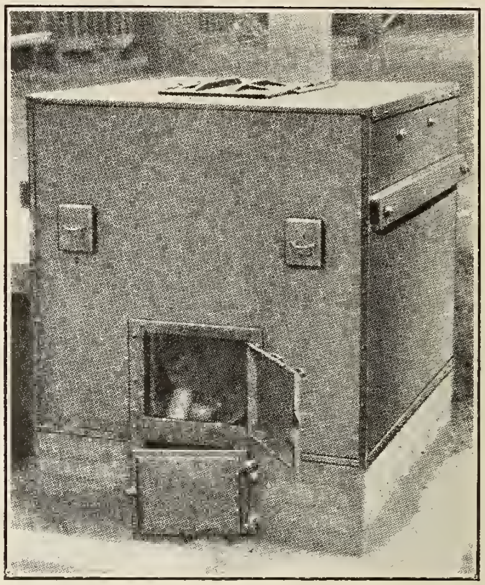
"Specifications should not be the starting point of systematic research which should cover, not only the problems that occur during manufacture, but the occurrence in nature and characteristics of the raw materials. Their concentration and purification, proximate and ultimate analysis, mineralogical description and thermal analysis are all points on which additions to our present knowledge would be of great value. But the refractory materials are so complex, and the problems involved are so difficult of direct attack, that any contributions to our knowledge of the properties of the pure minrals, or of the impure aggregates which are used in practice, would be welcomed, even if their immediate application did not happen to be possible."

Iron and Steel in Canada, 1916

Revised statistics and comparison with 1915, furnished by the Division of Mineral Resources and Statistics Department of Mines, Ottawa.

	1915 Short tons	1916 Short tons
Iron Ore—Shipments:		
Hematite	205,989	45,541
Magnetite	59,217	19,113
Roasted Siderite and Hematite	192,906	210,522
Total shipments	398,112	275,176
Sold for export	89,730	140,608
Imports (customs record)	1,504,113	2,339,677
Charged to blast furnaces, Canadian ore	293,365	221,773
Charged to blast furnaces, imported ore	1,463,488	1,964,598
Charged to steel furnaces	74,872	55,059
Shipment from Wabana, Newfoundland	868,451	1,012,060
Pig Iron—Production by Provinces:		
Nova Scotia	420,275	470,055
Ontario	493,500	699,202
Production by grades:		
Basic	739,613	953,627
Bessemer	29,052	31,388
Foundry and Malleable	145,110	184,242
Total production	913,775	1,169,257
Exports of pig iron	17,307	23,304
Exports of ferro-alloys	9,238	22,802
Imports of pig iron	47,482	58,130
Imports of ferro-alloys	13,758	14,777
Steel—		
Production of ingots and castings	1,020,896	1,428,249
Production by ingots by classes:		
Open hearth	962,411	1,377,387
Bessemer	19,448	1,416
Electric steel	–	17,939
Other steels	– 7,970	961
Direct castings by classes:		
Open hearth	28,384	23,496
Electric	–	1,700
Other castings	– 2,683	5,350
Electric steel, total production	5,625	19,639
Imports of steel ingots, billets and blooms from United States	58,486	118,070
Production of steel rails	232,411	90,123
Production of wire rods	124,381	179,226
Imports of wire rods	71,839	66,166
Imports of tin plate	45,165	57,543
Value of total exports of iron and steel goods	$48,268,148	$63,837,681
Value of total imports of iron and steel goods	$74,308,983	$129,090,168

Incinerator for Industrial Plant.



The above illustration shows a type of incinerator intended for industrial plants, hotels, military camps and small villages. It is 4 feet wide, 5 feet decp and 5 feet high. The base consists of brick to the thickness of a foot, enclosing the ash-pits, and there is a foot of brick arching at the top, leaving a depth of three feet for the furnace. The arch at the top is of firebrick, the rest being ordinary brick. A fire grate rests upon the inner course of brick. In the front is a double door, the upper door being provided with air ducts. There are also two hot-air tubes near the top, for regulating the combustion. The smokestack, placed at the rear, is 10 inches in diameter, and 10 feet high, and the brick work is enclosed in a casing of sheet steel. The incincrator has a capacity of 1½ tons of garbage per day and is designed to consume the refuse in a community of about a thousand people.

There were thirty-eight of these refuse burners at Camp Borden last year. These are made by the Reid Products Company, Mail Building, Toronto.

If a system of saving the fats were adapted to this type it is thought that the resultant oils and the potash recovered would make their systematic use profitable under war conditions.

NATURAL INDIGO

Development of Industry in India

By Professor H. E. Armstrong*

So-called "synthetic ind]go" has been manufactured in large quantities of late years, mostly in Germany and to a much smaller extent in Switzerland, the raw material being derived from coal tar. It is usually supplied in the form of a paste containing 20 per cent. of the dyestuff, free from impurities apart from watcr. The term "synthetic," be it noted, is applied to all substances "put together" in the laboratory. Synthetic indigo consists of a single definite compound known as *Indigotin*; natural indigo contains this same indigotin together with certain impurities, of which there is rarely less than 30 per cent.; in addition, it regularly contains small but varying amounts of indog red. The presence of this latter constitutes the main difference between the artifical and natural indigo as a dyestuff. Synthetic indigo has now a strong position, particularly among calico printers, because it may be completely discharged, leaving clear whites on patterned goods; it has no advantage, as a dyestuff, in dying heavy uniform shades; indeed, most dyers give the preference to natural indigo for this

*In the London Times Trade Supplement.

purpose owing to the effect the indigo red has on the shade, though few if any are prepared to pay a higher price for it on this account. Natural indigo was outsed from the market mainly because of its irregular composition; also because of the difficulty and cost of grinding it to powder.

The amount of "synthetic" paste produced in 1913 is believed to have have been about 55,000 tons, of a value of £3,300,000. The export to Great Britain in 1913 was 1,180 tons; to India, 324 tons; and to China and Japan about 27,000 tons.

The export of natural indigo from India, reduced to a basis of 20 per cent. paste, was slightly over 2,000 tons in each of the years 1910-11 and 1911-12; it fell to less than 1,500 tons in the two following years; it then rose to 2,142 tons in 1914-15, and to 5,242 tons in 1915-16.

Outlook for Industrial Revival

When in Calcutta in November, 1914, I found that the revival of the industry was already under discussion, owing to the fillip which the war had given to the sale of indigo; I then took the opportunity of gathering what information I could. My opinion of the prospects was expressed in a ltetr which I wrote befoe leaving to the *Statesman* of Calcutta in the following terms:—

If the advantage gained by natural indigo through the war is to be maintained, I believe it will be necessary for planters in future in some way to arrange to bulk their products and put upon he market a paste of fixed composition comparable with that supplied by the Germans.

I cannot help thinking that it should still be possible to secure a fair share of the trade for natural indigo in competition with the synthetic article. The possibilities in the way of effecting improvements, especially in agricultural practice, in the plant itself and in the process of manufacture, seem to be in no wise exhausted. Our understanding of such matters is now so much greater than it was even 10 years ago. Various inquirers have studied this or that side of the problem, but apparently no attempt has been made to deal with the subject comprehensively from the many points of view from which it must be regarded if success is to be assured. The men who have been engage have not had the allround knowledge or the ripened ability as investigators that is required to deal with the many issues, scientific and economic, that are involved. It cannot be insisted too strongly, in fact, that the problem is one requiring very special knowledge and acumen. But it is nothing short of a disgrace to us that such an industry should be allowed to lapse in a country where the need of native industries is so great. The recovery of the position of natural indigo may be a costly business, but if one-tenth of the zeal put by the Germans into the production of the artificial pigment be brought to bear on the problem I believe it will be solved satisfactorily.

An official conference was held at Delhi early in 1915, and as a result the matter came under discussion at the India Office. Eventually an aggreement was entered into with the Bihar planters, and it was resolved that the necessary steps should be taken to study and develop the industry with competent scientific aid.

Considerable progress was made last year. Important improvements are already fore-shadowed in agricultural practice, which should increase the crop and render it more certain. It is also clear that the methods of extracting the dyestuffs may be developed so as to increase the yield and improve quality. Not least important, the advantages to be derived from cooperation are being brought home to planters. Only recently the Madras Government has consented to the imposition of a small cess on exports of indigo. The proceeds are to be utilized in carrying on experimental inquiry. Steps are now being taken here to reduce Bengal indigo to a fourth of uniform composition before offering it to dyers.

It has already been demonstrated, on a practical scale, that natural indigo may be produced and sent here in paste form comparable with that in which synthetic indigo is put upon the market by German and Swiss manufacturers.

I am strongly of opinion that dyers, therefore, should not commit themselves in advance too hastily to the synthetic product and regard this as the more suitable material. They may expect that natural indigo will be supplied in all the various forms in which it is now required, ready for use, eventually at prices which will put it on a level with the artificial material manufactured by German methods even if made here. It is essential, however, that users should, for a time, give their patriotic support to the effort.

Perkin's Discovery and Its Results*

In 1825, Faraday discovered benzene, the initial product for the production of aniline. William Henry Perkin, son of a London builder, left school in 1851 at the age of 15, and became a student under Professor A. W. Hofmann at the Royal College of Chemistry, in Oxford-street, London. Taking a keen interest in laboratory work and developing a great capacity for it, young Perkin became Hofmann's private assistant at the age of 17.

In his holiday time, in a small laboratory in his father's house, and entirely on his own initiative, he attempted the synthesis of quinine. He started with a derivative of toluidine as raw material, and as oxygen is absent in this substance and present in quinine he tried the effects of oxidation. The result was a brownish precipitate, which he showed Hofmann, who advised him to throw it away. Research chemists at this time had a strong objection to substances that would not crystallize or that were coloured, and this combined these objections.

The Discovery of Mauve

Perkin, however, continued his experiments and turned his attention to the oxidation products of aniline, closely allied to toluidine. The result was the production of a mauve dye mixed with a much larger proportion of a black pigment. This was the famous pioneer dye mauveine, or Perkin's mauve, together with insoluble ainiline black. The aniline he used was not pure; it contained toluidine. To accentuate the accidental nature of the discovery it has frequently been stated that if Perkin had not been working on impure aniline he would not have dicovered the dye. This is not correct. Later he produced from pure aniline a mauve, which he called pseudo-mauveine.

The young inventor at once realized that he had produced a potential textile colouring matter of great beauty, and commenced a series of dyeing experiments. He found that it dyed silk without mordant, but that cotton required preparation with tannin and tartar emetic. It was a basic, the most brilliant but least fast class of dyestuffs. Perkin next consulted Messrs. Pullar, the Perth dyers, who gave so favourable an opinion that he at once took out a patent. This was in 1856.

Greenford Green Works

In partnership with his brother, Thomas Dix Perkin, and his father, who put most of his capital into the venture, the works at Greenford Green, near Harrow Hill, were started on a modest scale in the following year under the style of Perkin and Sons. The mauve dye was quickly in vogue with silk dyers; the British cotton dyers and calico printers objected to the high price and complained that it would not stand bleaching powder. The French textile printers took it up more readily, and when their patterns appeared in the markets all other calico printers had necessarily to follow suit. Mauviene was supplanted in the course of time by faster violet dyes, and its last employment in England was for the colouring of postage stamps.

With W. H. Perkin busily engaged on research and his brother energetically and capably conducting the sale department the business prospered. Other dyes were put on the market, not-

*By the editor of The Dyer and Calico Printer.

ably synthetic alizarin. Colin and Robiquet, Frenchmen, had in 1826 isolated the colouring principle of madder and called it alizarin, from the Levantine name of the plant, alizarin. Graebe and Liebermann, Germans, first synthesized this substance by fusing dibromanthrakinone with caustic potash far too expensive a process to be employed commercially. The practical solution of the problem was found in substituting anthrakinone sulphonic acids for the bromine compound. Perkin, Caro, Graebe, and Liebermann were all working at the same time on these lines. Perkin's work was entirely independent, and on May 20, 1899, he sent samples dyed with artificial alizarin made with sulphonic acid to Mr. Robert Hogg, of Glasgow. Unfortunately, he did not at once take out a patent. Graebe and Liebermann's specification is date June 25 of the same year; that of Perkin one day later! As regards the actual manufacture, the Greenford Green works in 1870 were the sole source of supply of the artificial alizarin. Perkin eventually sold his patent rights to Brooke, Simpson, and Spiller, who resold them to Burt, Bolton, and Hayward. These firms were in successive occupation of the works at Greenford Green. On the expiration of the patents they passed into the hands of the British Alizarine Company, still a flourishing concern.

Perkin, it must be noted, was the first to prepare an artificial perfume from coal tar. This was coumarin, the ordoriferous principle of the Tonka bean. In the researches that led to this discovery he discovered reactions which have since been of essential service in the sythesis of indigo.

Other British Dye Makers

Perkin's initiative quickly led to the evolution of a British coal-tar colour industry. Before 1860 Simpson, Maule and Nicholson and Roberts, Dale and Co. were at work and prospering. By 1865, they were joined by Read Holliday and Sons, Dan Dawson, Williams, Thomas and Dower and Levinsteins. By far the greatest development took place in Germany, not from any scientific or technical superiority, but by reason of economic advantages; the founders of the German industry were not chemists, but sound men of business with an imagination which displayed to them the possibilities of the future of the synthetic colours, and an admirable foresight which led them to reserve their profits and invest them in the business. Bismarck had not yet converted the King of Prussia into the German Emperor, and Germany was a collection of separate states. The result was that the German patent law was in a state of hopeless confusion and the German manufacturers exploited British patents with impunity. British processes could not be patented in Germany with any sort of a guarantee of security, and the manufacturers of the Fatherland used any English working process that they could discover without paying anything in the shape of a royalty. Our pioneer, then Dr. Perkin, F.R.S., remarked to the writer in this connection: "We could not protect our own patents in England, much less abroad."

As an example of the clear insight of the future which was a great factor in the essential German success, take the case of alizarin. In 1870 a combine of German manufacturers of alizarin was formed, and for some years netted a clear million sterling annually from this dyestuff alone. A large portion of this huge profit was wisely devoted to building and equiping modern factories, and to the endowment of perfectly-appointed research labories occupied by ample staffs of specially-trained chemists. Success in research is on the side of the heavy battalions. In proportion to the number of chemists engaged, probably more important discoveries in the field of dye making have been made in England and France than in Germany.

Aniline Black

The Rhine factories have had the lion's share of the profits from aniline oil and salt (hydrochloride of aniline), and yet the long history of the evolution of aniline black is remarkable for the absence of German names. The step-by-step progress of the art is almost entirely due to England and France. It is true that Germany can claim old-time laboratory experiments on aniline obtained from the dry distillation of indigo, but these academic researches had been completely forgotten when Perkin obtained aniline black in powder in commercial quantities as a by product of his mauve. This insoluble black was used by the calico printers as a pigment colour. Crace Calvert first produced the black on the fibre and showed calico prints of it at the Exhibition of 1862. Lightfoot, an Accrington calico printer, perfected the process ot such a degree that he may be considered the veritable inventor. Lauth, a Frenchman, realized the most important improvement of Lightfoot's black. This was in 1864, and his process is still in current use. So far these were printing processes. Boboeuf, a Frenchman, took out the first patent for dyeing hanks, and his process is still largely used in the North of France. Prud'homme, a Frenchman, completely solved the problem of producing white and coloured effects on aniline black. Professor A. G. Green as lately as 1907 made the highly important discovery that the oxidation of the aniline can be effected by the oxygen of the air, thus avoiding tendering.

On the mechanical side Thom, a Lancashire man, produced the first practical apparatus for steaming the dyed or printed goods, and a Salford firm improved this to such an extent that the machine is known in universal technical literature as the Mather and Platt. These are the most important steps in the evolution of this black; even in minor matters the progress of the art has been due mainly to England and France.

Retirement of W. H. Perkin

In 1873, at the early age of 37, W. H. Perkin decided to retire from business. His father was dead, and he and his brother had realized comfortable fortunes. The reasons for the step were many. Greenford-green in many ways was unsuitable for dye-making; in any case to keep abreast of competitors the necessity of doubling or trebling the factory was realized and the Perkins were satisfied with the profits they had accumulated and unwilling to risk them in the extension of a business which was beginning to be heavily handicapped in England. They were weary of litigation. Possibly a main reason of the decision was that Mr. W. H. Perkin's mind was turning to research in other directions unconnected with commercial activities. He turned his house at Sudbury into a series of well-equipped private laboratories, building for himself a larger dwelling-house close at hand. It will be within the remembrance of readers that as Dr. Perkin, F.R.S., he lived to celebrate the jubliee of his discovery. The scientific world joined in the celebration, and in the same year—1906—he was knighted. He died the following year.

Rapid Developement of the Industry

The coal-tar colour makers have aimed at simple application in textile colouring on every description of fibre combined with qualities of fastness suitable for every possible requirement. Direct cotton colours have been introdueced capable of dyeing that most inert of textiles, cellulose, in a simple salt bath without previous mordanting of the fibre. The sulphur colours, with the exception that they require dissolving in, or reducing with, sodium sulphide, are as simple in application and have an excellent fastness to washing and light. The first of the modern vat dyes, apart from artificial indigo, was introduced in the year of the Perkin Jubilee. This thio-indigo red approaches in its composition indigo on one hand and sulphur dyes on the other and can be reduced after the manner of indigo dyeing or like the sulphur colours with sodium sulphide. Primuline, the discovery of A. G. Green, was the first of a highly important group of dyestuffs which can be diazotised and developed upon the fibre. For instance, primuline developed with betanaphothol gives a red, with resorcinol an orange, and with phenol a yellow. Dyes used in a simple bath of acid were introduced for wool, and another class giving a high resistance to milling which are dyed on chrome mordanted wool, or together with the chrome in a single bath, or are dyed and then after-chromed. Bichromate of soda was not used in the dyeing trades before the advent of the coal-tar colours; it is now used in enormous quantities.

The vat colours, used for both wool and cotton, are the most modern of dyes. On cotton they realize the ideal of fastness, resisting constant visits to the laundry and outlasting the material itself. This is necessarily a mere glance at the types of dyestuffs which have been introduced for every special purpose.

If the textile colourists's work has been simplified in some directions it has been rendered more difficult in others. He has the choice of a multiplicity of dyes and the widsom of his choice may determine the difference between profit and loss. Whereas his ante-coal-tar colour brethren kept more or less to long ravelled paths the modern dyer and printer is working under constantly changing conditions. Indigo, madder, and logwood were the colouring matters used on a wholesale scale before the days of Perkin, and each was in the hands of specialits of lifetime experience. Now the colour makers are not only in competition with each other, but with themselves, so to speak; no sooner do they put a colour on to the market than they try to improve on it and a much hued dyestuff may be almost obsolete in a decade.

The introduction of the coal-tar colours has had important results on the natural dyes, Logwood was formerly sent to the dyer in logs and chips, and the "ageing" process, that is, the oxidation of the colouring principle, was a delicate operation which required experience. This and other woods are now sent out in powder and liquid extracts ready for immediate use in the dye bath. Cutch, fustic, Persian berries, and other largely used natural colours are also prepared in the same way. The introduction of the synthetic dyes led gradually to a very extended use of machinery. As a rule, this is a of a simple description, but it has, of course, almost revolutionized dye-house practice and has led to a remarkable speeding up to the work.

American Institute of Chemical Engineers

One of the most successful meetings of the American Institute of Chemical Engineers from the number of those who attended was that held at Buffalo from June 20th to 22nd. The program was well interspersed with automobile trips around the city and Niagara Falls, the plant of the Buffalo Foundry and Machine Co., providing many attractions for the visitors, with machining operations on large chemical castings being in progress.

On the second day, the meetings were held at the Buffalo Canoe Club, Crystal Beach, Ont., which is across the river from Buffalo, the afternoon being taken up with boating and sailing and other similar diversions, while the reading of papers and the resulting discussion took place in the morning and evening.

The list of papers presented is as follows:

Some Machinery Employed in the Manufacture of Glue, by A. Lowenstein.

Treatment of Sewage by Aeration in the Presence of Activated Sludge, by Edw. Bartlow.

The Manufacture of Linseed Oil, by Glenn H. Pickard.

Trade Wastes Disposal, by H. P. Eddy.

The Elevation of Sulphuric Acid and other Liquids, by O. R. Sweeney and Jas R. Withrow.

Conservation of Sulphuric Acid, by Jas. R. Withrow.

Chemical Engineering Aspect of Renovating a Sulphide Mill, by H. K. Moore.

Waste Heat Utilization, by H. D. Baylor.

The paper on Trade Wastes Disposal is reprinted in another part of this number.

The Vulcan Iron Works, Vancouver, will install a shipbuilding plant on Industrial Island.

Tenders are now being received by the architects, Burke, Horwood & White, Ryrie Bldg., for the erection of a $10,000 brick booster house for the Consumers Gas Company, Toronto

Canadian Manufacturers Association

Professor Ruttan, of the Canadian Advisory Council of Scientific Research, told the convention of the Canadian Manufacturers' Association last month that the problem of utilizing the vast deposits of lignite coal in Saskatchewan as a source of fuel for Western Canada and had practically been solved. As the results of the efforts which had been made by the Research Council, a process had been found which would successfully convert these present lignite deposits into briquette form for fuel purposes at a cost equal to two-thirds of that now paid on the prairies for anthracite coal. "Pound for pound, these briquettes will contain as much heat power as anthracite coal," Professor Ruttan declared.

The professor also stated that the Dominion Government had been advised by the Research Council to adopt the process and estabblish a plant as soon as possible in Saskatchewan to commence operations. The cost of wuch a plant would be some $400,000, and the output would amount to 200 tons per day. It was suggested by Professor Ruttan that the size of the inital expenditure might cause the Government to hestiate in undertaking it immediately.

Money Guaranteed by Winnipeg Man

The announcement regarding the utilization of the lignite beds in the West, however, was received so enthusiastically by the convention that T. R. Deacon, of Winnipeg, declared that in one afternoon in Winnipeg he would guarantee to find the required $400,000 with which to promote such a valuable enterprise. "We should ask the Government," said he, "for two million dollars to carry on this scientific work. What is a million dollars? One good idea cannot be valued in dollars and cents when the resstls of it are so inestimable."

Adopts Scientific Methods

The convention, when it entered upon its second day's session was addressed also by Dr. A. B. Macullum, Chairman of the Research Council. He sketched in a broad way the conditions which were bound to confront the world after the war, and after showing what other nations were doing to prepare for an era of fierce competition in trade, urged the manufacturers of Canada to lend themselves in every way to the adoption of scientific methods in the development and extension of their industries

Standard Chemical Elect Officers

At the annual meeting of shareholders held on 7th of June, the retiring Board of Directors were re-elected for the ensuing year, as follows:

L. M. Wood, M. L. Davies, E. F. B. Johnston, K.C., Hon. Wallace Nesbitt, K.C., M. H. Robinson, T. H. Watson, of Toronto; Wm. Thomson and J. B. Tudhope of Orillia; W. J. Sheppard, Waubaushene; and W. H. Lane, London, England.

At a subsequent meeting of Directors, Mr. Wood was reelected president, and Mr. Davies vice-president.

Mr. Wood, the President, reported that the business of the company was continuing satisfactorily and that although operating difficulties would probably become intensified in the Fall and Winter months, the rate of earnings as shown lats year will most likely be maintained.

Wanted

A specialist in industrial chemistry is wanted for a Canadian technical institution in education work. Information may be obtained from the Canadian Chemical.

Six month's subscription will be credited to any reader who will send us a copy of the May number of the Canadian Chemical Journal in good condition.

More Good Will Greetings

As indicative of the highly stimulated condition of the Canadian chemical industries incident to the war period, we have received the initial number of The Canadian Chemical Journal, published at Toronto, Canada, under the same management which founded The Canadian Engineer, The Canadian Textile Journal, The Pulp and Paper Magazine, The Canadian Woodworker and other technical publications. The new journal, to be issued monthly, is "devoted to the chemical and metallurigcal interests of Canada." The present issue contains interesting articles on Canadian water powers, the nickel industry of the Sudbury region, potash from Canadian feldspar, chemistry in Canadian woods, etc., and many up-to-date industrial notes. We desire to extend best wishes to the new journal and to predict for it a career of marked usefulness in the industrial chemical life of our neighbors across the almost imperceptible northern border-line.—Journal of Industrial and Engineering Chemistry.

It is a pleasure to mention the apperance of a periodical dealing with the chemical industries of Canada. The newcomer is The Canadian Chemical Journal. There is no doubt that the chemical industries of the Dominion have a very promising future, and should support a magazine. Pulp, paper and metallurgy seem to have the major part of the field at present, but the very rapid development and bright prospects of Canada's electro-chemical and electro-metallurgical possibilities should not be lost sight of. The recovery of sulphur dioxide from ore roasting would support a considerable acid industry. Electrolytic bleach and soda, colors, paints, wood distillation products, and other chemical products furnish a fascinating field of conjecture as to what might be done. Canada certainly has the resources for a very considerable chemical industry and there is nothing so essential to their development as a good live industrial journal.—Pulp and Paper Magazine.

The latest addition to the ranks of Canadian technical and trade publications is that of The Canadian Chemical Journal. The first issue of the new journal made its appearance recently, and is the equal of many of the best technical and trade publications now being published. There is an excellent opening for a journal of this class, and its wide field will be immediately apparent to those who read the first issue. Millions of dollars of new capital have been invested of late in the chemical industries of Canada, and the future of the industry is so great that one hesitates to predict its boundaries.—Canada Lumberman & Woodworker.

One of the signs of the increasing attention that is being paid in Canada to scientific work as applied to industrial affairs is the apperance of another technical journal, the first number of The Canadian Chemical Journal, has just been issued at Toronto. It is a well printed monthly, devoted as its name implies, to the development of the chemical industries of Canada. The war has brought about a very clear understanding of our dependence on other countries for some things that should be and many believe can be profitably produced at home. Much inquiry and experimentation are now in progress, looking towards the production of chemicals from our woods and minerals. It is a field of industry that is very promising, and The Canadian Chemical Journal comes out at a time when it should have a favorable reception.—Journal of Commerce.

My first thought on receiving the sample copy of The Canadian Chemical Journal was that there was scarcely a field for such a journal in Canada. However, on looking over the number and noting the quality of the manager's contribution and the somewhat popular nature of the journal I was convinced that the enterprise was being so launched as to give good promise of substantial service to the cause of chemical industry in this country. It is with great pleasure that I enclose money order for $2.00 in payment of subscription for the first year.—J. F. Snell, Professor of Chemistry, Macdonald College, Que.

I have received and carefully read the sample copy of the journal which you have sent me and am favorably impressed with it and am sending you a cheque for a year's subscription. I am much pleased to see that the journal is to be really Canadian. I wish you all success in your undertaking and hope to see it represented at the Industrial Exposition in New York in September.—R. B. Smith, Chemical Department, Colgate University, Hamilton, N.Y.

Enclosed find $2.00 for one year's subscription for The Canadian Chemical Journal. Am pleased to have cone in contact with the first issues of this paper. It is a timely edition and from contents am certain it gives promise of becoming an increasingly valuable journal. I trust you will have every success.—R. E. Pettingill, Port Colborne, Ont.

Platinum in Spain

Mr. F. Gillman described before the Institute of Mining and Metallurgy of Great Britian recently some investigations on the occurrence of platinum in Spain.

He stated that in 1913 Don Domingo de Orueta, during a field study of the peridotites in the Ronda highlands of the province of Malaga, was impressed by the apparent analogy between those areas and those of the platiniferous district of the Urals from which at least 90 per cent. of the world's supply of platinum is derived. After a laborious petrological examination of both Spanish and Russian rocks he found his surmise confirmed, and proceeded to test the alluvial deposits and beds of the numerous rivers in the Ronda highlands, working in the mass of partly serpentinized peridotites, which extends from near the Mediterranean at Estepona to the north as far as Tolox, a distance of 25 miles, with a width of eight to ten miles.

On analysing his sand samples, each weighing from 30 to 40 kg., he found most of them to be platiniferous. The metal generally appeared in the form of minute rounded or flat grains, though sometimes as small, more or less water-worn nuggets, with a maximum weight of about 2 grammes. As in the Ural district, the platinum is concentrated in a stratum of sand one to two metres thick, resting on bedrock and covered by a practically barren overburden varying in thickness from eight to twelve metres. Apart from samples of four borings which proved exceptionally rich, nearly one-third of the borings yielded platinum at the rate of two to three grammes per cubic metre; more than a third contained 25 to 40 cgrm., while the remainder had only a few microscopical grains. At the present price of the metal, alluvial ground containing only 20 to 25cgrm. of platinum per cubic metre is profitably worked in the Ural district. The Malaga crude metal contains from 78 to 82 per cent. of platinum, the residue being palladium, rhodium, ruthenium, and osmiridium.

In order to determine whether the deposists can be worked industrially, Senor Orueta has obtained Government aid, and, provided with mechanical drills and other equipment, has again taken the field to face two or three years more of research.

A five story store and apartment building has been taken by the Chemists' Club, New York, which occupies the modern ten story building adjoining, for the purpose of an annex. It will be extensively altered and connections made with the club building on several floors. The lease, which aggregates approximately $100,000, also contains an option to purchase, which will probably be exercised by the club in the near future.

Interesting News Items

Women are now employed in the chemical laboratory of the Algoma Steel Corporation. Two-thirds of the force of rountine chemists are girls, who have shown aptitude, accuracy and notable orderliness after a short period of training.

Ore receipts at Trail Smelters, B.C., for the week ending June 14, as reported by the Consolidated Mining & Smelting Co., were 3,852 tons, of which 3,308 tons were from the company's mines, and 564 from other mines. The total receipts from October 1 to June 14 were 280,449 tons, of which 74,451 were from other than the company's mines.

Arrangements have been made for meetings of the Council of the Biritsh Association for the Advancement of Sdience, the General Committee and the Committee of Recommendations to be held in London on July 6, in order to amke appointments, receive the report of the Council for the year, and transact other necessary business.

The Ladysmith Smelter, Ladysmith, B.C., is preparing to handle ore shipments and has laid additional trackage at its yards. The smelter itself is practically ready to commence operations, and ore shipments will arrive shortly from various points on the Island and from mines on the British Columbia Coast.

The Regent Asbestos Corporation, which owns about 400 acres in the asbestos district of Thetford, Que., will resume operations owing to the improvement in the market.

Development of the lime industry on Texanda Island, British Columbia, has reached such proportions that the Pacific Lime Company of Vancouver, has taken over a four-masted schooner to carry the product to San Francisco.

Granby Consolidated Mining, Smelting & Power Company in May produced 3,159,284 pounds of copper at the Anyox mine, as compared with 3,775,140 pounds during April, of which 3,026,975 pounds were from Anyox and 748,348 from Grand Forks, and 3,901,398 pounds in March, of which 2,814,780 were from Anyox and 1,086,618 from Grand Forks. The Grand Forks property was closed down during May on account of the strike of miners of the Crow's Nest Pass Coal Co. Nothing definite has as yet been learned as to whether or not the miners have returned to work.

That there is every likelihood of a modern smelter being erected at Port Arthur, Ont., seems evident from the fact that an Ontario charter has been granted to W. F. Langworthy, A. J. McComber, and Gerald McTeigue, to carry on business as a mining and smelting company under the name of the Hennepin Mining Company, Limited, with head office at Port Arthur.

The Elora White Lime Co. plans the installation of electrically operated stone-crusheing equipment.

The Consolidated Mining & Smelting Company of Canada, operating a large smelter and appurtenant plants at Trail, B.C., plans to more than double the capacity of its sulphuric acid plant, now producing 12 tons daily. Twenty-four furnaces, built in the last previous year, will be erected, and extension made to the acid furnace building. The chamber building is also being doubled in size. The initial unit covered an area of 8983 sq. ft., built of tile brick and contained two lead chambers and towers. Increase of capacity is necessitated by the enlarged demand for sulphuric acid in the copper, lead and zinc refineries.

A natural gas well of great capacity has been struck five miles west of Fingal, Ont.

The Molybdenite Mining & Reduction Company, Prince Rupert, B.C., which owns a large deposit of molybdenite near that city, has built an aerial tram mill and concentrator which will treat 150 tons daily.

It is reported that a huge deposit of molybdenum ore has been struck thirteen miles from the Canadian Pacific Railway line, north of Jackfish Bay, by Captain W. Pritchard, 806 Northern Avenue, Fort William.

Personals

Major W. E. Phillips, D.S.O., who graduated in applied chemistry at the University of Toronto in 1914, is home on leave.

S. R. Parsons, of Toronto, president of the British-American Oil Co., Limited, and of the Toronto Iron Works, has been elected president of the Canadian Manufacturers' Association for the next twelve months.

Mr. Charles N. Candee, president of Gutta Percha & Rubber, Limited, and a number of subsidiary enterprises, has been elected a director of the Canadian Bank of Commerce

C. A. Magrath, Chairman of the Canadian section of the International Waterways Commission, has been appointed Fuel Controller for the Dominion.

Mr. C. B. Gordon, president of the Dominion Textile Co. of Montreal, and a member of the Imperial Munitions Board in Canada, it is reported, will become purchasing agent of the British Government in the United States, so far as munitions

A. H. Cole, field organizer for the central joint committees assisting the Research Council, is organizing the collection of industrial information on the Pacific Coast.

T. J. Dillon has been appointed general manager of Canada Foundries and Forgings, Limited, Welland and Brockville.

Col. Thomas Cantley, who has resigned the presidency of the Nova Scotia Steel & Coal Company and has been made chairman of the Board of Directors, is one of Canada's big business men. Col. Cantley is a Bluenose, born at New Glasgow, N.S. Some thrity-two years ago he joined the Nova Scotia Steel & Coal Company, then a very small and unpretentious organization, as it had started its career a short time before in a blacksmith's shop. In turn he has been sales manager, general manager for sixteen years, vice-president, and for the past two years president of the Company.

J. R. Donald, B.A., B.Sc., of the firm of J. T. Donald, Consulting Chemists, Montreal, has been appointed inspector of explosives under the Imperial Munition Board. Mr. Donald's headquarters will be at Ottawa.

Dr. A. B. Macallum, of Toronto, and Dr. R. F. Ruttan, of Montreal, represented the Canadian Council of Scientific and Industrial Research at the meeting of the Canadian Manufacturers Association held in Winnipeg during the month.

Frank H. Crockard, Vice-President Tennessee Coal, Iron & Railroad Company, has been elected president of the Nova Scotia Steel & Coal Company. In addition to being a successful coal mine operator, Mr. Crockard is a steel manufacturer of wide experience and in the United States steel business he is given credit for making Tennessee Coal & Iron one of the most profitable and important subsidiaries of the United States Steel Corporation.

George F. Sheppard, the eastern agent of Canadian Hoskins, Limited, will this month open business on his own account, with offices at 222 St. James Street, Montreal. Mr Sheppard will still represent the Canadian Hoskins, Ltd., having the territory of eastern Ontario, Quebec and the Maritime Provinces, and he will act as special agent of two or three companies in electrical and metallurgical equipment. Mr. Sheppard starts out with three great assets—youth, alertness and the conception that service to his client rather than mere gain to himself should be the chief aim of business. On this foundation his friends will wish him every success.

The Granby Consolidated Mining, Smelting & Power Company plans to install an experimental plant of 100 tons capacity, using the floatation process, to treat millions of tons of siliceous ore which the company has heretofore not used. If successful, a plant of large capacity will be installed. Operations at the Grand Forks smelters have been interrupted by lack of coke supplies, but the full battery of four furnaces at Anyox are now in operation.

B.C. Mineral Production Increased 44 per Cent.

The total value of the mineral production of the Province for all years to the end of 1916 was roughly $558,500,000, says Premier Brewster of British Columbia. The value of the output for 1916 was nearly $42,300,000, an increase of forty-four per cent. over that of the preceding year. The output from metalliferous mining in 1915 was valued at nearly $21,000,000, while in 1916 it was more than $32,000,000, an increase over the first mentioned year of about $11,000,000, or fifty-four per cent., while, as compared with the previous record, which was for the year 1912, the increase was seventy-six per cent.

While some of this enormous increase in value is undoubtedly due to the higher market value of most of the metals, yet in each of the metals, except gold, there has been a largely increased quantity produced. Of the more important economic metals lead, the output of which in 1915 was 46,500,000 pounds, was in 1916 nearly 49,000,000 pounds of metal produced. Similarly, the output of copper increased from 57,000,000 pounds to nearly 65,500,000 pounds, an increase of about 8,500,000 pounds, and the quantity of zinc produced increased from about 13,000,000 pounds in 1915 in 1915 to 37,000,000 pounds in 1916, an increase of 24,000,000 pounds, or nearly 200 per cent.

These facts, represented by figures, indicate that the industry as a whole has been enjoying a most protable and successful year, while there is every reason to expect that such will continue during 1917, the first three months of which year have already expired, and have given such definite indications that it is safe to predict that the mineral output for 1917 will be greater by $50,000,000.

The tonnage of ore mined in the Province in 1915 was about 2,700,000 tons, while in 1916 it was about 3,200,000 tons. There was not doubt but that this great increase in output was stimulated by the high prices of metals due to war conditions, but it is now practically assured that these high prices will continue for the full year 1917.

Coal mining is largely dependent on other mining for a market and the increase in metal mining has had its influence on the coal and coke output, which in 1916 was nearly $2,000,000 higher than the preceding year, while it seems probable that a similar increase will be made in 1917, bringing the gross value of the products of the collieries up to more than $11,000,000.

Mint Capacity Enlarged

In a recent statement which he made to the Canadian Parliament, Sir Thomas White, Minister of Finance, explained how his Department has handled for the Imperial Government and for the Bank of England in connection with gold shipments since the outbreak of the war, no leass than $1,000,000,-000. The facts have aroused a great deal of interest in the financial circles but have not been adequately emphasized for the general public. The work of the Department of Finance in handling such tremendous shipments and the operations of the Ottawa Mint were outlined by the Minister as follows:

"In addition to handling gold for account of the Bank of England the department has been indirectly concerned—and here I desire to pay a tribute to the officials of the mint rather than to those of my department—with the operations carried on by the mint at Ottawa. It will surprise the House, I have no doubt, to learn that we have in Ottawa Mint a refinery for the refining of raw gold which has the largest capacity of any refinery in the world. That is due to the fact that about a year and a half ago the Mint was enlarged in order that we might treat gold from South Africa and Russia which had been refined to a sufficient degree of fineness when it reached this country. Late in May, 1916, plans and preparations were made for an extension of the refinery, and in seven weeks the extension was completed and in operation. The present capacity is 250,000 ounces or $5,000,000 per week, and the method employed is what is known as the chlorine process. Since September, 1915, there has been received at th Mint $225,000,000 in raw gold, practically all of which has been reqned and delivered, which work has been done in addition to the regular work required at the Mint.

Du Ponts to Make Dyes

Washington.—Announcement that the du Pont Powder Company is to enter the coal-tar industry, manufacturing synthetic dyes and kindred products, was welcome news to government chemists. As the du Pont plant is readily convertible into a dyestuffs factory, it means that with private capital back of this project ready to develop a new American industry on a large scale that the United States is practically assured of dye products in sufficient quantities to meet all demands.

The officials of the Bureau of Chemistry were aware that the du Pont Company was considering very seriously taking this step, because the du Pont officials had been in conference with the Bureau of Chemistry officials. Since these conferences the colors experimental laboratory of the Bureau of Chemistry has been enabled to announce laboratory success with a new method of producing phthalic anhydrates, which is the basis for a series of very vivid dye colors. The Bureau of Chemistry, through public announcement by David F. Houston, Secretary of Agriculture, has offered to co-operate with any person or corporation desirous of development this new process. It is considered very probable that the development on a commerical scale of this method of making phthalic anhydrates will be undertaken at the du Pont plant.

Prof. Stafford K. Kirkpatrick, head of the Metallurgy Department of Queen's University has been notified by the Board of Governors of the University of Toronto that he has been awarded the McCharles Prize for the invention or discovery of a new and improved process for precipitation of silver from its solution in the ores of Cobalt, and also a new and improved process for separation of cobalt and nickel in solution made from Cobalt ores.

The twentieth annual convention of the American Society for Testing Materials was held at Atlantic City, June 26-29, inclusive, with a large attendance and with a great deal of constructive business to be considered. The drafts upon the productive interests of the country owing to the exigencies of war conditions have made the work of the society of unusual moment and importance at this time, and particular consideration was given analysis of metals and metal products, and of other commodities.

Foreign Trade Inquiries

The following inquiries of interest to the chemical trade have been received at the Department of Trade and Commerce, Ottawa. The names of the firms making these inquiries, with their addresses, can be obtained only by those interested, on application to "The Inquiries Branch, The Department of Trade and Commerce, Ottawa," quoting the reference number. The Secretary of the Canadian Manufacturers Association, Toronto, and the secretaries of the various Boards of Trade can also supply this information.

930. **Aniline dyes.**—A dyer at Genoa would buy aniline dyes.

934. **Chemicals, colors, varnishes, etc.**—A commission agent at Caglieri (Sicily) would represent manufacturers or exporters of chemicals, colors, varnishes, soap-making materials, mineral oils, linseed oils, iron, steel, coals, enamelled hollow-ware.

939. **Chemicals, aniline dyes, etc.**—An agent at Turin would represent manufactureres or exporters of chemicals, pharmaceutical products, aniline dyes.

943. **Chemical manure, sulphate of copper, etc.**—A Genoa merchant would buy for own account chemical manure, chemicals, sulphate of copper, nitrate of soda, engineering sundries for cotton mills, dye works, iron foundries.

944. **Industrial and agricultural machinery, etc.**—A party at Rome would represent manufacturer of industrial and agricultural machinery, electric motors, gas stoves, chemicals, pharmaceutical specialties, artificial silks, etc.

949. **Soaps, chemicals, jute, etc.**—British subject would represent on commission or own account firms supplying soaps, chemicals, jute, upper leather, pig-iron, oil-seeds, sago, china-clay and fire-clay, dry coulors and indigo, vegetable invory, bristles, mother-of-pearl, etc.

955. **Rubber, colors, sulphates, etc.**—Rome agent seeks connections in rubber, colors, sulphates, coal, iron, chemicals, electrical machinery, instruments and apparatus, woollen piece-goods.

957. **Coal, coke, tin-plates, etc.**—Genoa commission agent would handle coal, coke, tin-plates, rolled iron, manganese ore, old rails, iron and steel scrap, etc.

958. **Chemicals, machinery and engineering sundries.** Party at Genoa would represent on commission manufacturer of the above.

961. **Tin, zinc, copper, lead, etc.**—Genoa agent would buy on a commission basis tin, zinc, copper, lead, pig-iron, hematite, scrap-iron and metals, tin-plates, raw and dressed leather.

971. **Coals, pig-iron, etc.**—Rome firm would handle coals, pig-iron, tin, copper, lead, fire bricks, etc.

972. **Chemicals, metals, coals, etc.**—Leghorn agent would represent shippers of chemicals, metals, coals, etc.

975. **Fisu, sulphate of copper, metals, etc.**—Party at Bari would handle Canadian produce, salted fish, sulphate of copper, metals, etc.

976. **Colors, oils, soaps, etc.**—Florence agent would buy for his own account or on commission, colors in general, oils, soaps, chemicals, etc.

979. **Chemicals, caustic soda, etc.**—Firm at Genoa would buy for own account or represent on commission chemicals, caustic soda, soda ash, silicate of soda (glass), colphony, paraffin wax, iron, pig-iron, steel, oils, engineering articles, electrical sundries, etc.

986.—**Chemicals and dyes.**—A London company dealing in chemicals and dyes (according to the following list) is prepared to purchase these supplies from Canada, and in this connection to appoint a resident firm as buying agents upon a commission basis: acetic acid, benzoic acid, gallic acid, lactic acid, salicylic acid, stearic acid, sulphuric acid, tannic acid; alum chrome, alum lump, alumina sulphate, ammonia carbonate, ammonia nitrate, ammonia sulphate, aniline colors; benzidein, calcium chloride, calcium permanganate, dinitrophenol, dinitrochlorbenzol, dywood extracts, monochlorbenzol, napthaline, pitch, potash bichromate, potash carbonate, potash caustic, potash permanganate, potash prussiate, rosin, soda bichromate, soda carbonate, soda caustic, soda permanganate, soda prussiate, soda sulphide; tolidine, toluidine, and zinc dust.

987. **Glues, oils, etc.**—A London company dealing in the following articles is prepared to purchase their supplies from Canada and are willing to appoint a resident firm as buying agents upon a commission basis: gelatines, glucose, glues, greases, gums, oils (animal, vegetable and mineral), potato starch (Japanese).

988. **Metals and metal goods.**—A London company dealing in brass, cobalt, nickel, steel, hacksaw blades and press studs is prepared to purchase their supplies from Canada and in this connection to appoint a resident firm as buying agents upon a commission basis.

991. **Casein and flour.**—A Lancashire firm would like to hear from Canadian manufacturers who can ship casein, and also low-grade flour suitable for cotton sizing purposes.

Recent Incorporations

Of Interest to the Chemical and Metallurgical Industries

Montreal.—The Canada Iron Products Company, Limited, $1,000,000.

Montreal.—The Foundation Company of British Columbia, Limited, $30,000. G. W. MacDougall, W. B. Scott, J. G. Cartwright.

Montreal.—Dominion Bottle Company, Limited, $40,000. H. Weinfield, M. M. Sperber, J. Y. Fortier.

Toronto.—Waterbury Chemical Company of Canada, $125,-000. J. R. O'Connor, A. A. Bain, Laura A. Baves.

Toronto.—Kirkland Combined Mines, Limited, $2,000,000. J. E. Day, J. M. Ferguson, J. P. Walsh.

Toronto.—General Mining & Exploration Company, Limited, $40,000.

Toronto.—Fisher Gold Mining & Milling Company, Limited, capital $2,500.000.

Toronto.—Wasapika Gold Mines, Limited, $1,000,000. G. A. Young, W. D. McKay, D. A. Sheriff.

Toronto.—Chemical Products of Canada, Limited, $40,000. G. G. Grover, A. O. Thorne, S. D. Fowler.

Toronto.—Sterling Iron and Metals, Limited, $40,000. L. Davis, Ethel Frise, Lilly August.

Toronto.—Wheel and Foundry Company, Limited, $25,000; A. J. Thomson, W. S. Marlock, R. H. Parmenter.

Toronto.—Kirkland Combined Mines Ltd., $2,000,000.

Toronto.—Fisher Gold Mining & Milling Company Limited, $2,500,000.

Collingwood.—Paragon-Hitchcock Mines, Limited, $2,000,000.

Chatham, Ont.—Canadian Des Moines Steel Company, Limited, $100,000. R. L. Brackin, B. L. Bedford, E. M. Reeve.

Haileybury, Ont.—United Kirkland Gold Mines, Limited, $2,000,000. A. E. Cranstoun, T. H. Connor, J. J. McLean.

Haileybury, Ont.—Fidelity Mining and Development Company, Limited, $2,000,000. A. E. Cranstoun, E. W. Kearney, J. A. Amm.

Hamilton, Ont.—Dominion Foundries and Steel, Limited, $6,000,000. E. H. Ambrose, H. A. Burbridge, J. R. Marshall.

Peterborough, Ont.—Sugar Products, Limited, $50,000. G. N. Gordon, H. R. Armstrong, Jessie Srevens.

St. Catherines, Ont.—Kinleith Paper Mills, Limited, $400,000.

Welland, Ont.—Electric Steel and Engineering, Limited, $20,000,000. J. S. Lovell, C. D. Magee, W. Bain.

Winnipeg, Man.—Independent Tyndall Quarries, Limited, $250,000. L. D. Smith, F. C. Hamilton, L. M. Young.

Winnipeg, Man.—Pan Extension Gold Mines Company, Limited, $3,000,000. J. G. Reahil, W. D. Shaw, E. J. Harden.

Winnipeg, Man.—The Kiskis Mining Company, Limited, $1,000,000. H. E. Swift, R. W. Campbell, C. J. Macleod.

Calgary, Alta.—Canada Southern Oil and Refining Company, Limited, $200,000.

Calgary, Alta.—Illinois Alberta Oil and Refining Company, Limited, $1,000,000.

Calgary, Alta.—Baker Lake Mining Company, Limited, $150,000.

Edmonton, Alta.—The Tekoa Athebasca Oils, Limited, $1,000,000.

Vancouver, B.C.—Aspen Grove Mining Company, Limited, $20,000.

Vancouver, B.C.—Hematite Mining Company, Limited, $45,000.

Vancouver, B.C.—Canadian Kelp Products, $40,000.

Victoria, B.C.—Nit-i-nat Copper Cines, Limited, $1,500,000.

The following companies increased their capital stock:—Scottish Canadian Magnesite Company, Limited, with Quebec charter, from $40,000 to $50,000; the B. J. Johnson Soap Company, Limited, with Dominion charter, from $100,000 to $300,-000; Brown's Copper and Brass Rolling Mills, Limited, with Ontario charter, from $1,000,000 to $5,000,000.

Chemical Prices

The quotations below represent average prices for the quantities indicated at the time of going to press. Larger amounts, of course, may be obtained at lower figures.

Toronto, July 3, 1917

Inorganic Chemicals

Alum, lump ammonia	100 Lbs.	$6.50
Aluminium Sulphate, high grade, bags	100 Lbs.	4.00
Ammonium Carbonate	Lb.	.16
Ammonium Chloride, white gran	Lb.	.21
Aqua Ammonia .880	Lb.	9
Bleaching Powder, 35% drums	100 Lbs.	4.50
Blue Vitriol	100 Lbs.	14.00
Borax, crystals	Lb.	.11
Boric Acid, powdered	Lb.	.16
Calcium Chloride, crystals fused	100 Lbs.	2.50
Caustic Soda, ground, Bbl.	Lb.	8
Chalk, light precipitated	Lb.	.10
Cobalt Oxide, black	Lb.	2.10
Fuller's Earth, powdered	Lb.	5
Glauber's Salt, in bags	100 Lbs.	1.50
Hydrochloric Acid, carboys, 18°	Lb.	3
Lead Acetate, white crystals	Lb.	.18
Lead Nitrate	Lb.	.27
Lithium Carbonate	Lb.	2.10
Magnesium Carbonate, B.P.	Lb.	.40
Mercury	Lb.	3.65
Nitric Acid, 36° carboys	100 Lbs.	8.75
Phosphoric Acid, S.G. 1750	Lb.	.80
Potassium Bichromate	Lb.	.60
Potassium Bromide	Lb.	1.85
Potassium Carbonate	Lb.	1.50
Potassium Chlorate, crystals	Lb.	.80
Potassium Hydroxide, sticks	Lb.	2.15
Potassium Iodide, bulk	Lb.	4.25
Potassium Nitrate	Lb.	.50
Potassium Permanganate, bulk	Lb.	5.00
Silver Nitrate	Oz.	.80
Soda Ash, bags	Lb.	4
Sodium Acetate	Lb.	.30
Sodium Bicarbonate	100 Lbs.	3.25
Sodium Bromide	Lb.	.80
Sodium Cyanide, bulk, 98-99 per cent	Lb.	1.25
Sodium Hyposulphite, bbls.	100 Lbs.	2.50
Sodium Nitrate, crude	Lb.	8
Sodium Silicate	100 Lbs.	4.00
Sodium Sulphate	Lb.	4
Strontium Nitrate, com	Lb.	.55
Sulphur, ground	100 Lbs.	3.50
Sulphur, roll	100 Lbs.	4.00
Sulphuric Acid, 66°Be, carboys	100 Lbs.	3.00
Tin Chloride, crystals	Lb.	.50
Zinc Oxide	Lb.	.25
Zinc Sulphate, com	Lb.	.18

Organic Chemicals

Acetanilid, C.P.	Lb.	$ .75
Acetic Acid, 28 per cent. in bbls.	Lb.	.7¼
Acetic Acid, glacial, 99½% in carboys	Lb.	.75
Acetone	Lb.	.60
Alcohol, methylated	Gal.	2.15
Alcohol, grain	Gal.	7.50
Alcohol, wood, 95 per cent., refined	Gal.	2.25
Benzoic Acid	Lb.	8.50
Carbolic Acid, white crystals	Lb.	1.00
Carbon Bisulphide	Lb.	$ .10
Chloroform, com.	Lb.	1.15
Citric Acid, domestic, crystals	Lb.	1.40
Ether, 725	Lb.	.50
Glycerine	Lb.	.80
Oxalic Acid	Lb.	.80
Salicylic Acid	Lb.	2.00
Sodium Benzoate	Lb.	8.00
Tannic Acid, commercial	Lb.	2.00
Tartaric Acid, crystals	Lb.	1.10

Metals

Aluminium	Lb.	$ .68
Antimony	Lb.	.30
Brass, yellow ingots	Lb.	.23
Cobalt	Lb.	2.25
Copper, casting	Lb.	.35
Copper, electrolytic	Lb.	.37
Lead	Lb.	.15
Magnesium	Lb.	2.50
Nickel	Lb.	.47
Spelter	Lb.	.12½
Tin	Lb.	.65
Pig Iron, No. 1 Foundry	100 lbs.	....
Mild Steel	100 lbs.	5.25
Common Bar	100 lbs	5.00

Chemical Markets

Little change in the prices of general chemicals has taken place in the last month. Owing to the warm weather, the price of bleaching powder has fallen from 7 to 4⅕ cents with large amounts of the material on the market. Heavy acids, especially acetic, are strong mostly owing to purchases by the United States Government and a rise in price might be expected in the near future. Little change is noted among the metals, pig iron being still off the market locally although the small amount offered in the States has been snapped up at continually rising prices, consumers offerings of $50.00 a ton being refused recently. Silver has advanced again, owing to heavy shipments to the orient.

New Electric Steel Company

The incorporation of the Electric Steel and Engineering Company, Limited, head office Welland, with a capitalization of $2,000,000 is announced, the company having secured a Dominion charter.

The new concern is an amalgamation of the Electric Steel and Metals of Welland with the Wabi Iron Works of New Liskeard and the Boyine Hydraulic and Engineering Co., of Lindsay. The last two named firms have a high reputation and are strong financially, and the new merger will be one of the strongest concerns in Canada.

The New Liskeard and Lindsay plants will continue to operate as at present but will be controlled from Welland, and the location of the head office here will mean the employment of a large extensive staff.

The amalgamation will have an important influence upon the future development of the Electric Steel and Metals plant here.

The first meeting of the new company will be held here on July 4th.

The Sidio Company, 37 Murray Street, New York, have recently started the manufacture of fused silica products, including crucibles, combustion boats, evaporating dishes, etc. To keep pace with the demand for the "Sidio" products the company is now enlarging its works.

What Our Advertisers Offer

Acetates—
Standard Chemical Co.
Acids—
Madero Bros.
Merck & Co.
Standard Chemical Co.
Alum—
A. M. Huestis.
Apparatus, Drying—
Aetna Steel Products Co.
H. E. Jacoby.
General Cermaics Co.
Machinery Utilities Co.
Toronto Pottery Co.
West Pulverizing Machine Co.
Buffalo Foundry & Machine Co.
Apparatus, Electrical—
Canadian Allis-Chambers, Limited.
Volta Manufacturing Co.
Apparatus, Evaporating—
Buffalo Foundry & Machine Co.
H. E. Jacoby.
Machinery Utilities Co.
Apparatus, Laboratory—
Lymans, Limited.
Thomas, Arthur H., Co.
McKay School Equipment Co.
Scientific Materials Co.
Valley Iron Works.
Apparatus Pulverizing—
West Pulverizing Machine Co.
Barrels, Steel—
Smart-Turner Machine Co.
Chemicals—
Huestis, A. M.
Lymans, Limited
Madero Bros.
Mendelson, A's Sons.
Merck and Co.
O'Reilly, T. E.
Carbide—
Canada Carbide Co.
Caustic Soda—
Mendelson, A's Sons.
Wilson, Patterson Co.
Chemical Engineers—
DeCew, J. A.
Donald, J. R. & Co.
Chemical Stoneware—
General Ceramics Co.
Toronto Pottery Co.
Chemists, Analytical—
FitzGerald Laboratories, Inc.
Welland Analytical Laboratory.
Consulting Engineers—
James, Loudon and Hertzberg.
Drugs—
Madero Bros.
O'Reilly, T. E.
Scheel, Wm. H.
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Angel, H. Reeve and Co.
Lymans, Limited.
Scientific Materials Co.
Thomas, Arthur H.

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O'Reilly, T. E.
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Jacoby, H. E.
Machinery Utilities Co.
Rockwell, W. S. Co.
Smart-Turner Machine Co.
Valley Iron Works.
Volta Manufacturing Co.
West Pulverizing Machine Co.
Metal, Babbitt—
Dominion Metal Co.
Minerals—
Coniagas Reduction Co.
Foote Mineral Co.
Nickel—
Coniagas Reduction Co.
Oils—
Madero Bros.
Standard Chemical Co.
Platinum Ware—
Lymans, Limited.
Scientific Materials Co.
Thomas, Arthur H. Co.
Refiners—
Coniagas Reduction Co.
Salt—
Canadian Salt Co.
Societies—
Society of Chemical Industry.
Specialties—
Scheel, Wm. H.
Sulphur—
Union Sulphur Co.
Tanning Extracts—
Madero Bros.
Wardlaw, T. D.
Turpentine—
Brown Corporation
Wastes, Disposal of—
James, Loudon and Hertzberg.
Process Engineers, Limited.
Scott, Ernest and Co.
Zinc Dust—
Metals Disintigrating Co.

Index of Advertisements

BOOKS

For the Chemist and Chemical Student

Practica. Inorganic Chemistry for Advanced Students. By Chapman Jones, F.I.C., F.C.S., etc. London, 1898. Latest reprint, 1906. 239 pages. Price, 60 cents.

Chemistry: An Elementary Text-book. By W. C. Morgan, Professor of Chemistry in Reed College and J. A. Lyman, Professor of Chemistry in Pomona College. New York, 1911. Twelfth reprint, 1916. 429 pages. Price, $1.25. Manual, 142 pages. Price, 40 cents. Both in one volume. Price, $1.40.

A College Text-book on Quantative Analysis. By H. R. Moody, Professor of Chemistry in the College of the City of New York. New York, 1912. Latest reprint, 1916. 165 pages. Price, $1.25.

Theoretical Organic Chemistry. By Julius B. Cohen, Ph.D., B.Sc. London, 1902. Second edition, 1912. Third reprint, 1916. 578 pages. Price, $1.60.

Practical Organic Chemistry for Advanced Students. By Julius B. Cohen, Ph.D., B.Sc., London, 1900. Second edition, 1908. Third reprint, 1915. 356 pages. Price, 90 cents.

Methods of Organic Analysis. By H. C. Sherman, Ph.D., Professor of Food Chemistry in Columbia University. New York, 1905. New and revised edition, 1912. 407 pges. Price, $2.40.

Elementary Household Chemistry. By Prof. J. F. Snell, Macdonald College, McGill University, Montreal. New York, 1914. Fifth reprint, 1916. 307 pages. Price, $1.25.

Organic Agricultural Chemistry. By J. C. Chamberlain, Ph.D., Professor of Organic and Agricultural Chemistry, Massachusetts Agricultural College. New York, 1916. 307 pages. Price, $1.60.

Outlines of Industrial Chemistry. By F. H. Thorpe, Assistant Professor of Industrial Chemistry and W. K. Lewis, Professor of Chemical Engineering, Massachusetts Institute of Technology. New York, 1905. Third edition, 1916. 65 pages. Price, $3.75.

The Elements of Physical Chemistry. By the late H. C. Jones. Fourth edition, revised and enlarged. New York, 1915. 650 pages. Price, $4.00.

Introduction to Physical Chemistry. By James Walker, D.Sc., Ph.D., F.R.S., Professor of Chemistry in the University of Edinburgh. London, 1899. Seventh edition, 1913. 421 pages. Price, $2.75.

The Manufacture of Organic Dyestuffs. By Andre Wahl, D.es Sc., Professor of Industrial Chemistry in the University of Nancy. Translated by F. W. Atack, M.Sc., M.Sc.Tech., A.I.C. of the School of Technology of the University of Manchester. London, 1914. 338 pages. Price, $2.00.

The Gases of the Atmosphere and the History of Their Discovery. By the late Sir William Ramsay, K.C.B., F.R.S. London, 1896. Fourth edition, 1916. 306 pages. Price, $2.25.

Photography for Students of Physics and Chemistry. By Louis Derr, M.A., S.B., Professor of Physics in the Massachusetts Institute of Technology. New York, 1906. Third reprint, 1916. 247 pages. Price, $1.40.

Famous Chemists. By E. Roberts, B.Sc., London, 1911. 247 pages. Price, 75 cents.

The Chemistry of Paints and Painting. By A. H. Church, F.R.S., D.Sc., Professor of Chemistry in the Royal Academy of Arts, London. Fourth edition, revised and enlarged. London, 1914. 388 pages. Price, $2.50.

Chemical Technology and Analysis of Oils, Fats and Waxes. By Dr. J. Lewkowitsch, F.I.C., late Consulting Chemist to the City and Guilds of London Institute. Complete in three volumes. London, 1895. Fifth edition, entirely rewritten and enlarged, 1913-14. Vol. I, 688 pages, price, $6.50. Vol. II, 944 pages, price, $6.50. Vol. III, 483 pages, price, $6.50.

The Plariscope in the Chemical Laboratory. By G. W. Rolfe, A.M., Instructor in Sugar Analysis in the Massachusetts Institute of Technology. New York, 1905. 320 pages. Price, $1.90.

A Treatise on Chemistry. By Sir H. E. Roscoe, F.R.S. and C. Schlorlemmer, F.R.S. Vol. I, The Non-Metallic Elements, London, 1877. Fourth edition, 1911. 931 pages, price, $5.00. Vol. II, The Metals. London, 1878. Fifth edition, 1913. 1,470 pages. Price, $7.50.

The Canadian Iron and Steel Industry. By W. J. A. Donald. Price, $2.00.

The Tin-Plate Industry. By Donald E. Dunbar. Price, $1.00.

Book Department

CANADIAN CHEMICAL JOURNAL

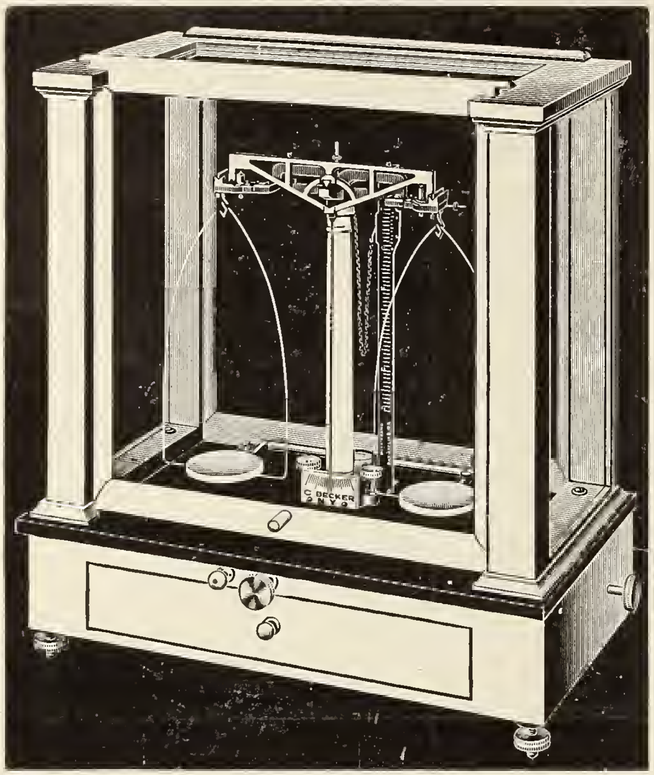
2 Toronto Street, Toronto

CANADIAN
CHEMICAL JOURNAL
A Canadian Journal devoted to Metallurgy
Electro-Chemistry and Industrial Chemistry.

Vol. 1, No. 4 TORONTO, AUGUST, 1917 20c. a copy; $2 a year

Analytical Chain Balance

INVALUABLE FOR RAPID WORK



The **chain balance** is of the usual construction of analytical balances, with the exception that there is no rider and consequently no graduations on the beam. All weighing below 50 m.g. to 1/10 m.g. is accomplished by lifting or lowering a small gold chain, suspended at one end from the beam, and at the other from a sliding hook attached to the graduated scale, from which direct readings are taken. To operate it is only necessary to rotate the thumb screw, conveniently placed outside the balance case, on the right hand side. (See illustration). This operation can take place while the beam is swinging, this in conjunction with the **elimination of all riders, and small weights below 50 m.g., resulting in a great saving of time.**

ANALYTICAL CHAIN BALANCE No. 15
With Vernier

Capacity	100 grams
Sensitiveness	1/20 milligram
Diameter of Pans	3 inches
Length of Beam	6 inches
Bearings	Agate
Knife edges	Agate
Capacity of bar and vernier	50 Mg. to 1/10 Mgm.

Polished mahogany case, front sliding frame, counterpoised. Mounted on black plate glass.

Price Duty Free) **$120.00**
" (Duty Paid) **168.00**

Above prices subject to advance without notice.

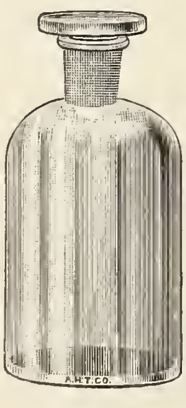
SALES AGENTS

LYMANS, LIMITED

344 St. Paul St. West MONTREAL

BOTTLES FOR LABORATORY USE

IN OUR STOCK FOR IMMEDIATE SHIPMENT



No. 22235

22235. Bottles, Narrow Mouth, of white glass, with flat glass stopper. These Bottles are the first made in the United States of the shape provided heretofore only in imported bottles. They are made in private moulds and are of excellent appearance and quality as compared with any regular stock iron-mould tincture or salt mouth bottles. They are very suitable for use as reagent bottles where labelling is done in the laboratory.

Capacity, cc	125	250	500	1000
Number in original case	100	100	100	50
Each, net	.16	.20	.28	.40
Per 100 in original case, net	**11.00**	**14.50**	**20.00**	**27.50**

22247. Bottles, Wide Mouth, of white glass, with flat glass stopper; otherwise same as above.

Capacity, cc	125	250	500	1000
Number in original case	100	100	100	50
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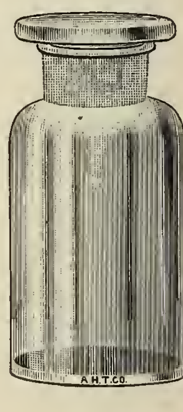

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CANADIAN CHEMICAL JOURNAL

A Canadian Journal devoted to Metallurgy Electro-Chemistry and Industrial Chemistry.

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Contents

The Waste of our Industries

WANT is the natural offspring of waste, and the history of Canadian industries teems with examples showing how the brood has increased. An instance of this was given last month in the history of the potash industry at the period when woods of such present high value and great scarcity as black walnut, hickory, white oak, etc., were valued only for the potash that could be produced by the destruction of the timber.

The virtual monopolization of the world's chemical industries before the war by Germany can be explained by the German faculty of saving waste materials. It was the failure to utilize the by-products of the coal tar industry which lost that British-born discovery to Britain and transferred it to the cities along the Rhine. For the same reason the manufacturers of the United States were content to leave to any European country the finer branches of the chemical industries so long as their own abounding supplies of wood, iron, coal, etc., could be turned to trades of immediate profit, though such profit involved enormous waste of precious by-products.

The severance of commercial relations with Central Europe, not only arouses Canadians and Americans to a sense of the economic sin of our wasteful methods, but has revealed to the people how near we stood to disaster in the famine of raw materials had the regime of waste continued unchecked by war.

Now that Canada, the United States, Great Britain and other allied countries are compelled to create self-sustaining groups of chemical industries the campaign of self-education shows a great and varied field of possibilities in saving.

The waste that still continues in lumber manufacturing in Canada would support a round of industries that would amount to millions annually, as might be seen by a glance at the instructive diagram of wood industries worked out by Dr. Bates, at the Forest Products Laboratory, in our May number.

There is enough wood left each year as "slash" in our forests to supply every chemical pulp mill in Canada with raw material for digestion into pulp; and the sin of this is not merely the lamentable waste, but the danger created in forest fires. It is now pretty well agreed that the great Porcupine fire with its suffering and loss of life to settlers and the fearful desolation of the land was due to the large quantities of slash which fed the fire. In the pulp and paper industry of Canada the waste of pulp and of chemicals through lack of screening, the misuse of spent liquors which are turned into the rivers to pollute the water and endanger the fish life, are problems of anxious thought, alike for the chemist, the mill owner and the law maker. Lumber mills of the Ottawa Valley and other regions are still burning enough sawdust to supply the world with wood flour, and they do not, so far as we know, even recover the potash from the burning, as in former days.

The Need of Nitrates

THE "conquest of the air" implies more than success in aviation. There is implied in the phrase the chemical control of the air—or at least the control of chunks of it—and in this control the fixation of nitrogen, the production of nitric acid, nitrates and the various compounds derived from nitrogen, marks a most wonderful step in applied science. Though the earth's atmosphere is three-fourths nitrogen it is very difficult to "fix" or separate it and keep it separate, and this was only made possible, on a large scale, by the electric arc. The story is as wonderful in its scientific aspect, as the achievement is vital to the concerns of mankind in peace or war.

By the act of hoeing his back-yard garden a man gets a little nitrogen into the soil from the air, but to get it in quantities that will fertilize large areas of impoverished soil is one of the greatest of modern problems. By controlling the natural deposits of nitrates of soda, in Chile (Chilian saltpetre) German manufacturers were able for years to practically control the world's fertilizer industry and this control helped to hold other branches of the chemical industry in German hands. The war by cutting off direct imports into Germany threw this industry into confusion, but, even before the war, the use of hydro-electric power to fix the nitrogen direct from the air had already begun to change the industry. A factory at Notoden, in Norway, had in 1905, made a commercial success of producing calcium nitrate from the air and limestone through a high tension arc flame, the process being worked out by Prof. Birkeland and Dr. S. Eyde. The process was developed by these and others till at the outbreak of war about 250,000 horse power was employed in making nitric acid from the air in Norway alone. One new Norwegian nitric acid factory installed last year absorbs 120,000 horse power, so that Norway now devotes probably 500,000 electric horse power to this work. Germany is largely in it of necessity since the war cut off Chilian supplies, but steam power is used in Germany for lack of available water powers. Even so Germany, after keeping up her war demands for nitric acid, is not able to furnish nitrates for agricultural purposes because of shortage of labor. For similar reasons the soil of all Europe is deteriorating for lack of nitrates.

It is understood that the Dominion Government is looking into this matter with a view to the installation of a plant under government control; but the problems of peace have to be anticipated and the United States Government have shown characteristic energy and promptness in making an appropriation of $20,000,000 to start the industry, of which total $4,000,000 has already been allotted to start a nitrate plant using steam as motive power in order to save time. Since it requires time to develop a large water power this is all the more reason why the Canadian Government and people should get to work at once.

There have been reports that the Chilian nitrate deposits have shown signs of petering out, but whatever happens to those deposits the production of nitrates and other nitrogen products from the air and the water powers of Canada should be undertaken on an ample scale and at once. The fact that the hydro-electric method of production successfully competed with the older system when Germany had unrestricted access to Chile and had all the advantages of its affiliated industries will show that, in alliance with the newly created chemical industries of Great Britain, the United States, France, etc., there is no risk in this business, but a firm foundation for a great new industry in Canada. As will be seen in another part of this issue a large British nitrate industry is now being established near Manchester, England, although the process adopted has not the advantage of water as a prime power.

The Chemical Exposition

THE third National Chemical Exposition to be held at the Grand Central Palace, New York, during the last week of September, will constitute such an assemblage of chemical products and chemical industrial equipment as no interested Canadian should miss seeing. The machinery in motion, the number and variety of the chemical products to be displayed, the addresses at the daily conferences on subjects of interest to chemists and manufacturers, and the concourse of people in every branch of applied chemistry will combine to make the exhibition equal in educational value to a year's study and thousands of miles of travel. For these reasons every Canadian firm engaged in the chemical industry should see that they should send at least one intelligent representative to this exposition.

As a demonstration of what has been achieved by the American people in the creation of the chemical industries from their foundation during the preceding two years, the show of last year was astonishing in view of the difficulties that had to be faced when the war broke out. The achievements to be demonstrated at the coming show will be still more wonderful, as the exhibits will be more than one-third greater and will require three floors of the Palace Building for their display.

THE CANADIAN CHEMICAL JOURNAL has arranged for a booth at the exhibition and will place its office, at Booth No. 490, at the disposal of all Canadian and American visitors for any help or information in our power to give.

The Chemistry of Oleomargarine *

By Dr. A. McGill

I am asked to treat of the chemistry of Oleomargarine. If by this term were meant the oleomargarine of 1868, the article made by M. Mege Mouride, my subject would be an easy one. As matter of fact, however, the oleomargarine of to-day is most variable in its composition and character, and the only feature possessed in common by commercial oleomargarines is that they are various mixtures of fats, capable of replacing butter as a food material and resembling that article as closely as the law permits, and methods of manufacture render possible.

It is well known to you that the numerous animal and vegetable fats in commerce, are, if prepared with suitable regard to cleanliness and purity, mainly capable of replacing each other as regards wholesomeness, digestibility and calorific value in human food. The exceptions are a small number of vegetable oils belonging to the chaulmugra group, characterized by dextrorotation, and distinctly poisonous.

Most of these fats and oils are therefore, so far as their food value is concerned, available for the manufacture of a butter substitute; and it only remains to make a suitable selection to produce a blend which shall possess the necessary physical properties—shall become, in short, an oleomargarine. It follows naturally, that in every country where the manufacture of oleomargarine is carried on, those fats and oils will be employed which are most readily procured.

Dr. Donald has already explained this phase of the matter, and has shown that, in America, as well as in most European countries, the most characteristic component of oleomargarine, is so-called oleo oil, or "Premier Jus." I may be permitted to quote Professor J. J. Farrell, of Minnesota, who gives the following oleomargarine formulas as used by six factories in that State. (Amer. Food Jour., March, 1916).

	Oleo	Lard	Cotton Oil	Salt	Water	Milk Solids
I.	40	28	15	3	14	0
II.	37	0	46	4	13	0
III.	41	4	38	4	13	0
IV.	48	6	30	4	12	0
V.	22	17	49	2	8	2
VI.	35	30	20	3	12	0

Tibbles, in his work on Foods, page 350, gives the following percentages for high grade. Medium and low grade oleomargarines, made in the United States of America. I think, however that little importance can be given to these figures.

	Oleo	Lard	Cotton	Salt	Butter	Cream	Milk
High grade.....	28	37	0	9	26	0	0
Medium grade..	23	36	0	8.5	0	20	12
Low grade......	33	17	23	8.0	0	0	19

These figures suffice to show the extremely variable character of the article, whose chemistry is to form the subject of my remarks; but they entirely fail to furnish any idea of the scope of this variability. For not only will each fatty component named be subject to replacement by another, as the price and availability of a substitute may determine, but natural fats and oils which have been altered by one or other of the hydrogenation processes now practiced commercially will undoubtedly become components of oleomargarine.

In France, a regulation of April, 1897, thus defines margarine. "All alimentary substances, other than butter, which either by their origin, their manufacture or their composition resemble butter, and are prepared for the purpose of being used as butter." A more recent decree (Manuel Pratique d'Analyses Chimiques, Huiles, etc.—p. 457—Halphen, 1912), in view of the fact that many fats which are not sold as oleomargarine, but are specially prepared by modern methods, for the manufacture of the same, interprets the above regulation as follows:

Fats are to be classed in two groups:

1. Those which are prepared by simple melting, like lard or cocoa fat, and which do not contain water.

2. Those which contain water, because they have been prepared by an emulsion process.

The fats of the second group are to be regarded as coming under the definition of margarine, quoted above.

Since as shown, oleomargarine is so indefinite a substance, it would seem more practical for the analyst, to consider in detail the characteristic properties of butter, and to discover, if possible, such of these properties as are not found in any of the multiform types of oleomargarine.

Volatile Fatty Acids

In the first place, we note the absence of any fats in oleomargarine which are the glycerides of volatile fatty acids. Butter fat contains the glycerides of Butyric, Caprylic and Caproic acids to the extent of from 8 to 9 per cent. These acids, being volatile in a current of steam, are easily determined by the well-known Vollny or Reichert-Meissl process. Of course, when butter itself is present in oleomargarine, a titre will be obtained corresponding to the amount of butter fat in the mixture. England prohibits the addition of more than 10 per cent. of butter fat to oleomargarine; as also does France. Germany and Austro-Hungary limit the amount of milk (or cream) which may be used.

The limiting titre for butter is about 24; for an oleomargarine containing 10 per cent. butter fat, it is about 4 cc. $\frac{N}{10}$

The only component, other than butter itself, which can be used in oleomargarine, so as to introduce volatile fat acids into this latter, is coconut oil (palm-oil). Unless this oil is specially prepared, its flavor makes its employment in oleomargarine impossible. Under any circumstances, the Reichert-Meissl value of coconut oil is below 8. *Cohune oil*, another palm oil, not yet largely in evidence, resembles coconut oil, in this respect, having a Reichert-Meissl value of 8.4. Whale and porpoise oils give Reichert-Meissl numbers approximating that of butter fat; but their fishy odour, and other properties make them of no value for manufacture of a butter substitute.

Modifications of the Reichert-Meissl process, by Polonske and others have been worked out; and in careful hands yield results which, for instance distinguish between volatile fatty acids which are soluble in water and those which are insoluble in that menstruum; thus the volatile acids of coconut oil, chiefly capric and caprylic, are distinguished from those of butter fat, in which butyric acid predominates. These refinements in operation are however not justified in routine inspection of oleomargarine; although special cases may arise in which the most refined work may be necessary.

Specific Gravity of the Fat

The differences between the specific gravity of butter fat, and the fats likely to be used in oleomargarine, are most notable when these are determined at 35° C. and, it is therefore best to observe densities at this temperature. Typical densities are as follows:

Butter fat	(Skalweit)............	0.9121
	(Bell)................	0.911 to 0.913
	(Thorpe).............	0.909 to 0.914
	(Lewin)...............	0.911 to 0.912
Lard......	(Skalweit)............	0.9019
Margarine.	"	0.9017
Butterine..	"	0.9019

Refractive Index

For this determination, a refractometer is necessary. Any refractometer will do; but Zeiss has constructed an instrument (the Butyro-refractometer) of limited scale reading, and therefore more sensitive for the range required in determining the

* Presented before the Canadian Section of the Society of Chemical Industry, March 30, 1917.

indices of fats. The scale is arbitrary; and is best used at a temperature of 40° C. although by the use of correction tables, it may be used at other temperatures. The following readings are on record, for butters known to be genuine.

Norwegian	39.5° to 41.95	(?)
Russian	38.4° to 42	(45° C.)
British	37.3° to 43	(45° C.)
Fritzsche Dutch (stall fed)	41.9 to 43.2	(?)
(field fed)	43.3 to 47.6	(?)
Indwig Dutch	40.0 to 43.6	(40° C.)

The reading (at 40° C.) for other fats, is thus given by Bolton and Revis.

Beef fat	47° to 49°
Oleo oil	47.5 to 48.7
Lard	49 to 52

Thus, a reading above 44° may be taken to prove the presence of foreign fat in butter; while anything above 42° at 40° C, is decidedly suspicious.

Unfortunately, it is possible, by introducing small amounts of foreign substances into oleomargarine, to lower the refractive index. Thus coconut oil has a refractive index at 40° C. of only 35.2°; palm kernel oil, of 36.8°; whence it is evident that these oils may be used to lower the refractive index of oleomargarine.

It remains, however, to note that, as a rapid, and reasonably trustworthy means of classifying samples of butter, the Butyro-refractometer possesses a very high value.

Spoon Test

It remains to note a rough and ready test, which serves to indicate whether or not we are dealing with a genuine butter, or a renovated butter, or oleomargarine. A few grammes of the sample are slowly heated, in a large spoon. Genuine butter boils quietly with much froth; while surrogates sputter greatly, and yield no foam, or very little. This behaviour is, of course, due to the physical condition of the water in the respective samples.

Milk Test

This is another simple test which in careful hands may give useful information. A few grammes of the fat are added to hot milk and stirred until the fat is melted. On rapidly cooling, while the stirring is continued, oleomargarine forms a clot or lump; but genuine butter remains distributed through the milk.

It will have been noted that considerable variations exist in butter itself as regards the properties upon which we define butter. These are still more in evidence when butter which has become rancid, is treated in such a way as to correct its rancidity and other objectionable features. So-called "renovated" or "processed" butter finds a large market; and has distinct claims to be regarded as butter. This is essentially a butter which has been melted, well washed, its acidity neutralized by carbonate of soda, and then churned with milk, or milk solids. It may be a very desirable article, difficultly distinguishable from fresh butter. The rancidity of butter is sometimes due to the development of free fatty acids; but as a rule, the chemical changes are too slight to be ascertainable by our tests. The organs of taste are more sensitive than laboratory methods, and it frequently happens that sensation alone is able to determine rancidity. Under these circumstances it is open to question whether the renovation of butter should not be regarded as a positive gain of desirable food material.

Market butter is not always a perfectly clean article; and the development of rancidity is probably a consequence of the presence of organic dirt.

I may merely mention here the blending of milk with butter, with the object of introducing excess water. Many samples of milk blended butters have recently come into our hands, in which the water content has exceeded the legal limit of 16 per cent.; often reaching 25 or even 30 per cent. Nor is it to be supposed that oleomargarine is the only butter substitute existent. Cacao butter is largely used in Hindostan and other Asiatic countries; peanut butter is on our own markets. Where bakers and confectioners formerly used butter, cocoa nut oil, cotton seed stearin, palm-nut butter, shea-butter, etc., in various admixtures, are now largely used.

Recognizing the cupidity of manufacturers and dealers and the temptation to offer substitutes, resembling butter, as being actually butter, most countries have enacted special legislation in order to render such fraudulent substitution impossible, or difficult. So-called "ear-marks."

Germany requires addition of 10 per cent. sesame oil to oleomargarine; and forbids addition of butter to the article, which however may be churned with equal weight of milk.

England forbids addition of more than 10 per cent. of butter to oleomargarine.

Austria forbids addition of butter to oleomargarine, as in Germany, and requires 10 per cent. sesame oil.

Belgium forbids addition of butter. Requires 50 parts sesame oil and 2 parts of starch to each 1,000 parts fat.

Denmark requires 10 per cent. sesame oil.

Spain has no regulations affecting oleomargarine.

Holland limits the Reichert-Meissl number of oleomargarine to 10.

Italy forbids the coloring of oleomargarine.

Russia forbids coloring.

Sweden and Norway requires 10 per cent. sesame oil.

Switzerland requires 10 per cent. sesame oil. Except where noted, the use of coloring matter, of harmless character is permitted.

The United States of America permits the use of coloring matter; but imposes a tax of 10 cents per pound on colored oleomargarine. Most of the States of the Union have their own legislation in the matter.

Since fats are absolutely necessary to the sustenance of human life; and since careful scientific investigation has demonstrated that the normal nutrition of man requires a very considerable amount of fat in his ration, it follows that no legislation which prevents his access to a proper amount of fatty food can be, or should be effective.

Whether or not our own country, which alone of the civilized nations of the world prohibits the manufacture, importation and sale of butter substitutes of the oleomargarine type, furnishes sufficient available fat for the use of its inhabitants, is an open question. With butter at from 40 to 50 cents a pound, it is difficult to believe that our people, and especially our young people, are properly supplied with edible fats.

It cannot be denied that, in many countries, a vast amount of fraud in the substitution of oleomargarine for butter, with a view to realizing a butter price for the article, exists.

The only justification for permitting oleomargarine to be sold, is its relative low cost, as compared with butter; and if the manufacturer succeeds in selling it as butter, and at the price of butter, the desired object is frustrated. For this reason, every effort should be made to prevent fraudulent sale of oleomargarine.

Experience has proved that the most effective measure is the making illegal the sale of colored oleomargarine. This really imposes no hardship upon the consumer, since he can easily color the article himself, if he desires to do so; and he is assured of getting the substitute under its own name, and at its proper price. I have already noted that Italy and Russia expressly forbid the sale of colored oleomargarine.

The labelling of the article is also of importance. Every sale, at retail, should be clearly labelled.

Very severe fines, or imprisonment, should be exacted for violation of legal enactments. Small fines are useless, since the profit made is so large as to make it easy to recoup them by continuing fraudulent manufacture and sale.

Manufacturers of olemargarine should be licensed, if for no other reason than the facility which registration affords to inspection. Food Commissioner Foust, of Pennsylvania, speaking with thirteen years' experience of oleomargarine legislation finds that $500 for wholesaler's license, $100, for a retailer's license, and $50 for a hotel license, are not excessive amounts, in that State. Of course, these license fees are ultimately paid by the consumer, and enhance the cost of the article; for which reason they should be graduated so as not unreasonably to increase the retail selling price.

Food Commissioner Caspari, of Maryland, has found fines of $1,000 to be paid, by manufacturers; and recommends imprisonment, together with a fine.

It will have been observed that most of the strictly chemical methods of distinguishing between butter and oleomargarine are such as can only be carried out in a properly equipped laboratory. It is highly desirable that the article should carry on its face the evidence of its identity. Quite naturally the manufacturer seeks to make his product resemble butter in taste, smell, flavor, consistency and color. With exception of color, it is desirable that he should succeed in this endeavor; but I think that a vivid and easily perceived difference between butter and oleomargarine should be drawn at the color line.

The Milkman Process for Potash

By Saul E. Melkman

In the year 1860, the agricultural value of potash became generally known, through the researches of Professor Justus von Liebig, an eminent German scientist. In 1861 the first works for refining crude potash minerals was established at Stassfurt, Germany. Stimulated by the success attained in the use of potash as a fertilizer, the industry of mining and manufacturing its salts has grown to enormous proportions; new deposits have been discovered and mines opened, until to-day there are about one hundred and fifteen large mining establishments in active operation throughout Germany.

The beds from which the potash salts are mined occur from 1,100 to 4,000 feet below the surface. At these depths the salt is mined and thence carried into the chemical works, where the potash is recovered. The crude salts are charged into a dissolving vat containing a boiling, saturated solution of magnesium chloride, the mixture is agitated thoroughly by means of a live steam jet, and is boiled until it shows a degree of concentration equal to 32° Beaume.

The contents are then drawn off into settling tanks, from which the clear solution is run into crystallizing vats and left three or four days to cool and crystallize, the crystals containing about 60 per cent. pure muriate of potash. The liquors drawn from the crystallizing vats are boiled down in a vacuum evaporator, during which process some chloride of sodium and sulphate of magnesium fall out. This second solution settles and runs as into crystallizing vats where practically all the potash separates crystals of pure artificial mineral carnallit, ($KCl.MgCl_2.6H_2O$), which is then treated precisely as was the crude carnallit and gives a nearly pure muriate of potash in one crystallization.

The crystallized muriate of potash thus produced is contaminated by chloride of sodium and magnesium, through adhering solutions, and these impurities are removed by a series of washings with water. The liquor from these washings of the crystals is saved and used on fresh batches of the mineral ore.

The foregoing description deals with the production of concentrated potash salts from the inexhaustible supply of crude potash salts existing in Germany. Apparently this class of deposits occur only in that country. Some small discoveries of similar salt beds seem to have been made recently in Spain and California, U.S., but they do not appear likely to become a factor in the world's potash market. Does this, therefore, mean that Germany will forever retain a monopoly on this commodity, and that the world will have to depend on that country for its potash requirements?

Before answering this question it is well to note that Germany in 1913 produced about 2,000,000 tons of concentrated potash salts (worth $150,000,000) of which the United States and Canada alone took about 300,000 tons worth over $25,000,000.

Years ago, when wood ashes was the most common source of potash, there did not exist any easier or cheaper method of obtaining it than by leaching out these ashes. The burning of ashes was a favorite business undertaking by negroes who had run away from slavery in the South and had settled in Canada. As late as 1898 Canada exported over 1,300 barrels of potash, the equivalent of some 20,000 barrels of wood ashes. But ashes are no longer to be had in quantity. The ash heap of the pioneer is a thing of the past, while wood as a fuel for factories and railroads has been replaced by coal and oil. Besides, the economical aspect of the matter to-day makes it prohibitive to manufacture potash from that source any longer. Where then, shall we turn for our needs of potash?

Feldspar as an Inexhaustible Source of Potash Salts

There exist in Canada huge deposits of feldspar, some of which are very favorably situated to cheap transportation. Two such deposits in Canada have been examined by eminent experts, who found them capable of supplying the American Continent with potash salts (at its present rate of consumption) for at least two hundred years, providing a method could be devised for economically extracting the potassium from the rock.

Many inventors have patented processes to produce potash salts from the silicates; but not one of them enables the manufacture of a final product that will compete with the German potash salts in quality or in price. Undoubtedly some of these processes deserve a large amount of credit, and especially the one perfected by Messrs. Allerton S. Cushman and George W. Coggleshall. In their paper presented before the American Institute of Chemical Engineers, at the Philadelphia Meeting of December 2, 1914, they actually have submitted absolute proof that by their method they can extract potash in the form of chloride to a very satisfactory extent, but they also prove that theirs is not an economical success. Their final product according to their own figures, will cost about $32.00 per ton. If they could secure feldspar containing 10 per cent. K_2O laid down at their works for $1.00 per ton, and, they state, every additional fifty cents in the cost of the feldspar will increase the cost of the final product by one-third of one cent. per pound. The writer has made an exhaustive study of the feldspar situation the world over, and can effectively prove that no matter where the proposed works could be located in the United States, the cost of 10 per cent. potash spar would not be less than $2.50, and should the works be built on the feldspar deposit itself, then the freight rates on the other raw materials would be much higher than estimated. Therefore, and to make figures easier to absorb, the writer will assume a cost of $2.50 per ton of spar, which would increase the cost of their final product by one cent per pound, on $2.00 per ton, making the cost of the potash chloride $32.00 plus $22.00 or $54.00 per ton. At these figures, it would be impossible to remain in existence after the cessation of hostilities in Europe. Yet, the Cushman process would be the only really possible process, had not the author succeeded in perfecting a method to arrange certain raw materials, inclusive of feldspar, in such a manner, as to produce three final products, one as saleable as the other, and thus extracting the potash from feldspar at such a low cost, as to preclude the possibility of any future price-cutting by the German Syndicate. This process is known as

The Melkman Process to Obtain Potash from Potassium Bearing Rocks

It has been the dream of chemists for years past to extract the potash contained in certain silicate rocks, especially feldspar. Contrary to the German potash minerals, in which the potash occurs in soluble form, the potash in the silicates exists as an insoluble mass.

Under the Melkman process, the potash-bearing rock is ground to pass a 200 mesh sieve. This powdered material is then made into a homogenous mixture with an alkali chloride in a granular form together with a reducing substance, such as crude carbon in a finely pulverized condition. This intimate mixture is next fed into a quantity of sulphuric acid of 62° to 65° Beaume using the so-called salt cake furnace and heating at first at a moderate, relatively low temperature, and subsequently to redness. There are three phases of this process. In the first two phases a certain amount of the potassium present in the mineral in the form of water soluble salts is obtained. In the final phase, the neutral alkali sulphates, assisted by catalytic action of the carbon present, liberate more potassium in the form of sulphide of sulphate. Then the carbon in the presence of air is mostly consumed and alkali sulphides converted into sulphates.

The cinder obtained from the furnace is allowed to cool, then ground. The alkali sulphates are then dissolved out of the ground cinder and the sodium and potash sulphates separated by evaporation and fractional crystallization.

Comparison Between the German and the Melkman Methods

Whereas the German potash manufacturers have but to charge crude salts into a boiling solution in order to liberate the potash, the Melkman method necessitates a furnace treatment of the raw material before obtaining water soluble compounds of potash. Once the potash salts have been liberated from the mineral, the treatment of the liquor obtained by leaching out the soluble salts from the furnace cinder is practically the same as in Germany. Vacuum evaporators are used to separate the different salts.

The by-product obtained from the treatment of potash-bearing silicate rocks by the Melkman process are all very important and in enormous demand all over the world. The hydrochloric acid driven off during the beating process is collected in acid towers, and is then mostly converted into bleaching powder, a part of the acid being sold as such. Sodium sulphates are extensively used by glass and paper manufacturers as well as the drug trade the world over. Potash salts have an unlimited market. The residium of the entire operation consists of a ground silicious substance very rich in alumina, which makes a splendid material for the manufacture of vitrified bricks for street paving and other ceramica, or for cement. It may also be possible later on to extract the aluminum contained in this residue.

Description of Process

The Melkman process consists in intimately mixing finely pulverized orthoclase feldspar, salt and coke. This mixture is fed into what is known as a salt cake furnace, containing concentrated sulphuric acid of 62° Beaume.

This mass is heated externally by soft coal to a temperature of about 700° F. Hydrochloric acid gas is liberated by the interaction of the sulphuric acid and common salt leaving as a clinker a mixture of salt cake (normal sodium sulphate) and the feldspar which has been attacked to a greater or less degree. This clinker is next fed into a rotary kiln lined with fire-brick and heated internally by a crude petroleum air blast flame, so controlled as to give a reducing atmosphere and a temperature of 2300° Fahrenheit. During this stage of the process most of the potassium of the orthoclase is displayed by sodium of the salt cake giving soluble potassium sulphate and leaving a practically insoluble residue of potassium and sodium aluminum silicates. The ground clinker is next leached with hot water yielding a concentrated solution of sodium sulphate containing potassium sulphate.

Impurities, principally iron, are removed from the solution by adding soda ash and filtering. The filtered solution is then made neutral by adding a slight excess of sulphuric acid and then stirring in powdered marble or precipitated chalk. If the filtered solution has not already a specific gravity of 1.23° Beaume or less, water is added until this degree is reached. The conditions necessary in the subsequent separation of sodium sulphate are, freedom from iron, a neutral solution and a specfic gravity of 1.23° Beaume or less.

The solution is next evaporated in a vacuum evaporator, preferably of the Zaremba type. The temperature is kept at 140° F. and the pressure reduced to give about 25 inches vacuum. Anhydrous sodium sulphate precipitates out in the salt pans and is removed at intervals. This process is continued until the mother liquor contains the desired concentration of potassium sulphate when the final product is obtained by evaporation in open pans. A product containing as high as 90 per cent. potassium sulphate can be obtained by this separation.

Report on Chemical Process for Potash Extraction from Feldspar

by Dr. J. A. Dawson

Chemist Dominion Laboratories,

Ottawa, Ont., January 22, 1915.

To Mr. Saul E. Melkman,
Montreal, Que.

The object of the process which you have submitted for my investigation is to produce from three cheap materials, namely: Feldspar, Sulphuric Acid and Salt, three other products containing the same chemical elements, but so arranged chemically as to make chemical compounds of much greater value than the original materials.

The average cost per ton of the raw material is $4.00 while the average selling price of the finished products is $16.00 per ton. It has been established that the value of the finished products is equal to a value of $8.17 per ton of raw materials treated. It is thus apparent that a difference of $4.17 per ton of raw materials is available to cover the cost of the process and the earnings on the same.

It has also been established that the cost per ton of treating the above mentioned materials is $2.43. We therefore have a net profit of $1.74 per ton of mixture treated. The details of operating costs and the estimated profits are given later in this report. Feldspar containing 11 per cent. potash is mixed with coke and common salt. This mixture is fed into sulphuric acid of 60° to 65° Beaumè, using the so-called salt cake furnace. Thereafter it is submitted to a temperature of approximately 2300° F.; when a reaction takes place, liberating Hydrochloric acid and forming two new compounds, namely, sodium sulphate and potassium sulphate. The hydrochloric acid mentioned above is absorbed in water in suitable towers, producing a commercial form of hydrochloric acid.

The other two materials, sodium sulphate and potassium sulphate, as they come from the furnace, are fused together into one mass and must be treated with hot water, which dissolves both of these salts. This leaching process leaves a residue which contains a combination of aluminum and silicon oxides.

The solution coming from the leaching process containing the sodium and potassium sulphate must now be sent to the evaporator in which by use of a vacuum, the proper temperature at which to precipitate the sodium sulphate in solid form is maintained. In this manner we produce a sodium sulphate containing only a fractional percentage of potassium sulphate, thus effecting a practically complete separation of the two salts. The solution containing potassium sulphate is now evaporated to dryness and is then ready for the market.

Regarding the hydrochloric acid, it will be easy to dispose of the quantity we will produce by converting this acid into other chemical forms. The most available use is in the manufacture of bleach powder, which has a very large market, and the price of which could not in any way be influenced by the output of your plant. By the Weldon process this can be accomplished very economically.

It will no doubt be possible to dispose of a considerable proportion of the output of hydrochloric acid as such; but the manufacture of bleach powder is highly desirable.

Details of Cost of Operating a Plant Treating 100 Tons of Feldspar Daily

Raw Material

Feldspar	100 tons	$175.00	
Sulphuric acid	100 "	700.00	
Salt	100 "	300.00	
Coke	5 "	25.00	
Coal	50 "	150.00	
			$1,350.00

Labor

Unloading material	$40.00	
Crushing and grinding	25.00	
Mixing	10.00	
Handling material	15.00	
Furnaces	26.00	
HCL. towers	27.00	
Leaches and filters	22.00	
Evaporators	21.00	
Assembling products	45.00	
Foreman, repairs, etc	32.00	
		$263.00
Operation Bleach plant		$1,000.00
Power		85.00
Depreciation on plant	50.00	
Salaries and office expenses	100.00	
		150.00
Total daily cost		$2,848.00

Detailed Cost of Power

	H.P.	Hrs.	H.P. Hrs.
Crushing and Grinding Spar	400	8	3,200
Grinding furnace cake	75	8	600
Mixing plant	50	10	500
Furnaces	100	24	2,400
Hydrochloric acid pumping	25	24	600
Cinder grinders	50	8	400
Leaching plant	25	24	600
Crane	100	12	1,200
Lights	50	12	600
	875		10,100

10,100 H.P. Hrs. 7,575 K.W. Hrs.

7,575 K.W. Hrs. requires 20 tons of coal	$60.00	
Power house labor	15.00	
Repairs and miscellaneous	10.00	
Total per day		$85.00

Detailed Labor Costs

Unloading Material—		
100 tons of Spar at 15c	$15.00	
100 tons of Sulf. acid at 15c	15.00	
100 tons of Salt at 10c	10.00	
		$40.00
Crushing and grinding spar, furnace coke and cinder—		
2 foremen at	$5.00	
10 laborers at	25.00	
		25.00
Mixing Plant—		
5 men at	$2.00	
		10.00
Handling materials in plant—		
2 Cranemen (day)	5.00	
1 Craneman (night)	2.50	
2 Weighers (day)	5.00	
1 Weigher (night)	2.50	
		15.00
Furnaces—		
1 Foreman (day)	$3.00	
4 Men (day)	10.00	
4 Men (night)	10.00	
And 1 foreman (night)	3.00	
		26.00
Hydrochloric Acid Plant—		
6 Men (day)	12.00	
6 Men (night)	15.00	
		27.00
Leaching and Filtering—		
5 Men (day)	10.00	
3 Men (night)	12.00	
		22.00
Evaporators—		
3 Men (day)	9.00	
3 Men (night)	12.00	
		21.00
Assembling Finished Products—		
Hydrochloric acid	20.00	
Salt Cake and Potash	15.00	
Handling Cinder at	10.00	
		45.00
Foremen and Repairs—		
2 Day foremen	$8.00	
1 Night foreman	5.00	
3 Pipe fitters	7.50	
2 Pipe fitter helpers	2.00	
3 Mechanics	7.50	
1 Helper	2.00	
		$32.00
Total		$263.00

Operation of Bleach Plant

By heating the original mixture of feldspar, salt and sulphuric acid, hydrochloric acid gas is evolved, which is dissolved in suitable acid towers, thus:

$$2NaCl. + H_2SO_4 = Na_2SO_4 + 2HCl.$$

100 tons of salt plus 100 tons sulphuric acid of 62° Beaumè, will yield 190 tons of hydrochloric acid.

1½ tons of HCl. will make 1 ton of bleach, as follows:

Manganese dioxide (58%)	58 lbs. at..	$0.75
Lime for Chambers	1,200 " ..	2.10
Lime for oxidizers	1,300 " ..	2.30
Limestone for neutralizing	320 " ..	.20
Coal	1,100 " ..	1.65
Wages		3.00
1½ ton HCl.		
Cost per ton		$10.00

150 tons HCl. acid will make 100 tons of bleach at a cost of $1,000.00

The "Societa Electrochimca" of Rome, Italy, are using ten Hasenclevor machines and operate their works at Russe exclusively by this method. These machines consist of 4 superposed leaden cylinders, 6½ to 10 feet long, furnished with screw stirrers. This machine was patented in 1891.

Production of Plant Treating 100 Tons of Feldspar Daily

Available potash: 12½% extraction at 80%

110 tons of salt cake at	$9.00	$990.00
100 tons of bleach powder at	20.00	2,000.00
20 tons of potash sulphates at	32.00	640.00
Total value of products		$3,630.00
Cost of production		2,848.00
Daily net profits		$782.00
There remains 40 tons HCl. worth		
The plant operating 350 days per year, the annual earnings will be		$273,700.00

Market for Products

Canada and the United States consume about 500,000 tons of chloride of lime annually, representing a market value of twelve million five hundred thousand dollars...... $12,500,000.00

They also import the equivalent of 300,000 tons of concentrated potash salts from Germany, of a value of........ $22,500,000.00

Most of the hydrochloric acid used in both these countries is made in the United States, although some is made in Canada at the salt works in Ontario. About 200,000 tons of this commodity is annually marketed in the United States of a total value of.......... $3,250,000.00

Salt cake or sodium sulphate, used by all the glass manufacturers and by most paper and textile manufacturers, as well as in the drug trade, commands a large market. Normal selling price is ten dollars per ton f.o.b. works in bulk. It will be easy to dispose of large quantities of this material, but should your output of salt cake become at any time too large, the writer knows a very efficient way of utilizing the surplus in the company's own works.

The residue of the operations consist of a finely ground pulverized feldspar, very rich in alumina, which will make an excellent material for all kinds of ceramics, street paving blocks, vitrified bricks, glazed bricks, or for glazing enamel ware or pottery. This material now sells for $6.00 per ton f.o.b., Trenton, N.J., Wilmington, Del., or East Liverpool, Ohio. It

(Continued on Page 93)

Water Powers of the Prairie Provinces

By Percival H. Mitchell, E.E.

Within the provinces of the Dominion of Canada, and excluding the Northwest Territories, practically all of the Yukon, and the Northern and Eastern portion of Quebec, it is estimated that 17,764,000 horse power is available, this amount being inclusive, in the case of Niagara Falls, Fort Frances and the St. Mary's River at Sault Ste. Marie, of only the development permitted by International treaties, and further does not contemplate the full possibilities of storage for the improvement of capacities. The developed powers which are inclusive of all water powers whether for electrical production, pulp grinders, for milling or for the great many other uses, aggregate 1,711,188 horse power.

The Prairie Provinces are essentially agricultural. The deep rich prairie soil is a mine available to hundreds of thousands of farmers whose dividend of golden grain is never failing. The settlement of the great west has been fabulously rapid and the industrial development has far from kept pace with the agricultural requirements; the industrial era has, however, dawned, and it is to be expected that in the near future the local consuming market will be a to a great extent satisfied by local manufacturers.

The uses of electric power in an agricultural country are threefold; first, directly applied to the production, operation and marketing of the products and natural resources; second, for manufacturing purposes in the supplying of the market created by the people of such a country; and third, in the community life, the public utilities and transportation.

It is hard to predict the future of electric power under such conditions. The enormous strides of the last twenty years, in reality the period since the establishment of the first commercial electrical transmission system, has developed established loads necessitating in the United States and Canada, alone, the development of water power plants aggregating ten millions of horse power, the last ten years more than doubling the first ten years in the rate of growth. The load curves showing the growth in power requirements from year to year in each of the large cities of Canada show an increase from very small dimensions of from five to ten years ago to enormous demands, and at a rate of doubling in from one to three years, and with the curve of the load diagram indicating most vigorously similar increases in the years to come. While it is quite apparent that the greatest portion of these loads is consumed in the older districts of the Great West, the population and the quantity of output is, too, increasing very rapidly, adding a new factor of growth to the swelling power demand, the combined effect of which is readily borne out by the evidence of the respective records.

The water powers of Manitoba, Saskatchewan, Alberta, the Northwest Territories and the Yukon are under control of the Dominion Government, and its water power policy, as administered by the Water Power Branch of the Department of the Interior, affords every reasonable protection to the public as to rentals, periodic revisions, control of rates, limited grants, etc., and at the same time fosters legitimate private enterprise to return reasonable profits.

Regulations are in force affording all possible assistance to the development of water powers which have every reasonable assurance of economic realization, and further, before the authorization is given to proceed with development, complete investigations are undertaken to prove the economic features of design, capacities and costs, and eventually supervision is carried out during construction. Proper government in supervision and control of the construction and maintenance of all developments is the only safe method of intelligently initiating construction and maintaining an adequate system of river improvement for power purposes.

In the consideration of the water powers of Manitoba, Saskatchewan and Alberta, two river systems stand out preeminently, that of the Winnipeg River in Manitoba and the Bow in Alberta. The rapidly increasing utilization of these rivers for power purposes, the power plants at present contemplated for construction, and the value of the potential water powers not yet awarded, has required the immediate attention of the Dominion Government as to the possibilities in each case, and these demands have resulted in exhaustive investigations. The complete reports in these two instances have been embodied into the "Water Resources Papers" of the Water Power Branch of the Department of the Interior, under the title of "Bow River Power and Storage Investigations" and "Manitoba Water Powers," respectively.

Winnipeg Electric Railway Co., Power House of Pinawa Channel, Winnipeg River.

The Winnipeg River is notably one of the most important power rivers on the Continent, draining an area of some 55,000 square miles into Lake Winnipeg. This great watershed comprises the Rainy Lake and Lake of the Woods and the English River, all inclusive of the immense circular area about 250 miles in diameter, lying immediately north-west of Lake Superior.

While the headwaters of the Winnipeg River lie for the most part in the Province of Ontario, the power possibilities of grater magnitude are included in the Province of Manitoba. Two sites are already developed, the City of Winnipeg having constructed a plant at Point du Bois, the first site on the river within the Province, where 51,500 horse power of machinery is installed, delivering power 77 miles distant in Winnipeg, and the second plant being that of the Winnipeg Electric Railway on the Pinawa Channel, a short cut across a great elbow of the river which empties into Lac du Bonnet; this plant has 28.200 horse power of machinery, and the power is also transmitted to Winnipeg a distance of 65 miles.

Elbow River, above Power Dam Site.

The available undeveloped sites in their order coming down the Winnipeg River after leaving Point du Bois Falls, are Slave Falls, with a possible development of 44,400 horse power; Upper Seven Sisters, 29,600 h.p.; Lower Seven Sisters, 37,900 h.p.; McArthur Falls, 37,000 h.p.; DuBonnet Falls, 95,500 h.p.; and Pine Falls with 63,100 h.p. The figures of power contemplate the storage and regulation of the river when instead of the natural minimum water flow of 12,000 cubic feet per second, 20,000 cubic feet per second would be available. These sites range from 52 to 74 miles from Winnipeg.

The Bow River rivals the Winnipeg river in immediate importance although its various power sites are smaller in capacity. The source of the Bow River lie on the Rocky Mountains within an area of 3,138 square miles on the eastern slope. The river falls 2,750 feet before reaching Kananaskis Falls, 55 miles above Calgary and from this point to Calgary a drop of 720 feet takes place. Six power sites of large dimensions are available, the Kananaskis Falls and Horse-Shoe Falls, the highest of the series being now developed by the Calgary Power Company, which in these two plants has a generating capacity of over 30,000 horse power which is transmitted to Calgary and to the cement mills at Exshaw.

Four sites are available for economic development on the Bow. These are the Bow Fort site, for which a head of 66 feet operating three 4,400 horse power units is considered the best development by the Dominion Water Power Branch engineers; the Mission, to utilize a head of 47 feet on three units of 3,500 horse power; the Ghost site, also with three units of 3,500 horse power, on 50 foot head; and the Radnor site with three 3,500 horse power units at 44 feet head. All these four sites are located between the Horse Shoe Falls and Calgary and are within short transmission distance of Calgary.

Further dealt with in considering the water powers of the Prairie Provinces are the North and South Saskatchewan Rivers, which traverse the prairies and while not having many favorable sites include the La Colle Falls at Prince Albert, and the Grand Rapids below the junction of the two rivers.

The Elbow River, one of the mountain headwaters of the South Saskatchewan, has one economical site capable of over 10,000 horse power capacity and located but thirty-three miles from Calgary.

In the neighborhood of Lake Winnipeg are several valuable sites, these are the Fairford, Dauphin and Waterhen, in the Lake Manitoba and Lake Winnipegosis headwaters; those at Minnedosa and Brandon on the Little Saskatchewan and at Currie's Landing, on the Assiniboine, near Brandon. The rivers on the east shore of the lake are all under study from the power standpoint.

St. Andrew's Dam, Red River, Manitoba

The Nelson River is fabulously rich in water power and from the list of possible sites enumerated the aggregate for the minimum unregulated flow is over two and one-half million horse power, while with the extensive regulation proposed for the headwater rivers this would be much increased.

The Churchill, lying even more northward than the Nelson, and flowing into Hudson Bay, promises many sites which the future will probably find playing an important role in Canadian industry.

The Athabaska, in Alberta, rises in the mountains and has occasional power sites all of which require more or less expensive developments.

The Peace River flowing through the 45,000,0000 acres of arable land just recently made accessible for settlement, will no doubt rise to the demands for the electric power necessary in the many communities and industries bound to develop.

The Slave River drains Lake Athabaska into the Great Slave Lake, and as there are some sixteen miles of rapids in one stretch, its investigation will, no doubt, reveal an excellent power site.

The MacKenzie River, flowing from the Great Slave Lake to the Arctic, is not as yet investigated from the power standpoint.

The resources of these provinces are extensive, the agricultural possibilities are famed throughout the world; the Forestry products are astonishing in value according to our conceptions of the Prairie Provinces; in coal, Alberta is the richest province in the Dominion and in oil and gas, peat, bitumen, stone, cement and clay products, gold and iron, the real wealth is only beginning to be appreciated.

The future of water power in the West requires no questioning as to its ultimate complete development. The new uses of electricity, bound to be evolved from time to time and quickly to be absorbed into the routine requirements of ordinary life, combined with the present rapidly growing power loads, will, within the period of one or two generations hence, demand the utilization of practically all the available water powers of the country.

As possibly affecting the west most vitally, the problem of chemically fertilizing of soil must demand serious attention. The great natural fertility of the prairie is dependent upon a wonderful, but gradually exhausting store of plant foods, and the agriculturists have neglected the replenishing to maintain the original or necessary supply. In some parts of the West artificial fertilizing is a need of the present, and in the near future the demand will be universal. Nature replenishes the earth by the decaying of the plants which have absorbed the nourishment, by animal manures, by bacterial action and by the electrical discharges of the air.

Nitrogen is the greatest essential in the replenishing of the soil; the atmosphere contains an unlimited supply, three-quarters of the weight of the air being nitrogen, but not in a form available for the soil. Above each square mile of land, it is estimated, there are 20,000,000 tons of nitrogen. As a result of electric action in the air about 100,000,000 tons of combined nitrogen are restored annually by nature to the soil of our planet, present in the form of nitric acid and nitrates in descending rain. By properly applied electrical discharges in the presence of air, this process can be duplicated and nitric acid and nitrates produced in commercial form. The locality of the manufacture of such a necessary commodity is, from the standpoint of transportation, nearest to the point of use, and the distribution of the atmosphere is universal; in the Prairie Provinces the proximity of the great water powers adjacent to this coming market is most notable.

The 200,000,000 acres of arable land within the provinces, when all placed under cultivation, will possibly consume on average more than 100 pounds of nitrates to the acre when extensive fertilization is resorted to. To-day the efficiency of electrical production of nitrates is low, but possibly five tons per horse power year would be beyond the highest efficiency to be obtained in the future. The power required to meet such a yearly demand would have to be two million horse power. The figures are staggering, but with time as an element and with Canadian wheat as a staple, in an ever widening market, such conditions must come to pass.

By electrometallurgy the iron ores of Lake Winnipeg assume a commercial value, and the future market of the West for iron and steel will find considerable quantities locally manufactured. Pig iron and steel from iron ore, produced by the electric furnace, is now an accomplished commercial fact.

Electrification of trunk lines is a matter for time to bring about; conditions in the West, on the Prairies and in the mountains, are ideal for this kind of transportation.

Distribution of electricity in the rural districts may become a reality of the near future, while hydro-electric distribution has been studied in Manitoba on a very extensive scale, embracing the greater portion of the southerly part of the Province the wide distribution necessary in supplying the rural remote districts, and the intermittent and comparatively small power demand now to be obtained does not at present justify its development. In the adjoining Province of Ontario, however, a notable publicly owned system has been established, and besides transmitting power to towns and cities throughout a great area over a network of over 2,000 miles of circuits, this system is now extending its lines so as to include many of the rural districts, with the expectation that the load to be procured will eventually justify the extension to include the whole are traversed by the system.

Lock and Dam, Cole Falls, North Saskatchewan River

A protrait of the late Professor Raphael Meldola is being painted by Mr. Solomon J. Solomon, in order that copies may be presented to the Royal Society and the Insitute of Chemistry.

Construction work on a new pulp mill at Edmunston, N.B., is making progress, as well as the installation of the new seweriage system.

The Manufacture of Linseed Oil *

By Glenn H. Pickard

Practically all of the flax seed or linseed crushed in America is handled in the open plate hydraulic press. Until recently a small proportion of the oil was won by the extraction of the seed with naphtha, but with the recent destruction by fire of the last plant operating on this principle the process, so far as linseed oil is concerned, ceased to be in this country. The expeller is employed in a few mills, but the amount of oil produced by this means is a very small proportion of the whole.

The first step in the manufacture of linseed oil from flax seed is the cleaning of the raw material. The removal of the foreign matter in a consignment of seed is accomplished by specially designed flax screening machinery, which employs the usual method of passing the grain over screens of proper sizes which separate, as completely as possible, the foreign matter from the flax seed. A current of air removes the chaff. This procedure will reduce the percentage of impurities to an amount lying between one and two per cent. The screenings are generally run through a separator and the wheat, corn, oats and possibly other grains are sold as such while the wild buckwheat, pigeon grass, wild mustard and other valuable weed seeds are sold to feed manufacturers.

The presence of oleagenous seed would deleteriously effect the quality of the linseed oil because the oils yielded by them are non-drying. The extent of the damage would, naturally vary with the amount present. Non obagenous matter, particularly immature seeds and bits of the plants, impart a dark greenish color to the oil. The presence of much foreign matter will reduce the yield by absorption. It is economically possible to clean to such an extent that from but one to two per cent. of impurities remain.

The cleaned seed is now crushed by passing it back and forth between rolls which are built in stacks of five. They are usually made of chilled steel and are 14 inches in diameter by 48 inches long. The journal boxes are loose in vertical guides so that the weight of the other four is carried by the bottom roll. The seed passes between rolls four times and at each successive passage the pressure is increased by the weight of an additional one. The top, middle and bottom rolls are driven by power applied by rope or belt drive as the case may be. The object of the crushing is to disintegrate the seed, thus breaking down the cell walls preparatory to expression of the oil. Consequently, subdivision to the greatest possible extent consistent with economy is the best practice. Generally all of the rolls travel at the same rate so that there is no grinding or mulling action to assist in the disruption of the seed itself.

Stacks of rolls have been built in which the speed of each varied, thus producing a grinding action by slippage at point of contact. No data is available to show whether or not an increase in yield resulted.

Given a standard set of rolls the two important variables are the revolutions per minute and the rate at which the seed is fed. Practice in both varies obviously the more rapid the rate in both instances the poorer the grinding will be. Observations have led to the conclusion that the crushing of about ten and a half bushels per hour at a roll speed of one hundred and fifty revolutions per minute is the most economical practice on rolls 14×48 inches.

In order that, when placed under pressure, the ground seed may more quickly, more easily and more completely give up the oil it contains, it is heated with or without the addition of moisture. This is accomplished in the hea er or cooker, the unit of which is a cylindrical chamber with a steam jacket on the bottom and around the sides. These cookers vary in diameter from 42 to 84 inches. Linseed oil mills are generally equipped with 72 or 84 inch cookers. The depth of the chamber is about 24 inches. From two to four units, one above the other are generally used. In each receptacle there is a sweep which lies very close to the bottom in order that the meal may not lodge there and burn. The shaft to which these sweeps are attached is hollow. A finely perforated pipe is fastened to the back of the sweep and is connected to the opening in the shaft. Through this system steam may be admitted to the meal.

There are two practices followed, one in which the two unit cooker is employed and steam is led into the meal in the upper chamber. The amount of steam varies with the moisture content of the seed. The feed is so regulated that the meal chambers are not full providing space above which allows evaporation to take place. The other method is to use the "three" or "four" high kettle, adjust the feed so that the whole apparatus is full all of the time and admit no live steam at all except possibly when crushing old, dry seed which is hard to soften.

The factors entering into this operation are the speed of travel of the meal, and consequently time under heat, the temperature to which it is heated, and the amount of moisture present. If the time is too short the tissues are not thoroughly softened and the yield is low as a result.

When the temperature is low the yield falls and the cake is brittle and easily broken; if it be too high the cake has a characeristic and undesirable odor and the oil will be dark and in certain uses will cause trouble.

Too little moisture yields a crumbly non adherent meal which will not pack well and from which the cake is unsatisfactory. If too wet the meal is soggy, the oil contains an excessive amount of moisture and the cake will be dark in color and tough.

We have, therefore, three factors to coordinate in the tempering or heating of linseed meal. The only means of control are the senses of the operator. He takes a handful of meal and compresses it. If it has a certain "feel" under pressure, packs in a definite manner and oil can be started by the pressure of the hand, he says that it is well tempered. He modifies one or another of the elements of control, when the cake or the meal varies from his standard.

Obviously the personal equation causes marked fluctuation. No two men are in complete accord upon fundamental principles. No accurate data are available, if indeed any exist, on which to base a system. Little is known of what really happens in the tempering operation The theory is that the combined heat and moisture break down the walls of the oil cells, coagulate the albuminous sediment forming portions of the seed and reduce the viscosity of the oil, thus making it possible for the flow to be more quickly and easily accomplished under pressure.

Of the mechanism of the changes within the ground flax seed, or of the manner in which variations in operation bring about the results noted in practice, little or nothing is known. It does not appear to be a difficult matter to apply scientific methods of observation during the process with the view of securing means of definite and positive control so that variations in raw material may be made convergent in the meal cooker and so that uniform efficiency of extraction and uniform products may result.

From the bottom of the lowest compartment of the heater the meal passes into a metal box mounted on a runway over which it travels to the "former," a machine which measures the amount of ground seed to constitute the charge for each of the plates of the press and compresses it to a soft cake. These formers are actuated by hydraulic, by steam or by belted power. The hydraulic type, the one commonly used, is operated from the low pressure hydraulic system. At the end of the runway on which travels the meal box is a hinged flapper frame on a table which moves at right angles to the travel of the box so that it may be pushed back under the stationary part of the machine. This consists of a head block of heavy cast iron supported by wrought iron pillars, designed to withstand the

* Paper read at the Buffalo Meeting, American Institute of Chemical Engineers, June 20-22.

upward pressure of a base plate actuated from below by a hydraulic ram. During the operation a slide gate in the bottom of the cooker is opened by hand to allow the box to fill with meal. On the table is laid the press cloth in a strip about fifteen inches wide and six feet long. The buggy box is now filled with meal and pulled out over the frame into which most of its contents fall. It is generally given two passages over the frame to insure an even filling of the space. Considerable skill is acquired by experience in the handling of the box in order to produce a clean uniform fill with the material evenly placed and of constant weight. The table is now pushed back under the head block, the power applied for an instant, then released, the table withdrawn and the flapper frame is lifted. The ends of the cloth are thrown over the top of the formed cake when the pressman slips a sheet iron pan, slightly larger than the frame and equipped with a handle on one end, under the cloth, and transfers the molded and wrapped cake to the press box. This type of former minimizes danger of injury to the operators because it it is practically impossible to get one's fingers in a position where they will be crushed.

To do good work a former must mold a perfect and compact cake that will fit the press boxes, must work cleanly, that is, not spread the meal out to litter up the press room, must make a cake sufficiently coherent to permit of necessary handling without loss of portions of it and must deliver a cake of uniform density and thickness so that uneven pressure will not be caused in the press and cakes of uniform weight will result after pressing.

There is a mechanically operated buggy box in which the box is on the end of a piston actuated by hydraulic power. The machine lacks the uniformity resulting from the effort of a man interested in doing good work because it will not run the meal box over the frame twice in order to have it evenly filled and thereby make a cake of uniform density. It doubtless, however, compares favorably with the work of green or indifferent operators. It does not make a reduction in labor expended because a man is required to operate this machine and to do the other work necessary to form and wrap the meal just as when all hand power is employed.

The press used in the winning of linseed oil is the typical open plate hydraulic machine, the essential parts of which are: The cylinder and lower block, frequently cast in one piece; a stationary head block which is bolted through to the lower block by means of heavy hammered iron columns; and the ram, on the end of which is placed a platen or heavy block rigid enough to prevent flexure at the ends so that even pressure will be exerted over the entire plate area.

Hydraulic pressure is obtained from power driven pumps so equipped as to be capable of supplying both high and low pressure. One of the most popular forms of pump is a four crank design furnishing both pressures. The hydraulic system consists of a supply tank for the liquid, which in this case is linseed oil, pumps, accumulators, valves, change cocks and piping. The accumulator consists of a mass of heavy material superimposed upon a ram and guided in its vertical movement. Its object is to store hydraulic fluid, which is intermittently used, thus producing more constant load on the pumps, to steady the pressure by reducing shocks which, if severe, would injure the machinery and piping, and to act as a regulating valve to maintain a uniform pressure. Both the high and low pressure systems have an accumulator. The low pressure is used to start the working stroke of the press and to operate the "former," the packer and possibly the other hydraulic machinery. It is usually set at 500 pounds per square inch. The high pressure varies between 3,500 and 4,500 pounds.

The regulation of the pressure is this. When there is no demand for fluid the plungers work idly by circulating the oil through and back to the supply tank by means of the automatic movement of a valve from a system of adjustable rods and levers at the accumulator. When working fluid is again required the by pass valve is closed by the fall of the accumulator and the pump again delivers fluid at working pressure. When communication is opened to a press through an automatic change cock the pressure is turned on into the ram only from the low pressure accumulator. The press ram travels up rapidly until a pressure of 200 to 300 pounds is reached, which is enough to start the oil. A choker in each pipe regulates the speed of the press by throttling the flow of the fluid. The ram travel is slowed down in proportion to the escape of the oil. When a pressure of five hundred pounds is reached the oil from the high pressure accumulator is automatically turned on to the press ram. The speed of travel is again governed by a choker so that the maximum pressure of about 4,000 pounds is not reached until the ram is nearly at the end of its travel.

Press plates are at present generally made of rolled steel about ⅝ inches thick. They were formerly made of iron or of brass. The sizes of the plates vary, though in linseed oil manufacture they are generally designed to hold a cake 13×32 inches or 16×34 inches.

Drainage is secured by cutting grooves or oil channels close to the edges of the plate which are pitched toward the rear where they connect with down spouts that conduct the oil to the receiving troughs at the floor level behind the presses. Some presses are tilted back to give a fall sufficient to cause the oil to run in that direction.

Suspension of the plates, when pressure is released, is usually obtained by the use of links, each set of which carries the plates beneath, unless sectional supports are provided. The links are of two sorts, the plain open type, or the square, flat headed type. The former are fastened to T headed bolts screwed onto the edges of the plates while the others are slipped into notches cut in the sides of the plate near the ends. Often the plates are divided into groups so as to lighten the load upon the links. This is accomplished by having lugs on the plates which engage the heads of screws set at proper intervals in the columns. Another very effective method of support is by a step ladder or inverted V shaped device, the feet of which are fastened into the columns near the bottom plate, while the top is attached to the head block at the centre of each side. The legs of the ladder are of steel plate and are notched at measured intervals. Into each side of a plate are screwed two headless bolts so placed that each engages its own step of the ladder. Thus, each plate is supported by a rigid frame and the load caused by a group of plates is done away with. The wear on the steps is slight and easily adjusted for when the press is up the supporting frame can be removed and repaired without removing the plates, while when the links are used each plate must be removed whenever it is necessary to shorten them. It is important that the links be kept true for they control the space between plates which must not fall below a minimum or the cakes cannot be placed easily. It is a too frequent occurrence, especially in new mills, to have the cake space shortened by wear or lengthening of the links so that the bottom cake is not easily put into proper position causing uneven pressure and the breaking of the platen. It is false economy to reduce the cake space in designing a press for time is lost during loading and cakes are not evenly placed causing them to lie at angles instead of parallel to each other. This means uneven pressure and loss of oil. With ample working space the molded and wrapped cake is quickly placed into proper position thus lengthening the time of pressure and insuring even pressure throughout.

Primarily the capacity of the press is controlled by the number of plates comprising it though variations in operation, to be discussed later, are factors of the capacity of any given press. The number of plates in the presses of American mills varies, generally, between 16 and 26. The obvious objection to the small presses is low capacity for when reduced below twenty plates little, if any, gain in yield results. When the large 24 and 26 plates presses are employed it is hard to find men tall enough to reach the top plate and agile enough to place the bottom one quickly. A slight additional expense is noted with large presses caused by the destruction of the ends of the slip pans which are broken by the exertion of downward pressure before they are entirely out from between the plates. When a large number of cakes are replaced the press is down a longer time and consequently cooled more. The temperature of the press and its contents has an important bearing upon the yield, consequently the lower it drops the lower is the extraction. It may be said that the meal can be raised to a higher temperature, but this is an undesirable thing for there is a limit beyond which meal ought never to be heated. Further, when the number of plates is large, there is a correspondingly great mass through which the pressure must be exerted. When this goes beyond a maximum excessive cushioning occurs and low yield results. The extent of the loss caused by the use of large presses is an unanswered question though one capable of easy solution. No data is available which shows, with all other variables constant, the effect that the increase in the number of plates has upon the yield of oil. What might be called circumstantial evidence, that is, the comparison of the percentages of oil in the cakes produced in mills known to have large and small presses, shows the latter to be more efficient. However, other factors enter which could account for the difference. It is the opinion of many versed in the operation of linseed mills that the 20 plate press combines the greatest number of elements that make for efficient extraction.

One of the relatively large items of expense in linseed oil manufacture is that of press cloth, that is, the material which is wrapped about the cake when molded. It is usually woven from camel's hair because of the elasticity of that fibre and its ability to retain its strength and form under high pressures and temperatures. At present, this material is very high in price and is scarce as well. Various mats of wool and mixtures of wool and camel's hair cloth are being tried, but preference would still be given to the camel's hair. Press cloth of human hair is now available. First tests of this showed up very well against camel's hair.

The torn cloths are darned, patched, mended and pieced until the waste comprises short strips which are beyond redemption. These are but typical causes for too rapid destruction of press cloth. Constant watching by intelligent men is necessary to keep down this item of expense.

When the oil runs from the presses it is caught in settling troughs or deep metal boxes in which coarse particles settle to the bottom. From here it goes to filter supply tanks. Filtration is accomplished by the plate and frame press. The filter medium varies from light sheeting to heavy duck and from light to heavy paper. At some mills the oil is filtered warm through cloth, sent to storage and then refiltered just previous to shipment. With many the second filtration is omitted. Others allow the oil to cool without the first or, as it is termed, "scalping" filtration and then pass through cloth or paper.

Any one of these practices will remove the suspended particles of seed and deliver a clear oil. However, moisture and materials taken into colloidal solution from the seed are present in larger amounts in warm oil. They gradually precipitate as the temperature falls, forming what is known in oil parlance as "foots." Therefore, the temperature of the oil at time of filtration is an important function of its quality. If single filtration is determined upon, excellent results may be had by allowing the oil to cool and then passing it through cloth or paper, prefereably the latter.

The quality of raw linseed oil is, obviously dependent upon the manner of its filtration. Further, too high a temperature in the heater darkens the oil and causes it to dissolve more material from the seed. A hot pressed oil will darken more under heat, will not bleach so well in the refinery and shows other deleterious effects of the high temperature.

The quality and cleanness of the seed have a marked influence as well. Seed selection for oil quality is unknown, because no means at present exists to connect the characteristics of perfect flax seed with the quality of oil contained.

An investigation of this problem is at present under way. We are hopeful of results that will enlighten us upon the effect of seed strain, soil and climatic conditions, upon the quality of oil and possibly enable prediction from an examination of flx seed of the quality of its oil.

Damaged seed, foreign oleagenous seed and chaff or weed seeds capable of yielding coloring or other matters soluble in the oil are detrimental to the quality of the raw oil.

The manufactures employing linseed oil demand of some of that product specific qualities such as, pale color, high content of fatty acids, proper action in the varnish kettle and high speed of polymerization when subjected to high temperatures. These qualities are imparted by chemical treatments of various sorts which are more or less secret and which involve only simple mechanical equipment and operation.

The yield of oil is, naturally dependent upon two things, the amount of it in the seed and the efficiency of the extraction.

During the last five years the average oil content of clean seed received by a mill on the seaboard was 39.02 per cent. North American seed comprised 75 per cent. of that crushed, the rest being South American, assuming that the cake will contain 5.5 per cent., an amount attainable by good practice, the theoretical yield of a cake will be 36.15 pounds and of oil 19.85 pounds or 2.64 gallons of 7½ pounds each. The word "theoretical" is used because there is a manufacturing loss of about 2 per cent. This is nearly all due to the evaporation of moisture, though some is accounted for by soakage, dusting and similar causes. If the moisture in the seed is high the loss will be above normal for oil carries very little water so the cake must contain all that is in the seed or a loss is inevitable.

The Possibilities of Developing an American Potash Industry*

By Richard K. Meade

The present methods employed for obtaining potash in this country may be grouped under four general heads.

1. By the evaporation of the brines from various lakes and marshes.
2. From the kelp and the ashes of various plants.
3. As a by-product of various industries, chief of which are the cement, iron, beet sugar, and molasses industries.
4. By the decomposition of silicate rocks, chief of which are alunite, glauconite and feldspar. Numerous other silicates are also available, among which are leucite and sericite.

Brines and Lakes

It is natural that the first attempts to obtain potash in this country were connected with the evaporation of brines from various lakes in the western part of the country. Geological Survey reports, even before the war, had called attention to the large amount of potash contained in the waters of some of these lakes, notably Searles Lake, in Southeastern California, which has been made the subject of extensive investigations on the part of the United States Geological Survey. The American Trona Corporation was organized in 1913 to exploit this lake, and had planned to spend something like $3,000,000 to build a railroad and to install the necessary machinery to recover borax and potash from this water. At that time, particular stress was laid on the borax rather than on the potash.

Searles Lake is located in the extreme northwestern part of San Bernardino County in southeastern California about thirty miles from the Southern Pacific Railway, at Searles. It consists of a dry bed of crystalline salts, hard enough to support a wagon and team. It occupies an area of from eleven to twelve square miles and has a depth of approximately 70 feet. The deposit

*Extracts from a paper presented at the Buffalo Meeting of the American Institute of Chemical Engineers, June 22, 1917.

contains a saturated brine in the interstices between the crystals, estimated to be 25 per cent. of the volume of the bed, and carrying approximately 2.1 per cent. potash (equivalent to 4 per cent. potassium chloride) and about 1.3 per cent. borax.

The American Trona Corporation has shipped quite a large quantity of potash in the past year. I understand that from the chemical standpoint, an objection is raised to their product owing to the sulphates and borax which it contains, and I am also informed that the fertilizer people have objected to the product on account of the borax.

There are numerous small lakes in the region of the Sand Hills of Nebraska, the waters of which are more or less alkaline and also contain potash. This potash is believed to have resulted from the leaching of the ashes from numerous forest fires which have occurred in that section. The larger and deeper of these lakes are only slightly alkaline and the only ones which are at all rich in alkali are the small lakes.

There are a number of other companies throughout the west who are experimenting on the production of potash from brines. One of these companies is the Inyo Development Company, who has a small experimental plant and are planning to develop the potash resources of Owens Lake.

Owens Lake is situated south of Mt. Whitney and northeast of Death Valley, Cal. The lake is twenty-seven miles long and twenty-three miles wide, and is estimated (H.S. Gale) to contain 3,000,000 tons of potash.

Several thousand tons of soda ash have been made at Owens Lake, and it is proposed to recover the potash from the spent waters from the soda ash manufacture. These waters were formerly wasted and contained about 4.25 per cent. K_2O in the form of carbonate.

There has been some attempt to develop a potash industry in connection with the Great Salt Lake, in Utah. The Utah Chemical Company is reported to be erecting a plant to make potash from the bitterns obtained as a by-product from the manufacture of solar salts from the waters of the Great Salt Lake. This plant is largely an experimental one.

The developments at Searles, Owens and Summer Lakes will depend almost entirely on the Pacific Coast market for soda ash and salt cake, and it is hardly probable that under normal conditions the market in that section will be sufficient to dispose of any very considerable quantity of these products. In the case of both Owens Lake and Summer Lake, the quantity of soda to be disposed of is so very much larger than that of potash, that they probably would never amount to anything more than very small potash producers. Against Summer Lake is also the difficulty of transportation and of obtaining labor, and the high cost of fuel.

Kelp

The fact that the giant kelps of the Pacific Coast are rich in potash has long been known. As early as 1911, kelp was gathered and dried by the Pacific Mulch Company, Terminal Island, Cal., but no effort was made by this company to do anything more than harvest the kelp, partially dry it, and chop it into pieces from 6 in. to 8 in. long. In the 1913 Mineral Resources, the United States Geological Survey reported that a number of companies had been formed to engage in the kelp industry. At that time, however, no effort was being made to extract potash salts from kelp, and attention was entirely devoted to the harvesting, drying and grinding of the kelp.

I believe that the American Potash Company was formed prior to the war and was the first company actively to attempt the production of potash from kelp. This concern had a plant at Long Beach, Cal., where they harvested and dried kelp, using an oil-heated rotary dryer for the latter purpose. Some dried kelp was sold as such, while the rest was burned in a reverberatory furnace, the potassium chloride and sodium chloride leached out of the ash, and separated from each other by fractional crystallization. The American Products Company, Pasadena, Cal., later bought the effects of the American Potash Company, and moved to the property of the latter.

Swift & Company, of Chicago, leased a small plant at San Diego and are harvesting and drying kelp. They make no effort to extract the potash, but are simply drying the kelp and shipping it to their fertilizer factories in the East, where it is used in the manufacture of mixed fertilizers.

The Hercules Powder Company have the only large plant on the Pacific Coast at the present time for actually obtaining potash salts from kelp. Their plant is located at Chula Vista, Cal., and represents a splendid example of chemical engineering ingenuity, although it is probably only a war-time proposition. The products obtained are potassium sulphate and acetone. The kelp is harvested by machinery and is ground by the harvesters to a thick, viscious mass. This latter is pumped into digestion tanks and fermented, whereby the slime and other organic matter form into acetic acid. This acetic acid is neutralized with calcium carbonate and converted into sodium acetate by sodium sulphate. This latter is a waste product from the acetone plant. The liquid is then evaporated and the sodium acetate crystallized out. The potash is obtained 80 per cent. pure, while the sodium acetate is recrystallized and then used in the manufacture of acetone. This plant is handling about 1,500 tons of wet kelp per day, obtaining from this about 18 tons of potash and 24 tons of acetic acid. The process of clarification, sedimentation, etc., is very similar to that used in sugar manufacture.

The United States Department of Agriculture is now investigating with a full-sized plant the possibility of the destructive distillation of kelp. The products obtained are gas, tar, ammonia, iodine, charcoal and potash. The gas will be used to heat the retort, and the potash will be leached from the charcoal.

The manufacture of acetone from kelp is manifestly a war time industry, so that potash as a by-product from this industry is not likely to survive the need of acetone for making smokeless powder.

By-Products of Other Industries

The Bureau of Soils, Department of Agriculture, is at the present time preparing a very extensive report on the potash possibilities of the cement industry, and this report covers the subject of the losses of potash at various plants very completely.

About the time of the beginning of the European war, I made a number of experiments in a small kiln, 2 feet in diameter by 20 feet long, to ascertain the possibilities of obtaining potash as a by-product from the cement industry, using feldspar, limestone and iron ore as the raw materials. If iron ore is not used, white cement would be obtained, but it was our idea to come as near as possible to producing the product of most of the cement mills.

These experiments followed two general lines. At first we furnaced at about 800 deg. C. a mixture containing salt or calcium chloride and lower in lime than would be used for cement, leached the resulting soft brown clinker with hot water to extract the potash, mixed sufficient limestone with the residue to make a proper cement, ground, and burned the mixture to cement. The second line of experiments consisted in making up a proper mixture for cement and burning it directly to cement, volatilizing the potash in so doing. We met with a fair degree of success along the second line. With the first process a number of difficulties were encountered. One was that with the best treatment we could give we could not render soluble more than about 60 per cent. of the total potash in the feldspar, and that we lost some by volatilization. We found on analyzing the commercial side of the case that it seemed to be a much better proposition to attempt to volatilize all of the potash and make a cement clinker at one operation, particularly as we were able to volatilize about 70 per cent. of the total potash, whereas we were never able to render more than 60 per cent. of it soluble in the two-stage process. Furthermore, it required very little additional fuel to produce a cement than it did to produce the lighter burned material, and with the latter there was of course the extra fuel needed to burn it to cement. Owing to the large amount of water in the leached material this latter operation required more fuel than would be required to manufacture cement in the first place.

The potash volatilized at various plants, as I have said, varies quite widely, ranging from 1.5 to 2.5 lb. At plants where the former amount is lost, recovery would probably give a dust too low in potash for sale in this form. At such plants recovery would have to be followed by leaching. Experiments which we have made convince us that this can be successfully done if proper means are installed. This would give a dust which could be used in the kilns and the potash would be in the form of a salt running 60 per cent. to 80 per cent. K_2SO_4.

It should also be borne in mind that there is always the possibility of increasing the liberation of potash by selecting raw materials high in potash. No doubt in many localities a change of clays from one low in potash to one higher would bring about the desired result. In many localities feldspar and sericite are available and might be mixed with the clay without detriment to the cement. Indeed, as I have indicated above, feldspar and iron ore might take the place of clay, or, if a white cement is desired, feldspar alone might be used. At the Riverside plant, feldspar is mixed with the shale to increase the potash in the raw material burned.

Potash from Silicate Rocks

The production of potash from silicate rocks has been the subject of much chemical investigation, and the patent offices of England, Germany and the United States have granted many patents on processes looking toward this end.

It has generally been conceded that to make potash from feldspar alone was an almost impossible undertaking under normal conditions and pre-wartime prices for potash. The reason for this may be readily understood when we take into consideration that feldspar as ordinarily mined, without careful sorting and selection, very seldom runs over 10 per cent. potash and frequently as low as 8 per cent. At a price of 80 cents a unit, this would allow only \$6.40 to \$8 for the mining or quarrying of the feldspar, its crushing and grinding, the reagents which are to be used with it and the fuel and labor necessary to liberate the potash. In view of the fact that it is generally conceded that feldspar mining will cost approximately \$2 per ton, we have only \$4.40 to \$6.00 left to carry on the rest of the process and to furnish overhead and profits.

A very much cheaper source of potash than feldspar is the green sand or glauconite of the Atlantic Coastal Plain. The deposits of this mineral are very extensive and the quantity obtainable is probably greater than that of any potash mineral. My own observations of the New Jersey field has convinced me that green sand can be found in many localities in New Jersey containing as much as 6 per cent. potash. These beds range from a few feet to 20 feet in thickness. They are covered with very little overburden and the material can be dug with a steam shovel just as cheaply as sand can be obtained. I estimate that 10 cents per ton will cover both the stripping and the digging of the green sand. In addition to this, there are extensive deposits of lime-sand or marl adjacent to the green sand beds. These latter contain about 75 to 85 per cent. carbonate of lime, and about 0.5 potash. In many instances the lime-sand overlies the green sand. These deposits are also located in a region where fuel is fairly cheap, where transportation facilities are of the very best, and where labor and living conditions are good. In view of these facts, it seems to be much more probable that potash can be produced directly from green sand at a profit rather than from feldspar.

Alunite has been largely exploited as a source of potash and is being used for that purpose now. It is, however, found as yet only in Utah. This deposit is comparatively small and is largely under control of a few people. It seems hardly probable, in view of the slow progress which has been made to date, that this will ever be the source of anything more than a local potash industry.

This applies to most of the other silicates, such as leucite and cerisite, all of which can be treated along the lines of attack proposed for feldspar and glauconite.

Considerable experimental work, some of it on a large scale, has been done on those processes in which lime and a chloride are mixed with feldspar or green sand and the mixture ground, furnaced, leached, and the resulting liquor evaporated. Mr. W. H. Ross, of the Bureau of Soils, published a very interesting paper along this line in 1912, giving the results which he was able to obtain by heating together a mixture of feldspar, limestone and either calcium chloride or salt. He found that unless he used quite a large proportion of lime and chloride that his yields were low. His best results being obtained on a mixture of one part feldspar, three parts limestone and one-half part calcium chloride, under which condition he obtained a yield of almost 95 per cent. But with a mixture of one part feldspar, one part lime and one-quarter part calcium chloride, he obtained a yield of only 60 per cent. Substituting salt for calcium chloride in the latter mixture, however, he obtained a yield of 68½ per cent.

Following along practically the same lines, and using a mixture of one part feldspar, one part calcium carbonate, and one-quarter part calcium chloride, and heating this mixture in a rotary kiln 2 feet in diameter and 20 feet long, I obtained a yield of 55 per cent. potash. By substituting salt in place of the calcium chloride a slightly better yield was obtained. As the amount of lime was decreased from the above formula less potash was obtained. The more finely the mixture was ground the better results were obtained, but the best yield I could get with feldspar, lime and salt in the proportions given above was 73 per cent. when the mixture was ground to a fineness of 98 per cent. passing the 100-mesh sieve and 86 per cent. passing the 200-mesh sieve. This was considered about the limit of economical grinding. Substituting sericite for feldspar I obtained practically the same yield, but with glauconite I was able to obtain a much higher yield—in fact, all investigations which I have made lead me to believe that this mineral is very much more easily attacked than feldspar. With the glauconite-lime salt mixture referred to above we have obtained yields as high as 85 per cent. of the potash theoretically possible.

This is a very easy process to carry out. The operation of crushing and grinding the material have been well developed, and the furnacing can, of course, be done in a rotary kiln. No complications are experienced in this latter operation. The required temperature is low, and either producer gas, pulverized coal or fuel oil could be used. In my experiments I used the latter fuel for convenience. I do not believe any complication would arise from the use, however, of pulverized coal, and certainly not from producer gas. The material furnaces easily at temperatures varying from 800 to 1,000 deg. C., depending on the composition of the mixture. No fusion takes place, the effort being made to produce a soft, porous clinker. This leaches easily without grinding, and 95 per cent. of the soluble potash in it can be extracted with water. The amount of fuel required in the kiln is much lower than that required for the manufacture of cement, and certainly should not exceed for the dry process 250 lb. to the ton, and for the wet process 350 lb. to the ton. Any loss by volatilization can be taken care of by Cottrell treaters.

By leaching in series very strong solutions can be obtained so that the amount of water to be evaporated is cut down to a minimum. Potassium chloride can be easily separated from either calcium chloride or sodium chloride, and the latter can be returned to the kilns with the next charge.

On the other hand, if the sulphates are used, a difficult separation nearly always results. While there is probably less volatilization with the sulphates, there is much more difficulty experienced in obtaining a pure potash salt and, as it is well known, the chloride is the most acceptable salt for fertilizer manufacture.

Strange to say, very few attempts have been made to produce potash commercially by this process—possibly because it has not promised anything like the returns offered by some of those other processes in which by-products are obtained.

The Atlantic Potash Company recently bought out the plant of the old Northampton Cement Company at Stockertown, Pa., which had been standing idle for some time. They are operating under the the patents granted to George F. von Kolintz (No. 1,201,396). This process consists in oxidizing the green sand and heating the same with calcium chloride without the use of lime. This plant is now in operation, and we understand that some potash has been produced.

Another method of liberating potash is covered by patents to S. Peacock, and consists in heating the finely ground mineral with lime under pressure in an autoclave, whereby the potash is made soluble and is leached out. The Waverly Chemical Company, Camden, N.J., has operated under Dr. Peacock's supervision, using green sand. They made some potassium carbonate which was sold to glass makers, but their operations have now been discontinued, presumably because they could not be conducted at a profit.

The Kaolin Products Company, Jones Point, N.Y., is using this same process in a small way, employing feldspar. They make a species of sand-lime brick from the residue. This brick, I am informed, is a very superior article.

Furman Thompson proposed to employ acid sulphate of soda and salt to attack feldspar (U.S. patent No. 995,105, and also No. 1,091,034, to H. P. Basset). Muriatic acid and salt cake are obtained as by-products. The Spar Chemical Company, Baltimore, Md., built a plant at Curtis Bay, Md., prior to the war, to produce potash by this method, but their efforts here failed, due largely to the difficulty of separating the sulphate of soda and potash.

Along the second line of patents referred to above (in which the potash is volatilized), we have the three granted to H. G. Brown, and covering the manufacture of potash and slag cement from feldspar. Brown proposes to fuse together limestone, feldspar and calcium chloride in a metallurgical furnace heated with coke. The potassium chloride is given off as a fume, which is to be collected by a Cottrell treater. The slag, which is tapped off, is to be mixed with slaked lime and ground into slag cement. The Buffalo Potash & Cement Corporation will operate this process. They have purchased the plant of the Niagara Cement Company in Buffalo, and expect soon to be ready to operate.

We also note in recent literature the organization of the Canadian Potash Corporation, which proposes to manufacture potash and cement along somewhat similar lines. They have purchased a crushing plant at Gravenhurst, Ont., where there is said to be a large feldspar deposit.

While we are disposed to criticize the cement end of these propositions so far as they anticipate making slag cement, the potash end looks entirely feasible, and if it can be operated independently of the slag cement production, it may be developed to any extent desired. Slag cement at the present time is not a very salable product, and we believe that practically all of those who first undertook its manufacture in this country have now abandoned it.

We now come to a series of patents most of which are dependent on some valuable by-product for their success with normal markets. For instance, we have the patent of Hart, in which barium carbonate, carbon and feldspar are heated together, and barium sulphate or other barium salts are obtained as by-products. The application of this patent is, of course, limited to the market for barium compounds. There are also a large number of patents in which aluminum salts are obtained as by-products. As there is about twice as much alumina as potash in feldspar, as ordinarily mixed, there would, of course, be a very large tonnage of alum or alumina to get rid of.

For instance, feldspar may average 20 per cent. alumina and 10 per cent. potash; therefore, for every ton of potassium chloride produced there would be possible 4¼ tons of dried aluminum sulphate, or 8¼ tons of dried alum. The amount of potash used in this country far exceeds the alum. If we consider the aluminum in feldspar on the basis of bauxite—the raw material for aluminum as well as alum, and of which the domestic production is about 225,000 tons annually—we can arrive at a better estimate as to the limitations of this field. Bauxite averages about 57 per cent.alumina, then the above amount is equivalent to 128,250 tons of alumina, which would take care of about 102,000 tons of potassium chloride or approximately 64,000 tons of potash.

I am informed that one experimenter is making brick of the residue from his leachings. This, of course, like the cement field, opens up a large market for the so-called by-product, especially since the brick is said to be of the highest quality.

In many of the processes proposed the quantity of potash is very negligible compared with that of the by-product, and under normal conditions its value is generally much less, so that with most of them potash is really the by-product and the other constituent the main one.

Summing up the situation, I believe that the largest future source of cheap potash available in this country is in the iron industry and the cement industry. Germany is reported to have $150 invested in her potash mines and equipment for every ton of potash produced annually. On this basis $37,000,000 would be needed to produce the 250,000 tons of potash imported into this country.

I believe that the expenditure of this amount of money in this country in these two industries alone would result in the recovery of potash now lost amounting to nearly 200,000 tons.

The balance could easily be obtained from the evaporation of lakes and brines, from beet sugar waste and from some of the processes now proposed for the manufacture of potash direct from feldspar or glauconite.

What is needed in this country to develop a potash industry is not research alone, but the feeling that when this industry is built up proper legislation will be enacted to prevent its being tumbled down by cut-throat methods from the foreign producer. While this might result in slightly higher-priced potash to the farmer, I fully believe that he will be justified in paying the higher price in order to be free from foreign dictation.

American Chemical Society

The annual meeting of the American Chemical Society will be held in Boston on September 11, 12 and 13. The Northeastern Section has been requested by the directors to omit the usual annual banquet and excursions, and to arrange a programme characterized by simplicity and seriousness, and bearing as fully as possible on questions concerning the activities of chemists both in the government service and in the industries during the present war. The general meeting will be held on Tuesday morning. This will be followed in the afternoon by a general conference to be opened by Dr. W. H. Nichols, chairman of the committee on chemicals of the National Defense Council, and by Dr. M. T. Bogert, chairman of the Chemistry Committee of the National Research Council, the conference then to be continued from the floor. It is expected that an informal, get-together meeting of a social character will be held on Tuesday evening, at which time opportunity will be given for informal discussion of problems of the day. Wednesday morning will be devoted to divisonal conferences, and the afternoon to divisional meetings, with papers or a continuation of the conferences, as the divisions may decide. The presidential address will be delivered on Wednesday evening. Thursday, both morning and afternoon, will be given to divisional meetings.

Notes on Electric Steel Melting *

By J. L. Dixon

The object of this paper is to discuss some of the everyday aspects of electric steel melting. The problems discussed are those concerning the electrical and mechanical design of the furnace and also those appertaining to the operation of the furnace.

Broadly speaking the subject may be separated into the following divisions:

1. Mechanical considerations.
2. Electrical considerations.
3. Thermal considerations.
4. Chemical considerations.

One and two may be said to concern the furnace designer, while three and four belong more properly to the metallurgist or operator of the furnace. It is obvious, however, that the manner in which the subject is divided is purely a matter of choice, and that the various divisions are necessarily overlapping and interlocking.

Mechanical Considerations

Considering the electric steel furnace from the mechanical aspect it need hardly be said that the apparatus should be of a good substantial construction and, as in the case of most of the apparatus for use in steel mills and foundries, the strengths of the various parts should be much greater than those resulting from the use of the ordinary factors of safety. The need for extra strengths in the main structural parts of the furnace, owing to the tendency for warping under heat expansion, is obvious. It is also obvious that the moving parts of the furnace mechanism, such as the tilting gear and the electrode-raising gears, should be of rugged design so as to withstand the rough usage and lack of attention they will receive in the average foundry.

As regards these gears, however, there are other considerations in addition to the purely mechanical ones. The design and location of these gears must be such that they are fully protected from any accidental break-out or overflow of liquid metal. With all possible precautions break-outs or overflows will occur and it takes only a few pounds of liquid steel to put a lifting screw or a worm gear out of business. The protection of the electrode-raising gears is generally quite a simple matter, but not so with the tilting gear. In the furnaces whose design the writer is partly responsible for, a type of tilting gear giving excellent results mechanically has been abandoned owing to the danger of the gear being damaged by liquid metal. The danger may be very small, but any improvements in this direction will immediately show almost unexpected benefits, owing to the fact that the furnace operators are relieved of an unnecessary anxiety.

Another essential, perhaps the most important, is to avoid too great intricacy. This remark applies in some measure to all parts of the furnace, but more especially to the parts comprising the electrode contacts and supporting devices. With the best possible design and care the insulating materials will occasionally fail. If the parts are water-cooled a breakdown may result from a failure of the water system, due perhaps to an interruption of the supply. The writer recently had an experience of this, owing to a laborer turning the wrong valve.

Whatever the cause of the breakdown it is certainly unpleasant to have to stand on the roof of a hot furnace and endeavor to remove the broken-down part, either by unbolting or by cutting it away with a hacksaw.

In making a choice between a simple and perhaps rough design and one that is more finished and also more complicated, it must be borne in mind that the apparatus of simple design will need a little more daily attention, but when it does break down its replacement can be made in as many minutes as will be required in hours by the breakdown of a more complicated mechanism.

Before leaving the mechanical part of this subject the writer would observe that in designing a very large electric furnace requiring a large number of electrodes the difficulties may be overcome by suspending the electrodes from an overhead device quite independent of the shell of the furnace. This will certainly be the most convenient arrangement if the furnace is not tilting but is of the stationary type, as is quite probable with the very large furnaces that will come in the future.

Electrical Considerations

The first question an electrical engineer asks about an electric furnace is "What is the power factor?" In a well-designed furnace the power factor should be 90 per cent. or more. The principles to which attention must be paid in designing and locating the bus-bars and other parts that carry the heavy current are so well known that it is not necessary to dwell on these here.

There may be noted, as tending to improved power factor, (1) an increased number of electrodes, more especially if they are all of different polarities, (2) a higher voltage on the electrodes. The question of voltage is discussed by the writer later, from another aspect. Another question of importance to the power-station engineer is that of current fluctuations or overloads. Here again an increased number of electrodes is beneficial, owing to the spreading and averaging effect.

A higher voltage on the electrodes tends to increase the fluctuations, but this may be largely overcome by reactance without seriously lowering the power factor.

It must be admitted that this question of current fluctuations and disturbances is often a very serious one, more especially with furnaces connected to small power stations, and the writer feels justified in saying that some radically new design in automatic controlling apparatus is necessary. The various kinds of apparatus in present use are of excellent workmanship, but in principle they do not go sufficiently to the roots of the trouble.

Take, for example, the case of a three-phase furnace with three upper electrodes. When there is an overload on one of the electrodes, either one or both of the remaining electrodes is also overloaded, even though at that moment they are correctly located relative to the bath of metal. But the fact that they are correctly located is not observed by the automatic controlling apparatus which, acting under the impulse of the increased current, raises these electrodes, so that when the offending electrode is brought to its correct position the unoffending electrodes are carrying currents that are too small. In this way a more or less continuous hunting is set up and partly on account of this the automatic controlling apparatus has to be "damped," which lessens its sensitiveness and ability to deal quickly with any real trouble that may occur.

Without attempting to discuss this question in detail the writer thinks that it should not be beyond the powers of electrical engineers to devise a special arrangement of current transformers and perhaps voltage connections also, which together with a suitable arrangement of solenoids would take care of current regulation almost as well as if the apparatus could, so to speak, actually look into the furnace and pick out for itself the particular electrode or electrodes that need adjustment.

The writer would like to note here that he believes that furnaces with a bottom electrode are more easily controlled than those without, because any fluctuation of current in one of the upper electrodes is partly taken care of by the bottom connection instead of being absorbed entirely by its remaining upper electrodes. In this way the hunting due to what may be called false regulation is to a large extent avoided.

The electrical end of the subject has so far been discussed almost entirely from the point of view of the power station. From the furnace operator's point of view it is important that

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the apparatus should be the best that can be bought, and should be installed in the safest possible manner.

It is not always easy in a steel foundry where room is limited and valuable to install the apparatus in the best way, but any extra money spent in doing this is a very small item compared with the value of the product of the furnace during a period of one or two months.

Thermal Considerations

Briefly the problem is to change the energy of the electric current into heat with the greatest efficiency, and in a manner such that the greatest portion of the heat is transferred to the material under treatment.

The writer strongly advocates the highest possible voltage for melting down the charge. Obviously the higher the voltage the smaller may be the electrodes and the higher will be the power factor. With furnaces of ten tons' capacity and upwards, a voltage higher than usual has been found to be absolutely essential, but even in smaller furnaces there are advantages in this respect not directly attributable to the smaller resistance or induction losses.

A low-voltage arc melts the material only in its immediate vicinity and, exaggerating a little for purposes of illustration, it may be said that with a low voltage the electrode melts the material immediately underneath it by contact resistance. In this way its electrodes bore down through the charge and there results a shallow pool of metal which must be greatly superheated so that it will quickly dissolve the metal lying in it and upon it. The superheating of this gradually-increasing poo- of metal requires an excess of energy, and also the high temperal ture of this metal is detrimental to the hearth.

On the other hand, with a high voltage the larger arc causes the electrode to melt the metal not only immediately beneath it, but also for some distance around it. In this way there results not a small pool of highly heated metal, but a larger pool of metal of more moderate temperature, which is less severe on the furnace hearth.

The ability of the high-voltage furnace to fuse the whole charge more uniformly and without taking a long time to melt down the outside fringes of solid metal resting on the banks leads to a saving in energy.

During the refining period it is essential that the voltage be lowered so that the arc becomes practically buried in the slag. This is especially essential if a white deoxidized slag is obtained, as such a slag is a good heat insulator and reflector and the heat of the long arc will be reflected on to the walls and roof of the furnace.

There has been much discussion as to the value of a lower electrode, and many times it has been confidently asserted that a lower electrode is valueless and also a detriment. With equal confidence the writer asserts that a lower electrode has a distinct value from a thermal point of view. On occasions when he has operated a furnace without a lower electrode he has experienced greater difficulty in maintaining the furnace bottom in good shape and more especially in making high chrome steels has experienced difficulty in dissolving the alloy additions.

The writer has already in this paper claimed advantages for a lower electrode from an electrical point of view.

A word may be said here as to refractory materials. For the furnace bottom the writer has always obtained good results from either magnesite or dolomite tamped in with tar.

As regards the walls and roof, every one operating electric furnaces is aware that these receive their greatest punishment at the end of a heat. This no doubt is largely due to the reflecting power of the white slag. In addition to this, however, the writer is inclined to believe that there is some chemical influence very active at that time. As is well known, silica bricks absorb mechanically occluded iron oxide (Fe_3O_4); at the end of the heat when the atmosphere of the furnace is strongly reducing the Fe_3O_4 is reduced to FeO, which at once fluxes with the silica. Perhaps, unlike the writer, some of the members have had an opportunity of trying clay bricks, which should be less sensitive to chemical influences than are silica bricks.

Chemical Considerations

The process of refining steel in a basic-lined electric furnace has been described many times, and with the large number of furnaces now operating the process has become common knowledge.

The acknowledged advantages of a white slag are sometimes attributed to the strongly reducing effects of calcium carbide. The writer is inclined to disagree in this, and to attribute the good results not to the presence of calcium carbide but to the absence of reducible oxides, the presence of the carbide being merely a symptom that the deoxidation is approaching completion. It is obvious that, as a result of chemical equilibrium, if there is no oxide in the slag there can be very little in the metal.

The writer is unaware that the mechanism of the reactions by which sulphur is eliminated has ever been described. He believes the reactions to be somewhat as follows:

$$\text{(a)} \qquad \frac{\text{FeS in metal}}{\text{FeS in slag}} = \text{constant.}$$

Disregarding the presence of manganese, the only way in which the amount of sulphur (FeS) in the metal may be adjusted is by some alteration of the proportion of FeS in the slag. An increase or decrease of any other sulphide in the slag will have no direct effect on the amount of sulphur in the metal. This is because any other sulphide, in this case CaS, is insoluble in the metal. In the slag itself the following equilibrium is established:

$$\text{(b)} \qquad CaO + FeS = CaS + FeO$$

This may be written as follows:

$$\text{(c)} \qquad \frac{CaO \times FeS}{CaS \times FeO} = \text{constant}$$

From this it follows that any decrease in the FeO in the slag will cause a decrease in the FeS, until when the slag is free from FeO all the sulphur exists as CaS. Referring to equation (a) it follows that when there is no FeS in slag there is no sulphur in the metal. Probably the slag might consist of CaS entirely without affecting the steel in any way.

Something might be said as to the effect of magnesia in the slag. MgO in the slag is generally recognized to be very undesirable. At the best the MgO dilutes the slag and also robs it of fluidity, so that for a given degree of fluidity an increase in the proportion of MgO means a much greater decrease in the proportion of the active constituent, CaO. In addition to this, however, it would appear that MgO is actively harmful, and the writer believes that under the electric arc it acts as an oxidizer.

Several years ago when burning in a magnesite bottom by lowering the electrodes onto a shallow bed of coke, it was found that whenever the arc came near to the magnesite bottom deep channels were cut in the bottom. It was apparent that the the following reaction was going on between the coke and the magnesite.

$$MgO + C = CO + Mg$$

Directly the vapors of CO + Mg got away into the cooler parts of the furnace the reaction was reversed and there was deposited on the walls of the furnace a powder consisting of finely powdered MgO and soot.

Possibly some reaction similar to this goes on between the MgO in the slag and the carbon in the steel and the carbon, such as coke, thrown on to slag for deoxidizing. Also it is possible that MgO reacts with metallic iron, forming Mg which is lost by volatilization and later reoxidation, leaving FeO in the slag.

The writer remembers with painful distinctness several heats in which the carbon could not be moved from about 0.10 per cent. Pig iron was added with no effect, about a ton of pig being added to a five-ton charge. No scale or ore had been charged, and the disappearance of the carbon could only be explained by some of the above assumptions as to the action of the magnesia in the slag.

These experiences were of several years ago, and by fettling the hearth of the furnace with good dolomite and making the slag from fairly pure lime, the difficulties were soon overcome.

In conclusion the writer would state that this paper is not submitted as covering the whole subject, or any part of the subject in detail, but merely as a few notes covering several years' experience in electric steel making.

The Bethlehem Ten-Ton Girod Steel Furnace

By C. A. Buck

The 10-ton Girod electric steel furnace made its first heat May 16, 1916, and has made a fairly consistent run to date. Until September 1st the furnace operated on single turn, but since then has been in continuous operation, except when down for repairs or power. To date (February 23rd) 247 heats have been made, and the quality of steel produced has been gradually improved.

The electric furnace building is 168 feet (50 m.) long and 58 feet (17 m.) wide, served by a 30-ton crane. The charging platform, which is elevated 12 feet 3 inches (3.6 m.) above floor and yard level, extends 14 feet 6 inches (4.2 m.) beyond building columns along the outside of building wall. On this extension there are covered bins for refractory materials, flux, ore, alloys and scale, these materials being unloaded from cars and stored.

The furnace proper, which is located above the charging platform, is cylindrical in form and made of ¾-inch (1.9 cm.) steel plate, approximately 15 feet (4.5 m.) in diameter and 5 feet (1.5 m.) outside depth, with laminated outside plates, ¾-inch (1.9 cm.) thick. It is equipped with one heavily-laden, counterbalanced charging door, sliding in a water-cooled frame. The pouring spout is directly opposite. On the side of the shell heavy copper angles are attached to which are electrically connected laminated copper bars conveying current from the transformers.

The furnace rests on heavy cast-iron rockers running on rollers supported by rocker frames anchored to concrete foundation. The tilting of the furnace is accomplished by means of worm drive, actuated by a 15 h.p. motor. The furnace can be tilted toward the charging side to discharge the slag through a notch in the charging door, or toward the pouring side to pour the molten metal into a 12½-ton ladle located in the pit in front of the furance. The bottom, 20 in. (50 cm.) in thickness, is made of double burned dolomite well rammed in with tar. The metal bath is approximately 16 in. (40 cm.) thick.

Fourteen soft-steel poles approximately 3½ in. (9 cm.) in diameter are connected electrically to the bottom of the furnace shell, the lower ends being water cooled. The roof construction which is arched, consists of 9-inch (23 cm.) silica brick, insulated from the magnesite brick of the hearth walls by means of asbestos plates, with provision for reception of three 17-in. (43 cm.) amorphous carbon electrodes. The electrode coolers in the roof are made of copper and are water cooled.

Ample provision has been made for adjustment, so that electrodes can be adjusted and centered firmly and speedily. Two laminated copper bars carry the current from the transformer to the contact pieces extending from the electrode carrier. The lowest point of an electrode during operation of the furnace is approximately 4 in. (10 cm.) above the surface of the metal bath.

The electrodes are raised and lowered by means of a revolving screw spindle centered in the structural column, which is driven by a 5 h.p. motor, mounted at the foot of the column, or, if necessary, it can be operated by means of a hand wheel. The total weight of one electrode-carrying column is approximately 2,600 lbs. (1,180 kg.) the weight of an electrode being about 1,000 lbs. (450 kg.).

The motors employed for this work are reversible, interpole type, using direct current at 230 volts, equipped with automatic speed regulation. The total weight of the furnace is approximately 90 gross tons, which includes about 35 tons of refractories.

About 1,500 KVA of 3-phase alternating current, 25 cycles, 65 to 80 volts, is furnished to the electric furnace, each electrode receiving one phase of a 3-phase current, the conducting hearth of the sheel acting as the neutral point. Special care has been taken to prevent the formation of induced currents in the shell and the roof frame, and to prevent sparking from the bus bars at the lower end of the electrode-carrying column to that column in electrical contact with the shell.

The current is conveyed to the furnace from three water-cooled single-phase transformers of 700 KVA each. It is generated by Bethlehem gas engines driving 2,500 kw. generators, producing 3-phase alternating current of 6,600 volts at 25 cycles. One reactance coil of 106 KVA capacity has been provided for the protection of each transformer. A special controller for each electrode is amounted in front of the switchboard, and one controller is provided near the pouring spout for the operation of the tilting motor. The transformers are sheltered in rooms underneath the charging floor on both sides of the furnace, while the reactance coils and oil switches are in another room. The high-tension conductors are well insulated cables, the low-tension conductors are heavy bus bars laminated only where flexibility is required.

Of the 700 KVA leaving the three transformers, about 620 KVA actually reach the electrode holder, the balance being lost in the form of heat through water-cooling, etc. The consumption of cooling water at the furnace is about 20 gallons (75 liters) per minute.

The yield from cold storage to finished ingots is about 92 per cent.

A thoroughly equipped laboratory erected for the open-hearth department, which is adjacent to the electric furnace department, takes care of the necessary testing of the steel, etc. The electric furnace will become a valuable adjunct to the Bessemer converter and the open-hearth furnaces, as a means of refining their molten product.

It is believed that the greatest field for this grade of steel will be in the alloy steel market and for many grades of tool steels. Thus far the following steels have been made: 1.5, 2.5, 3.5 per cent. nickel, nickel chrome with 0.50 chromium, chromium vanadium, and simple carbon steels ranging from 0.08 to 1.30 per cent. carbon.

The materials used for steel making are as follows: scrap rails, high-phosphorous turnings, billet crop-ends, drop-forge trimmings, etc., which mixture should average 0.040 sulphur.

The operation of the furnace is very similar to that of the basic open hearth. Following the tapping of a heat, turnings are charged and leveled down. Any necessary repairs along the slag line are made with dolomite. Billets or other heavy scrap are next charged, followed by turnings until the entire 21,000 lb. (9,550 kg.) charge is in the furnace. Lime is then added, current turned on, and melting is begun. Much of the phosphorous is removed through combustion, carbon is reduced by oxidation, and some of the sulphur is removed. The length of time required for the oxidation is dependent upon the carbon and phosphorus content of the charge.

When it is considered that the oxidation has proceeded far enough a test about 2.5 in. (6 cm.) diam. and 2 in. (5 cm.) long is taken, forged under a hammer, quenched in water and bent through 180 degrees. When the test bends without breaking through the bend, the oxidizing slag is removed by tilting the furnace backward and skimming off slag through the charging

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door. Slag flows through a chute in the charging floor into a slag car under the floor.

Following removal of the oxidizing slag, the recarburizer is added, followed by the deoxidizing slag of powdered petroleum coke, silica sand, lime and fluorspar. This slag dissolves ferrous oxide which has formed on the surface of the bath.

A reasonable time after the addition of the deoxidizing slag a test is taken for the laboratory for carbon determination. Varying amounts of ferro-silicon, ferro-manganese, etc., are added to bring the slag to the point where it becomes white, and quickly disintegrates into a fine white powder. These alloys act very energetically on the oxide in the bath, forming a very fluid slag, which easily rises to the surface. During this period, when the slag is completely deoxidized and is very basic, the desulphurization, which was incomplete during the first stage of the operation, proceeds further, and is rapidly completed at the time of tapping.

The average analysis of the preliminary tests taken after the charge is melted and before removal of oxidizing slag is as follows:

C. 0.07 Mn. 0.11 P. 0.008 S. 0.036 Si. 0.022

The analysis of oxidizing slag from heat Y-1219, a high-carbon simple steel heat, and of the finishing slag at time of tapping showed:

	Oxidizing Slag	Finishing Slag
SiO_2	8.89	6.49
FeO	36.82	1.26
MnO	4.71	0.16
CaO	35.26	69.83
MgO	9.25	2.61
P_2O_5	0.705	0.092
S	0.19	0.34

This heat finished with phosphorus 0.010 and sulphur 0.016.

Several heats have been made since this one analyzing below 0.010 P. and 0.015 S.

All of these heats are entirely satisfactory from a metallurgical standpoint. The ingots rolled well, and in many cases it was not necessary to chip a single billet.

Nearly all of the heats thus far have been cast in 19×19 in. (48×48 cm.)×6,000 lb. (2,730 kg.) or 21×27 in. (53×68 cm.) ×12,000 lb. (5,550 kg.) ingots, and the practice on the 35 in. (88 cm.) bloomer mill on the various grades has been from 75 to 82 per cent.

War Service for United States Chemists

The following is the report to the Council of National Defence of the United States on the utilization of chemists and the preservation of the supply of chemists and chemical students for war purposes:

"Chemists and chemical engineers are normally needed in almost all branches of industry (including the standardization and control of food products) for the successful operation of processes, the detection and speedy correction of difficulties and the improvement of products. England, France and Italy found it necessary to recall all chemists from the ranks; Canada does not allow chemists to enlist; chemists have saved Germany up to the present time.

There was a decided shortage in the supply of chemists in the United States even before April, 1914. The war has made the shortage acute, and it is certain that our own war needs and industries necessary to war will absorb chemists as rapidly as they can be trained.

It takes from four to seven years to train a chemist. The shorter time is for college graduates and chemical engineers who become wholly useful only after a further year of experience in a manufacturing plant or laboratory (corresponding to the hospital year required of medical students). The longer time is for the training of research men taking the doctorate degree in chemistry, on whose shoulders ultimately the vast need of the government and the industries fall for meeting and solving new difficulties and problems of organized research.

When chemists of mature years are called in for service in government laboratories, their places must be filled by younger men to keep the machinery working. It is, therefore, of the greatest importance that steps be taken:

1. To keep and impress into service in chemical lines chemists drawn by the draft for service in the United States Army or Navy.

2. To provide means for keeping open sources of supply of chemists from universities, colleges, and schools of technology, and to procure volunteers in chemistry.

A tentative plan for accomplishing these results is hereby appended and recommended.

William H. Nichols, chairman of the Chemistry Committee, National Defense Council. Past-president, Society of Chemical Industry. President, Eighth International Congress of Applied Chemistry.

Marston T. Bogert, chairman of the Chemical Committee, National Research Council. Past-president, American Chemical Society.

A. A. Noyes, Past-president American Chemical Society.

Julius Stieglitz, President American Chemical Society.

Charles L Parsons, Secretary, American Chemical Society.

Plan for the Impressment of Chemists for War Service as Chemists and for the Preservation of the Supply of Chemists

I. There shall be organized a committee of three to advise the President of the United States through the War Department on requests for exemption of chemists. This committee might well include besides a government representative two chemists, one a chemical engineer or technical chemist, the second a university man. These men should be nominated to the President by the Council of National Defense.

II. Requests for exemption of individual chemists shall be made to this committee by:

1. Government, state or municipal laboratories and bureaus.

2. Heads of manufacturing plants on the basis of the imperative need of these men for their successful operation.

3. Presidents of universities, colleges and schools of engineering or mining on the basis of proficiency, promise and ability of candidates for college or university degrees, specializing in chemistry. Men recommended under this head who are candidates for the doctorate degree shall not be over twenty-six years of age when they receive the degree, and men who are candidates for a four-year college degree shall not be over twenty-three years of age when they are to receive the degree.

III. (1) Chemists under twenty-one and over thirty years of age and chemists between twenty-one and thirty who have not been drafted may enroll with the above committee as volunteers in chemistry subject to the same conditions as the enlisted and exempted men.

(2) Students in chemistry under twenty-one years of age may enroll with the above committee for a "chemists reserve" under the conditions specified in II. (3).

IV. Men thus enrolled and accepted under the provisions of the above paragraphs for war service as chemists shall be subject to the orders of the government as to location and nature of service and shall be entitled to wear a badge or other insignia indicating their official status (practise of France and possibly of other European countries). Students enrolled in a "chemists reserve" shall be subject to the same conditions as obtain for other reserves of the government and shall also be entitled to wear some insignia or badge indicating their enrollment."

A new charter has been granted to the Union Cement Co., Owen Sound, the capitalization of the firm being increased to $1,000,000. The name of the company under the new incorporation is Union Cement, Limited.

Nitrogen from the Air

The Chemical News, London, reports that a plant is about to be erected in Manchester, England, for the manufacture of nitrogenous products from the nitrogen in the air.

Ever since the British blockade was enforced, Germany has found it impossible to import Chilian nitrates for the manufacture of explosives and fertilizers. It reverted, therefore, to the expedient of "fixing" the nitrogen from the air, and has adopted it to a huge extent since almost the beginning of the war. It has been stated in German technical journals that the output of nitrogenous products by the Badische-Anilin Fabrik, with the aid chiefly of the Haber-catalytic process, amounts now to about 500,000 tons a year. By these means the Germans get all the nitrogenous ingredients for their high explosives.

Attempts have been made to work the Haber process in this country, but all have failed, and the general concensus of opinion now is that this is not a commercial process, as the expense and risk appear to be enormous. With the Germans, however, it is a case of needs must.

The only other way by which nitrogen can be fixed from the air is by the electric processes, of which up to now the principal have been the Baekeland and Evde, the Schonhurr, and the Pauling. All of these are single-phase and electrical processes, and are considered workable commercially only in places like Norway, where electricity can be generated cheaply by water power. None of them has been worked in England, because of the high cost of electricity here, which makes them uneconomic under ordinary conditions.

The consequence is that the fixation of atmospheric nitrogen has not been adopted in this country, which relies for its supplies of this valuable ingredient of high explosives and an indispensable part of all the principal fertilizers on the utilization of Chilian nitrates, the price of which has increased enormously since the beginning of the war.

A new factor in the situation has now arisen in the new method of nitrogen fixation from the air which is about to be started in Manchester. National considerations preclude details being given at present, but it is believed that with this process nitrogen can be "fixed" anywhere in England at a very low cost, even where electricity is fairly expensive, because it apparently achieves the highest efficiency of nitrogen fixation per kilowatt hour of energy used that has ever been achieved or even dreamt of by any of the other processes mentioned. Its inventor is a British subject.

The Manchester Corporation succeeded in being the first to get the industry started, because it went out of its way to help the promoters, the International Nitrogen and Power Company, 8 Waterloo Place, London, who hold the exclusive rights to work the process in Great Britain.

The new industry is believed to have great possibilities, not only for war purposes but after the war. Possibly when the method comes to be worked throughout the United Kingdom it will make this country independent of oversea supplies of fixed organic nitrogen, and provide a new security against the danger of interruption of oversea supplies of essential ingredients of explosives in time of war. If it can be done the whole of our nitric acid supplies could be obtained in this way, and also picric acid, an essential ingredient in synthetic dyes.

Above all, it would bring to realization Sir William Crooke's prediction to the British Association at Bristol over thirty years ago that the future of the white race would largely depend on the economic fixation of atmospheric nitrogen, by which the world might be made to yield larger quantities of wheat and other foodstuffs.

Through the good offices of the Manchester Corporation an excellent site for the works has been provided. Construction has already begun, and the establishment should be working within six months from now.

There is no special virtue in the air of Manchester that has led to the selection of the city for this important pioneer enterprise. The choice was determined by other circumstances. Nor need the public have the least apprehension of the effects of the process on atmospheric conditions. The volume of air used up is an infinitesimal fraction of the aerial ocean.

Inquiries made recently by a representative of the *Manchester Guardian* showed that a movement for carrying into effect a project for obtaining nitrates from the atmosphere was started in Manchester ten or twelve years ago, the motive being, of course, mainly a commercial one. The promoters were, for the most part, engaged in the bleaching industry, who desired to avoid, if it was possible, the expenses of bringing nitrates so largely used in their business from South America. It was found, however, that an obstacle to the development of that scheme, was the intense heat required to make the process successful. "We needed heat," one of the promoters of that time said recently, "of an intensity of 2000°, and the result was that the whole of the ovens and appliances necessary were destroyed before it could be attained. Another obstacle was placed in the way by the shipping trade, who feared the loss, if the experiments then made proved a success, of the nitrate shipping trade. Means were subsequently found of overcoming the difficulty created by the intense heat required, and further efforts were made in France which proved to be successful. There is a works in that country now which has for a number of years been producing nitrates from the air."

A chemist at a large house in the dyeing trade expressed the view recently that but for the fact that the Germans had for years obtained nitrates from the air the war would have been over long ago, considering the present difficulties in the way of their obtaining them from Chili or other South American sources.

(Continued from Page 79)

will be to the advantage of your company to endeavor to recover the aluminum contained in this material, but this is of no immediate importance.

From the foregoing, it can be gathered that the total output of your company's plant will represent but a small part of the consumption in Canada and the United States, and that your company can sell its products either at the prevailing market prices, or also, meet successfully any possible rate competition.

Cost of Plant

Mining plant	$4,000.00
Temporary pier for dockage at mine	3,000.00
Crushers and grinding mills	10,000.00
Two revolving kilns, 8'×125'	18,000.00
Air compressor and piping	2,000.00
Power plant	15,000.00
Buildings	20,000.00
Miscellaneous equipment, 15 per cent	10,800.00
Elevators	4,500.00
Feeders	600.00
Salt cake furnace	3,000.00
Hydrochloric acid towers	10,000.00
Bleach plant	45,000.00
Mixers	5,000.00
Leaching, wash tanks, etc	10,000.00
Separation and evaporation plant	10,000.00
Stack alterations and stack base	2,200.00
Disposal system, sludge	1,000.00
Pumps and solution piping	3,500.00
Pulleys and line shafting, etc	800.00
Concrete foundations for various machinery	1,000.00
Walkways, etc	600.00
Superintendents, etc	10,000.00
	$190,000.00

(Signed) J. A. DAWSON,
Assistant Chemist, Dominion Laboratories, Ottawa.

[*An appendix to Dr. Dawson's report, containing an investigation with reference to prices of raw and finshed products has been omitted.—Ed.*]

Personals

Dr. Frank D. Adams, of the Faculty of Applied Science of McGill University, has been elected a foreign honorary member of the American Academy of Arts and Sciences, Boston, Mass., and also an honorary member of the Mineralogical Society of Russia at Petrograd.

O. F. Bryant, of the Forest Products Laboratory of Canada, was a recent visitor to the Forest Products Laboratory at Madison, Wis.

R. B. Freeland, for a number of years engineer with the Granby Mining Company at Grand Forks, B.C., has been appointed district engineer of the southern mineral survey district, with headquarters at Grand Forks. He is a graduate of the Cambourne School of Mines, Cornwall, England.

J. J. Manley, the curator of the Daubeny Laboratory, has been elected to a fellowship at Magdalen College, Oxford, for the prosecution of special researches in physics and chemistry.

O. J. D. Thomas has been appointed chemist in charge of the new research laboratory of the E. B. Eddy Company, Hull, Que. For the last four years Mr. Thomas has been in charge of the technical work of the Canadian Brake Shoe Company, Sherbrooke.

J. B. Tyrrell, consulting mining engineer, of Toronto, has been appointed Canadian representative of the Consolidated Mines Selection Company, of London. Mr. Tyrrell will also continue to represent the Anglo-French Exploration Company, of London.

J. White, of the ornamental iron department of Canadian Allis-Chalmers, Limited, has been appointed general superintendent of the Canada Foundry Company's Davenport works.

Sir George Perley, Canadian High Commissioner, has been named as Canadian representative on the Imperial Mineral Resources Bureau, which is to collect information and advise as to developments in economic minerals.

Interesting News Items

The Canadian Dyers Association, Toronto, are making a $9,000 addition to their warehouse.

The city of Brantford is installing three liquid chlorinators made by the Electro-Bleaching Gas Company.

Colonial Fertilizer Company, Windsor, N.S., plan to extend their plant.

Oshawa, Ont., Water Commissioners are installing a filtration plant.

L'Air Liquide Society, Montreal, have secured a site at Halifax and will establish a plant for the manufacture of welding and cutting machines.

A factory for the manufacture of potash from kelp is under consideration by R. W. Bridge, at Sidney, Vancouver Island.

Dominion Products, Vancouver, are extending their evaporator plant.

A permit has been issued to the Booth-Coulter Copper and Brass Company, Limited, Toronto, for a $6,500 factory addition.

The Ajax Rubber Company, London, Ont., is to build a $300,000 factory.

The Procter and Gamble Company, Hamilton, soap makers, will build a $25,000 factory addition.

The Canadian Consolidated Rubber Company are extending their works at Kitchener, Ont.

Sir Adam Beck, head of the Hydro-Electric Power Commission, is working on a scheme for the establishment of a large hydro system in Northern Ontario, which will furnish energy for the new nickel smelter near Sudbury.

The Yarmouth Trading Company, Yarmouth, N.S., will erect a $11,000 building for the drying of fish.

H. Mueller Manufacturing Company, Sarnia, Ont., are having plans prepared for a $200,000 brass rolling mills.

The Molly Mine, Nelson, B.C., next to the largest molybdenite mine in Canada, is to be immediately equipped with a large mill, Figures show that the mine ranks second as the largest producer of molybdenite and one of the most important of the country's munition properties.

At the new industrial centre at New Toronto, the machinery for the first unit of the Goodyear Rubber Company's plant is in place, and within the next week the wheels will be set in motion, giving employment to some twelve hundred men.

The large addition to the Brown Brass Rolling Mills is now completed, and several hundred more men will soon be employed. Their new three-storey office building on the corner of Lake Shore Road and Eleventh Street, will soon be ready.

The Dupont Fabrikoid Company will also start operations shortly, employing two or three hundred men.

Exposition of Chemical Industries

Indications are that the Third National Exposition of Chemical Industries at the Grand Central Palace, New York, during the week, beginning September 24th, will be a much greater success than its predecessors.

Whereas at the last Exposition two floors of the big building were occupied by 187 exhibitors, three floors, possibly more, will be occupied this year. Already the list of exhibitors contains 250 names of companies entering every field of industry.

The programme now forming shows that on Wednesday, September 26th, the Technical Association of Pulp and Paper Industry will meet at the Exposition. On Thursday, evening the American Institute of Chemical Engineers will meet, and Friday evening has been set aside for the American Chemical Society's New York Section.

Opening addresses will be made on that occasion on Monday, September 24th, at 2.00 p.m., by Dr. Charles H. Herty, chairman of the advisory committee of the Exposition, and editor of the Journal of Industrial and Engineering Chemistry. By Professor Julius Stieglitz, president of the American Chemical Society; Dr. Colin G. Fink, president of the American Electrochemical Society and Dr. G. W. Thompson, president of the American Institute of Chemical Engineers.

Among other speakers on the programme for other days are Mr. W. S. Kies, vice-president National City Bank, who will speak upon "The Development of Export Trade with South America"; Professor Marston Taylor Bogert, chairman, Chemistry Committee, National Research Council, who will speak upon "The Operation and Work of the National Research Council for the National Weal."

Dr. L. H. Baekeland, of the Naval Consulting Board, will make an address on "The Future of American Chemical Industry."

One day a symposium upon the National Resources as Opportunities for Chemical Industries will be given, and among the speakers will be: Mr. C. H. Crawford, assistant to president of the Nashville, Chattanooga & St. Louis Railway; Dr. V. V. Kelsey, chemist, industrial agent, Carolina, Clinchfield & Ohio Railway; Dr. E. A. Schubert, mineralogist-geologist Norfolk & Western Railway; Dr. T. P. Maynard, mineralogist-geologist Central of Georgia Railway, and Atlantic Coast Line Railway.

The motion picture programme will be one of wide interest. The American Cyanamid Company and General Electric Company having already arranged to supply their films. The Bureau of Commercial Economics at Washington will supply many toward completing the range of industrial films.

Chemists attending the Canadian National Exhibition, to be held in Toronto from August 25th to September 10th, are invited to use the offices of the Canadian Chemical Journal as their headquarters while in Toronto.

Foreign Trade Inquiries

1036. **Mirror Plates.**—A firm in Demerara inquires in regard to mirror plates from Canada.

1050. **Soaps and Perfumes.**—A firm of druggists in British Guiana inquires for soaps and perfumes.

1051. **Pharmaceutical Preparations.**—A large drug firm in British Guiana would like to get in touch with Canadian druggists.

1066. **Toilet Soaps and Perfumes.**—Canadian manufacturers of toilet soaps and perfumes are asked to communicate with a manufacturers' agent at Barbados.

1079. **Carbide of Calcium.**—A London firm desires the addresses of Canadian manufacturers of carbide of calcium.

1080. **Asbestos Fibre and Board**—A Canadian of high standing who has been established in Japan for many years wishes to secure supplies of asbestos fibre and board in lots of from one to twenty tons. Samples of the fibre can be seen at the Department of Trade and Commerce, Ottawa. He says those able to supply the present demand will find big business in future with Japan. Canadian producers are asked to send samples with full particulars of prices and code words together with advice as to quantities available.

1084. **Machine Tools, Metals, Chemicals and Oils.**—A Swedish firm established in Stockholm, Sweden, and Petrograd, Russia, desires to get in touch with Canadian manufacturing concerns wishing to develop export business after the war, especially machine tools, metals, chemicals and oils. A representative of the firm is now in New York city. The address can be obtained on application to the Commercial Intelligence Branch, Department of Trade and Commerce, Ottawa.

Recent Incorporations

Of Interest to the Chemical and Metallurgical Industries

Montreal.—Techno-Chemicals, Limited, $49,900.

Montreal.—Lynn Rubber Manufacturing Company, of Canada, Limited, $10,000. G. Derome, J. Bruneau, J. Ducharme.

Three Rivers, Que.—The St. Maurice Foundries, Limited, $49,000.

Collingwood, Ont.—Paragon-Hitchcock Mines, Limited, $2,000,000. C. W. Pitt, D. McKay, A. G. McKean.

Fergus, Ont.—Chelsea Green Iron Works, Limited, $200,000. W. G. Beatty, W. L. Ham, R. D. Kerr.

Hamilton, Ont.—Canada Emery Wheels, Limited, $50,000. F. Radigan, G. G. Sutherland, C. Nield.

Toronto.—Allied Chemicals, Limited, $40,000. B. Walton, A. W. Crouch, C. E. A. Carr.

Toronto.—Gas Processes, Limited, $50,000.

Toronto.—Canadian Incinerator Company, Limited, $50,000.

Toronto.—Nicu Steel Corporation, Limited, $200,000.

Toronto.—McEnaney Gold Mines, Limited, $3,000,000.

Saskatoon, Sask.—Western Chemical Manufacturing Company, Limited, $20,000.

Edmonton, Alta.—Goldlands, Limited, (non-personal liability), $200,000.

Nelson, B.C.—British-Alberta Mining Company, Limited, $300,000.

Victoria, B.C.—Gabriola Shale Products, Limited, $50,000.

Vancouver, B.C.—Aspen Grover Mining Company, Limited, $120,000.

The Canada Pipe and Steel Company has been granted permission to increase the capital stock from $300,000 to $600,000

Permission has also been given to change the name of the Federal Steel and Foundry Company, Limited, to the Monarch Tractor Company, of Canada, Limited.

Publications Received

Agriculture in War Time.—A booklet by Dr. Frank T. Shutt, Dominion chemist, containing an address delivered before The Royal Canadian Institute, Toronto, on the changed aspect of the farmer and the farm due to the great increase in the demand for foodstuffs. Published by the University of Toronto Press.

Mineral Production of Canada, 1915. Annual report of the Department of Mines for 1915, by John McLeish, B.A., Issued by the Department of Mines, Ottawa.

Answers to Questions on the Flotation of Ores.—Twenty-four typical questions are answered in a way to show how mineral separations are carried out by means of flotation. By O. C. Ralston. Published by the Bureau of Mines, Washington.

Filtros:—The New Porous Mineral Medium.—A catalogue showing the various grades and sizes of Filtros as well as some specific installations. Published by the General Filtration Company, Inc., Rochester, N.Y.

Air Compressors.—A bulletin illustrating power driven, single stage, straight line air compressors intended for industrial uses, made by the Canadian Ingersoll Rand Company, Limited, Montreal. Eighteen sizes are built, designed for either motor or belt drive.

New Industry at Shawinigan Falls

The Canadian Aloxite Company, Limited, a subsidiary of the Carborundum Company of Niagara Falls, N.Y., are erecting a large plant at Shawinigan Falls, Quebec., taking power from the Shawinigan Water & Power Company. The plant will be located on the outskirts of Shawinigan Falls, where fifteen acres have been acquired on the line of the Canadian Pacific Railroad along the St. Maurice River. The plant will consist of buildings for the storage and treatment of raw materials, furnace buildings, machine shop, locker building, boiler house, etc. When in complete operation it will use about 20,000 horse power and it is expected that some furnaces will be put in operation by December 1st.

The company will manufacture various electric furnace products including the artificial abrasives, carborundum and aloxite. Carborundum which, chemically is silicon carbide, is produced in the electric furnace from the raw materials coke, sand and sawdust. It is a most efficient brasive for the grinding of cast iron, brass, marble and many other materials and is also largely used as a refractory for high temperature work. Aloxite is an aluminous abrasive used in making grinding wheels for the grinding of steel. It is made by fusing bauxite in the electric furnace. The bauxite used will be obtained largely from Arkansas although after the war it is expected that South American bauxite will be employed.

Carborundum and aloxite grinding wheels are largely used by manufacturers of munitions in the grinding of shrapnel shells, rifle barrels, bayonets and various arms. These abrasives are indispensable also in the manufacture of automobile and aeroplane engines, in the shaping of armor plate and in the general metal working industries. A great shortage exists at the present time in the abrasive industry on account of the shutting off of all natural abrasives formerly obtained from Turkey and Greece and it is for the purpose of meething this acute situation that the Canadian Aloxite Company are constructing this new plant at Shawinigan Falls. It will be rushed to completion at the earliest possible date.

The coming of the Canadian Aloxite Company Limited adds another to the list of electro chemical plants now located at Shawinigan Falls, which is fast becoming one of the important world centers for electro chemical and electro metallurgical products.

The Fabri-Cord Tire Company, of Canada, Limited, Toronto, has been incorporated with authorized capital of $1,500,000.

Chemical Prices

The quotations below represent average prices for the quantities indicated at the time of going to press. Larger amounts, of course, may be obtained at lower figures.

Toronto, July 27, 1917

Inorganic Chemicals

Alum, lump ammonia	100 Lbs.	$6.50
Aluminium Sulphate, high grade, bags	100 Lbs.	4.00
Ammonium Carbonate	Lb.	.16
Ammonium Chloride, white gran	Lb.	.21
Aqua Ammonia .880	Lb.	9
Bleaching Powder, 35% drums	100 Lbs.	4.50
Blue Vitriol	100 Lbs.	13.00
Borax, crystals	Lb.	.11
Boric Acid, powdered	Lb.	.16
Calcium Chloride, crystals fused	100 Lbs.	2.50
Caustic Soda, ground, Bbl	Lb.	8
Chalk, light precipitated	Lb.	.10
Cobalt Oxide, black	Lb.	2.10
Fuller's Earth, powdered	Lb.	5
Glauber's Salt, in bags	100 Lbs.	1.50
Hydrochloric Acid, carboys, 18°	Lb.	3
Lead Acetate, white crystals	Lb.	.18
Lead Nitrate	Lb.	.27
Lithium Carbonate	Lb.	2.10
Magnesium Carbonate, B.P	Lb.	.40
Mercury	Lb.	3.65
Nitric Acid, 36° carboys	100 Lbs.	8.75
Phosphoric Acid, S.G. 1750	Lb.	.80
Potassium Bichromate	Lb.	.60
Potassium Bromide	Lb.	1.85
Potassium Carbonate	Lb.	1.50
Potassium Chlorate, crystals	Lb.	.80
Potassium Hydroxide, sticks	Lb.	2.15
Potassium Iodide, bulk	Lb.	4.25
Potassium Nitrate	Lb.	.50
Potassium Permanganate, bulk	Lb.	5.00
Silver Nitrate	Oz.	.80
Soda Ash, bags	Lb.	4
Sodium Acetate	Lb.	.30
Sodium Bicarbonate	100 Lbs.	3.25
Sodium Bromide	Lb.	.80
Sodium Cyanide, bulk, 98-99 per cent	Lb.	1.25
Sodium Hyposulphite, bbls	100 Lbs.	2.50
Sodium Nitrate, crude	Lb.	8
Sodium Silicate	100 Lbs.	4.00
Sodium Sulphate	Lb.	4
Strontium Nitrate, com	Lb.	.55
Sulphur, ground	100 Lbs.	3.50
Sulphur, roll	100 Lbs.	4.00
Sulphuric Acid, 66°Be, carboys	100 Lbs.	3.00
Tin Chloride, crystals	Lb.	.50
Zinc Oxide	Lb.	.25
Zinc Sulphate, com	Lb.	.18

Organic Chemicals

Acetanilid, C.P.	Lb.	$ .75
Acetic Acid, 28 per cent. in bbls	Lb.	.7¼
Acetic Acid, glacial, 99½% in carboys	Lb.	.75
Acetone	Lb.	.60
Alcohol, methylated	Gal.	2.15
Alcohol, grain	Gal.	7.50
Alcohol, wood, 95 per cent., refined	Gal.	2.25
Benzoic Acid	Lb.	8.50
Carbolic Acid, white crystals	Lb.	1.00
Carbon Bisulphide	Lb.	$ .10
Chloroform, com	Lb.	1.15
Citric Acid, domestic, crystals	Lb.	1.40
Ether, 725	Lb.	.50
Glycerine	Lb.	.80
Oxalic Acid	Lb.	.80
Salicylic Acid	Lb.	2.00
Sodium Benzoate	Lb.	8.00
Tannic Acid, commercial	Lb.	2.00
Tartaric Acid, crystals	Lb.	1.10

Metals

Aluminium	Lb.	$ .66
Antimony	Lb.	.26
Brass, yellow ingots	Lb.	.23
Cobalt	Lb.	2.25
Copper, casting	Lb.	.35
Copper, electrolytic	Lb.	.37
Lead	Lb.	.15
Magnesium	Lb.	2.50
Nickel	Lb.	.47
Platinum, pure	Oz.	105.00
Silver	Oz.	.78½
Spelter	Lb.	.12
Tin	Lb.	.64
Mild Steel	100 lbs.	5.50
Common Bar	100 lbs	5.25

Chemical Markets

No change is noticed in prices since last month except in the case of blue vitriol which is now quoted a cent a pound lower than last month. Ammonia is strong, but no change in price has been made. Containers have advanced, carboys being quoted at $4.00 and 100 gal. drums at $25.00.

Recovery of Coal By-Products

At a recent meeting of the British Society of Chemical Industry, Dr. Lessing described a process for the complete recovery of the benzol and toluol in coal gas, by means of which it will be possible to obtain about two gallons of benzol and a tenth of that quantity of toluol from every 10,000 cubic feet of gas. This is a discovery which will prove as useful in peace as in war, for benzol and toluol form the basis of most of our coal-tar colors, and will prove invaluable to our rapidly-growing dye industry, which is making gigantic strides towards filling the place formerly occupied by the German dye works. Further, we have here a prolific source of home-produced fuel for our internal-combustion engines.

Benzol, before the war, was coming rapidly into favor for driving these engines, though only about one-tenth as much benzol was used as petrol. After the war Great Britain ought to be producing in this country at least five times as much benzol as in 1914. Such a supply should mean the freeing of a very large amount of tonnage—and tonnage will be scarce for a long time after peace is declared. In fact, the whole of the petrol previously imported could be replaced if the home-produced fuel-alcohol question were properly tackled. There is good reason to suppose that the new Board of Fuel Research will give particular attention to the future of alcohol as a fuel. It has been estimated that fuel alcohol could be produced for 3d. per gallon. Mixed with an equal quantity of benzol we have an ideal fuel that can be used without engine alteration.

Classified Index of Advertisements

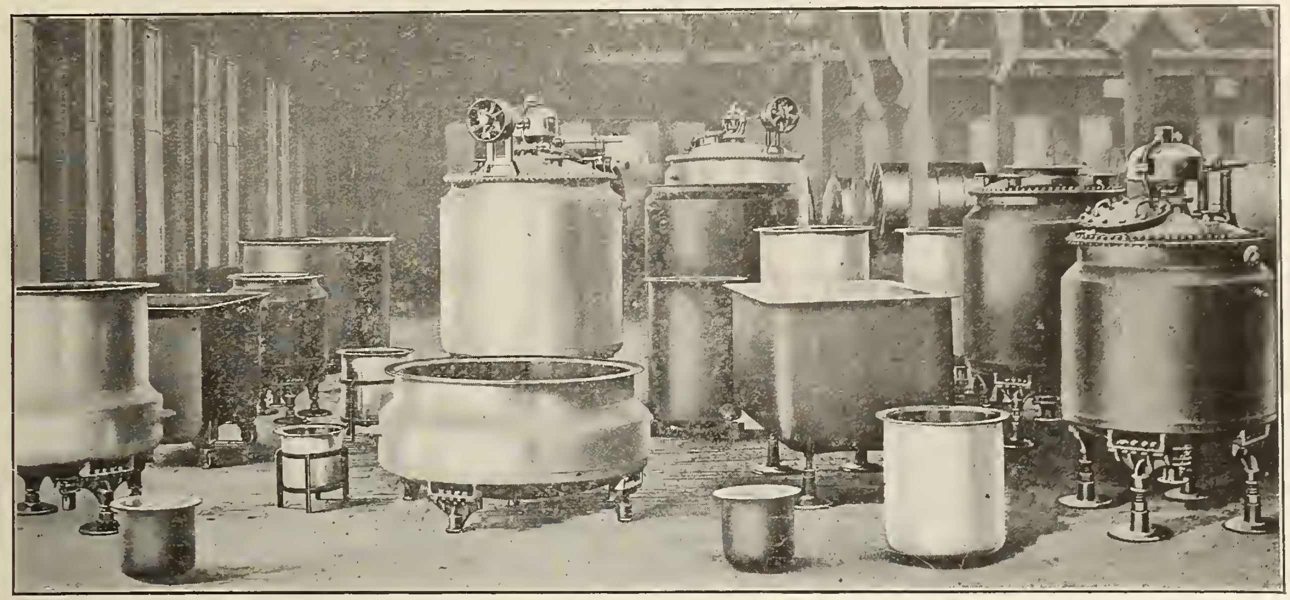
Index of Advertisements

CANADIAN CHEMICAL JOURNAL

A Canadian Journal devoted to Metallurgy Electro-Chemistry and Industrial Chemistry.

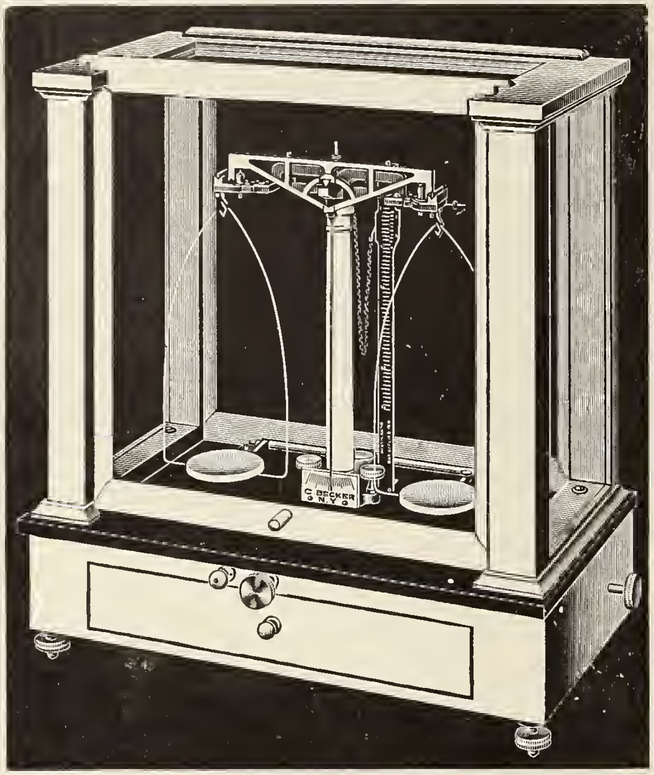
Vol. 1, No. 5 | TORONTO, SEPTEMBER, 1917 | 20c. a copy; $2 a year

PROFESSIONAL DIRECTORY



Analytical Chain Balance

INVALUABLE FOR RAPID WORK



The **chain balance** is of the usual construction of analytical balances, with the exception that there is no rider and consequently no graduations on the beam. All weighing below 50 m.g. to 1/10 m.g. is accomplished by lifting or lowering a small gold chain, suspended at one end from the beam, and at the other from a sliding hook attached to the graduated scale, from which direct readings are taken. To operate it is only necessary to rotate the thumb screw, conveniently placed outside the balance case, on the right hand side. (See illustration). This operation can take place while the beam is swinging, this in conjunction with the **elimination of all riders, and small weights below 50 m.g., resulting in a great saving of time.**

ANALYTICAL CHAIN BALANCE No. 15
With Vernier

Capacity	100 grams
Sensitiveness	1/20 milligram
Diameter of Pans	3 inches
Length of Beam	6 inches
Bearings	Agate
Knife edges	Agate
Capacity of bar and vernier	50 Mg. to 1/10 Mgm.

Polished mahogany case, front sliding frame, counterpoised. Mounted on black plate glass.

Price Duty Free)	$120.00
" (Duty Paid)	168.00

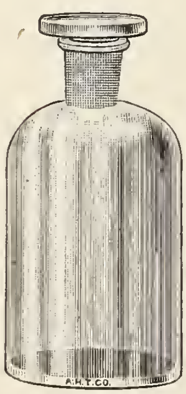
Above prices subject to advance without notice.

SALES AGENTS

LYMANS, LIMITED
344 St. Paul St. West MONTREAL

BOTTLES FOR LABORATORY USE

IN OUR STOCK FOR IMMEDIATE SHIPMENT



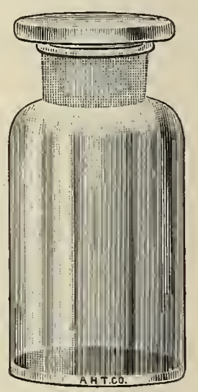
No. 22235

22235. Bottles, Narrow Mouth, of white glass, with flat glass stopper. These Bottles are the first made in the United States of the shape provided heretofore only in imported bottles. They are made in private moulds and are of excellent appearance and quality as compared with any regular stock iron-mould tincture or salt mouth bottles. They are very suitable for use as reagent bottles where labelling is done in the laboratory.

Capacity, cc	125	250	500	1000
Number in original case	100	100	100	50
Each, net	.16	.20	.28	.40
Per 100 in original case, net	11.00	14.50	20.00	27.50

22247. Bottles, Wide Mouth, of white glass, with flat glass stopper; otherwise same as above.

Capacity, cc	125	250	500	1000
Number in original case	100	100	100	50
Each, net	.17	.22	.30	.42
Per 100 in original case, net	12.00	15.50	21.00	28.50



No. 22247

ARTHUR H. THOMAS COMPANY

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LABORATORY APPARATUS AND REAGENTS

West Washington Square - - - - Philadelphia, U. S. A.

CANADIAN CHEMICAL JOURNAL

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Vol. 1 TORONTO, SEPTEMBER, 1917 No. 5

CANADIAN CHEMICAL JOURNAL

DEVOTED TO THE CHEMICAL AND METALLURGICAL INTERESTS OF CANADA.

Published monthly by the Biggar Press Limited

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Time of going to press, 25th of the month preceding date of issue. News and changes of advertisements should be in hand one week before.

Contents

The Ban on Oleomargarine

THE Canadian Society of Chemical Industry recently forwarded to the Minister of Agriculture a resolution passed by the Society asking that the ban be removed from the manufacture of oleomargarine in Canada. So far the Minister has not signified his intention. Considering the pressing problems arising out of the war, affecting agriculture as well as the industries, we are not disposed to be impatient with the Minister, but while he is deliberating on the question we would respectfully call his attention to a few facts.

First, Canada is the only country in the world which now prohibits the manufacture of oleomargarine.

Second, the United States, a country similarly situated in regard to this matter, and having a butter industry vastly greater than that of Canada, permits the home manufacture of this product under regulation. This is the more noteworthy since the United States farmers have for years been more insistent on their rights and more powerful in legislation than Canadian farmers. As an example of this power, the Grange revolt against the domination of Congress by the private railway interests was the prime influence which created the Interstate Commerce Commission and brought regulation of railway rates.

Third, it cannot be shown that the making of margarine has in any way injured the interests of the United States farmers.

Fourth, there is one country which is pre-eminent as a butter making country—that is Denmark—whose most important export is butter. If oleomargarine really injured the butter trade we should undoubtedly find the Danish farmers up in arms against its manufacture. But not only does Denmark permit the making of the product, but it is an interesting fact that while Denmark exports nearly all its own butter the mass of the Danish people themselves habitually consume oleomargarine because it is unobjectionable and cheaper.

Fifth, we have it on the high authorities cited in this JOURNAL that oleomargarine is a nutritious and sanitary article of food; and

Sixth, if no chemical authorities had ever endorsed it as a wholesome article of diet, we have the common sense and the common taste of the people in proof of the fact that oleomargarine which is agreeable to the taste must be preferable to that class of real butter—and there is no inconsiderable amount made in Canada—which becomes rancid before being used. This is not a sneer at the average Canadian farmer's wife, for she has many handicaps in making butter in a small way by the household churn. They do as well as those of the United States; but if the permission to make oleomargarine in the country has any effect on the home butter industry in Canada it should lead to an improvement in the quality of the dairy product.

The Chemical Exposition

PREPARATIONS are going on apace for the Third National Exposition of Chemical Industries to open on the 24th September in the Grand Central Palace in New York, and to continue for a week. It will probably be the largest of its kind held anywhere in the world.

The popular idea of an exhibition is a more or less interesting collection of exhibits sandwiched in between band entertainments, grand stand performances and midway shows. The Exposition of the Chemical Industries, however, may well be said to be educational and to exemplify a national and international movement, and the only form of entertainment will be the moving pictures and steropticon views which will of themselves be educational in their purpose. Those who attended last year, including many Canadians, were amazed at the evidences of progress in a group of new industries which it had been said at the outbreak of war would require many years to build up in countries like the United States and Canada. But the show will be one-third larger this year than last, and no intelligent man practically concerned with chemistry and metallurgy can visit this Exposition without acquiring information that will be worth the time and cost.

In the matter of chemical problems Canada and the United States have been in the same boat, and rowing with the same "skulls," since the war threw them on their own resources, and the chemical and metallurgical industries of the two countries are in a stronger alliance than those of any other group. For this reason all the advances that either country may make will be a benefit to the other; and hence the larger the delegation of Canadians the greater the mutual advantage.

The program will be published in our next issue in time for use by visitors to the Exposition.

WITH reference to the articles contributed to The Canadian Chemical Journal by Mr. Clapp it is interesting to note that the Board of Trade of St. John, has issued a bulletin in which the prospects for oil in New Brunswick are enthusiastically set forth. Sir Boverton Redwood, in his report on the oil shale deposits of that province two years ago, stated that a ton of these shales would produce 33 gallons of crude oil and 60 pounds of sulphate of ammonia. It is asserted that the New Brunswick shale is richer in oil than that of Colorado, and that the deposits are sufficient to maintain for fifty years the operation of five plants yielding eighteen million gallons of crude oil and over thirteen thousand tons of suphate of ammonia per year.

In developing the work of the Advisory Council for Scientific and Industrial Research organized under the auspices of the Department of Trade and Commerce a committee to take up the special field of chemistry has been nominated. This committee will advise on all chemical problems which may come before the Advisory Council, and is composed of the following members:

Dr. R. F. Ruttan, B.A., M.D., D.Sc., chairman, director department chemistry, McGill University, Montreal.

J. W. A. Bain, B.A., Sc., assistant professor applied chemistry, University of Toronto, Toronto.

Dr. John Bates, Chem. E., Ph.D., superintendent Forest Products Laboratories of Canada, Montreal.

Dr. F. J. Birchard, B.A., Ph.D., research chemist, Dominion Grain Laboratory, Winnipeg, Man.

Professor Adam Cameron, M.A., B.Sc., professor chemistry, University of New Brunswick, Fredericton, N.B.

Dr. W. H. Ellis, M.A., M.B., LL.D., professor applied chemistry, University of Toronto, Toronto, Ont.

Dr. W. L. Goodwin, B.Sc., D.Sc., director of School of Mines, Kingston, Ont.

Dr. Milton L. Hersey, M.A., Sc., LL.D., president, Milton Hersey, Limited, consulting chemists, Montreal, Que.

Dr. F. M. G. Johnson, M.Sc., Ph.D., chemist, Curtis & Harvey, Dragon, Que.

Dr. A. F. L. Lehmann, B.S.A., Ph.D., professor chemistry, University of Alberta, Edmonton, Alta.

Dr. E. A. Lesueur, B.Sc., consulting chemical engineer, Ottawa, Ont.

Dr. E. Mackay, B.A., Ph.D., professor chemistry, Dalhousie University, Halifax, N.S.

I. C. Mackie, B.A., chief chemist, Dominion Steel Corporation, Sydney, N.S.

Dr. D. McIntosh, M.A., D.Sc., professor chemistry, University of British Columbia, Vancouver, B.C.

Dr. R. D. MacLaurin, B.A., Ph.D., professor chemistry, University of Saskatchewan, Saskatoon, Sask.

H. W. Matheson, M.Sc., chemist and general manager, Canadian Electro Products Company, Shawinigan Falls, Que.

M. A. Parker, B.Sc., F.C.S., professor chemistry, University of Manitoba, Winnipeg, Man.

T. H. Wardleworth, Esq., F.C.S., chairman Canadian Branch, Society of Chemical Industry, Montreal, Que.

The names were selected with the assistance of the Canadian branch of the Society of Chemical Industry. They are intended to be representative both scientifically and geographically. Is the list fixed or will it be flexible enough to welcome the addition of other men whose practical experience would give strength to the public usefulness of the community?

The Mining and Metallurgical Treatment of Molybdenum Ores in Canada

By G. C. Mackenzie

(By Permission of the Director of Mines, Dept. of Mines, Ottawa)

The opening of the great European war found the British Empire lacking in adequate supplies of certain metals that were urgently required for the manufacture of munitions. We had grown so accustomed to securing many of these metals from foreign reduction works, that, rather than spend money in the exploitation of our own natural resources, we depended upon the foreigner to supply our requirements, because it was easier and cheaper to buy what he had to sell than to go to the trouble and expense of developing our own supplies.

This penny-wise, short-sighted policy of the past, with its foolish disregard of future contingencies, has cost the Empire much lost time in the manufacture of munitions, and, thereby, many valuable lives of its brave soldiers. The experience has been costly, but the lack of these materials has at least brought about an awakening that promises the adoption of a wiser policy in the future. Not the least of these deficiencies has been the lack of the steel hardeners, tungsten and molybdenum, and as these metals are important factors in the manufacture of modern ordnance and ammunition, the curtailment of supplies during the first two years of the war was a serious matter.

The name Molybdena, now applied only to the metal Molybdenum and its compounds, really means lead, and has come to us from the early Greeks who used the term to describe all of the dark metallic sulphides. The resemblance between lead, molybdenite and "black lead" or graphite especially, is best evidenced by lack of discrimination between them and our retention of the ancient confused term black lead and lead pencil. No doubt when better means of determination arose, the easiest one to identify, lead, was eliminated, but the difference, superficially slight, did not permit classification until late in the phlogiston period. The name molybdenum for many centuries, therefore, pertained to graphite and molybdenite which were considered identical.

It is interesting to note how these two were finally distinguished. By the action of nitric acid upon molybdenite, Scheele, in 1778, three years before his work on tungsten, showed that there were formed sulphuric acid and a white acidic earthy substance which we term molybdic acid to-day. In 1779, Scheele firmly established the difference between the two minerals, therefore confused, in another treaty on plumbago. In the Phlogiston way, the earth was considered the calx of a metal, and on this theory, in 1790, facts were made known regarding the first preparation of the metal by Hjelm, who, prompted by the current belief that carbon was rich in phlogiston, ignited the acid oxide of Scheele in a graphite crucible with carbon. The resulting gray metal must have contained considerable carbon. That process is commercially used to-day.

Until recent years, the metal was in little demand for industrial purposes, and very little search was made for the ores of molybdenum. At the present time, however, owing to its introduction into metallurgy, in the form of iron molybdenum alloys, there is a considerable demand for such ores. They are produced, however, very irregularly and in small quantities. If a larger and more regular ore supply were assured, there is no doubt that new uses would be found for the metal, its alloys and salts, and the demand for the ores would increase.

Properties and Uses

Physical and Chemical Properties of Molybdenum.—Pure molybdenum is a white metal, which is malleable, ductile, and soft enough to be filed and polished with ease. However, it is seldom produced in the pure state, and its appearance depends largely upon the method of production. Reduction of the oxides or sulphides of molybdenum with hydrogen yields molybdenum as a grey powder, which, under heat and pressure, may be compacted into a metallic bar that is brittle and even fragile. Molybdenum produced by the Alumino Thermic methods or by reduction in the electric furnace is a compact metal, but that produced in the electric furnace contains carbon, and its physical properties differ from those of carbon-free metal. The melting point of molybdenum is still in question. The United States Bureau of Standards has placed it at about 2,500° C., or 4,500° F. This is about 1,400°C., above the melting point of copper, and 740° C., above that of platinum. Osmium, tantalum and tungsten are the only three metals listed by the Bureau of Standards as having higher melting points. The specific gravity of molybdenum is increased appreciably by drawing or hammering the metal, as is that of many other metals, such as copper and tungsten. The Research Laboratory of the General Electric Company has determined the specific gravity of ductile molybdenum before drawing as 10.02, whereas, after drawing, it ranges from 10.04 to 10.32. Molybdenum wire has a tensile strength approximately one-half that of hard-drawn steel piano wire or tungsten wire of corresponding size, and this tensile strength increases very appreciably with the fineness of the wire. In other words, the more the metal is worked the stronger it becomes. The electrical resistance of ductile molybdenum is 5.6 microhmes per cubic centimeter of hard-drawn wire, and 4.8 for annealed wire, the resistivity being measured at 25° C.

Metallic molybdenum containing carbon is grey and brittle; it is also very hard and scratches steel and quartz, and even the hardest file will not cut molybdenum alloyed with a certain proportion of carbon. The melting point of the grey metal is much lower than that of pure molybdenum, and its specific gravity is also lower, ranging from 8.6 to 8.9, according to the amount of carbon present. Pure molybdenum surrounded with carbon and heated to about 1,500° C., absorbs carbon and becomes hard; conversely, carbon-bearing molybdenum melted with molybdenum-dioxide is refined by the oxidation of the carbon in the metal.

Pure molybdenum undergoes oxidation to an appreciable extent at the ordinary temperature, but it is superficially attacked at a dull red heat, and rapidly at 600° F., molybdenum trioxide subliming. Dilure acids have no effect upon it. Strong nitric acid oxidizes it, so does concentrated sulphuric acid, and at the same time there are formed lower oxides, which are soluble in the acid with the formation of a deep blue color. The halogens attack it with a formation of more or less volatile, variously colored halogen and oxy-halogen compounds.

The massive metal, on account of its less surface exposure, is less active toward reagents than the powder molybdenum.

The trioxide is volatile at high temperature.

Uses.—Molybdenum is used in the form of oxides, ammonium salt and metal. Several tons a year are used in North America in the form of ammonium molybdate for the determination of phosphorus in iron ores, pig irons and steels, and also in the determination of phosphorus in fertilizers. The salt finds further use in fire-proofing certain fabrics. The metal is used in self-hardening steel; from five to ten per cent. is introduced, and the resulting steel is raised in elastic limit and tensile strength and possesses greater toughness in addition to the former property.

Ferro-Molybdenum is found to be of value as a constituent in the manufacture of large castings, gun barrels, in which it is prized for its resistance to corrosive gas action, armour plate, armour-piercing shells, car steel, and magnets.

Equal parts of molybdenum and chromium introduced into steel are claimed to be more preferable for many of the above uses, especially self-hardening steel. Two to five per cent. of molybdenum and ten per cent. chromium with little or no carbon will make steel acid resisting to a great degree. Nickel steels alloyed with molybdenum are found to possess desirable qualities. The tensile strength of molybdenum wire is given at from 200,000 to 270,000 pounds per square inch, as compared to tungsten with 480,000 to 580,000 pounds per square inch.

Molybdenum wire-wound electric furnaces have special claims made for them. A thermocouple which uses the metal has been described recently. The lower oxides of molybdenum are highly colored. Their use is recorded in coloring leather, rubber and porcelain. A soluble variety is used as a substitute for indigo.

In some form not disclosed, molybdenum is added as a preservative to certain smokeless powders.

The principal use of molybdenum, however, is in the manufacture of special steels to which, particularly in conjunction with chromium, manganese, nickel, cobalt, tungsten and vanadium, it imparts many desirable properties. These steels are used for a large variety of purposes, such as for crank and shaft forgings, high pressure boiler plate, ordnance, armour-plate, armour-piercing projectiles, permanent magnets, wire, and self-hardening and high speed machine tools. In a general way, molybdenum acts like tungsten in steel, but it is more active, and less is needed to produce a given result. Absolute figures as to the relative effect of the two elements cannot be given, as the effects are not exactly similar. The effective ratio of molybdenum to tungsten seems to be between one to two and one to three.

Metallic molybdenum is used in various electrical contact making and breaking devices, X-ray tubes and voltage rectifiers, and in the form of wire for filament supports in incandescent electrical lamps, for winding electric resistance furnaces, and in dentistry, as a molybdenum tungsten alloy.

Canadian Molybdenum Products

The only molybdenum products manufactured at present in Canada are C.P. molybdic acid, C.P. ammonium molybdate, and ferro molybdenum. The International Molybdenum Company manufacture all three of the above at their Orillia, Ont., works, this company being the first Canadian operator to establish the molybdenum business on a commercial basis, therefore being the pioneer of this new industry.

The Tivani Electric Steel Company, of Belleville, Ont., have commenced the manufacture of ferro-molybdenum quite recently, but so far have made no attempt to produce molybdic acid or ammonium molybdate.

The manufacture of metallic molybdenum, ingot, molybdenum wire, molybdenum steels, etc., is not carried out in this country, but it is well within the range of possibility that, providing the mines are able to produce sufficient minerals to meet the demands of the market, all of these various lines of manufacturing will be entered into within the Dominion.

I am unable at this time to give particulars of the manufacture of these molybdenum products, but it may be stated that Canadian ferromolybdenum, molybdic acid and ammonium molybdate are now being marketed satisfactorily, and that the production of ferro-molybdenum up to the end of 1916 was in the neighborhood of thirty tons. The value of the molybdic acid and ammonium molybdate manufactured at Orillia during 1916 is stated by the management of the International Company to be $18,867.35.

Prices and Markets

Molybdenite ores and concentrates are marketed on their content of MoS_2, and are paid for as so much per unit of contained molybdenum sulphide. In Canada and the United States, the short ton of 2,000 pounds and the unit (1 per cent. of a ton) twenty pounds, are used, whereas in Great Britain and Australia, the long ton of 2,240 pounds and the unit of 22.4 pounds always apply.

Under existing abnormal market conditions, brought about by the war, the prices being paid at the present time for molybdenite concentrate are from 100 to 200 per cent. greater than pre-war quotations. In 1908, high grade concentrates containing 90 to 95 per cent. MoS_2 were sold for $6.50 to $7.60 per unit, and in 1909 the price was as low as $5.65 per unit.

In the fall of 1915 the Imperial Government fixed a price of 105 shillings per unit (long ton) for molybdenite concentrates containing not less than 85 per cent. MoS_2, f.o.b., London and Liverpool, and as the mineral was under embargo which prohibited its export to any country outside of the British Empire, this price naturally became the official standard quotation for all ores and concentrates produced within the Empire. Since that date, however, licenses have been granted for the export of the mineral to France and Russia at the official quotations given above.

The quotation, it should be noted, means 105 shillings per unit, 22.4 pounds of molybdenite (MoS_2), not 85 per cent. concentrates as many have imagined. This price corresponds to $1.09 per pound of MoS_2 contained in 85 per cent. concentrates, f.o.b., Ottawa, Ont., at which point the Canadian production is purchased for the Allied Governments by the Imperial Munitions Board.

Canadian molybdenum purchased by the Imperial Munitions Board at Ottawa in the form of molybdenite concentrate, is, at the moment, being converted to ferro-molybdenum in Canada before being exported to Europe, and as it is possible to manufacture the ferro-alloy from concentrates containing less than 85 per cent. MoS_2, the following sliding scale of payment has been adopted by the Board:

(a) For concentrates containing not less than 85 per cent. molybdenite, $1.09 per pound of contained MoS_2.

(b) For concentrates containing not less than 80 per cent. molybdenite, $1.05 per pound of contained MoS_2.

(c) For concentrates containing not less than 75 per cent. molybdenite, $1.02 per pound of contained MoS_2.

(d) For concentrates containing not less than 70 per cent. molybdenite, $1.00 per pound of contained MoS_2.

It is difficult to forecast with any accuracy the future conditions of the industry, but it is reasonable to assume that with increased production and a more normal market, the present prices will decline. It is possible that with the end of the war consumption may keep pace with production as the metal has a multitude of useful applications in the peaceful arts; however that may be, producers would do well to assume that a drop in price is inevitable with the end of the war and to prepare themselves accordingly.

Canadian Production

The mining and metallurgical treatment of Canadian molybdenum ores has up to 1916 played a very small part in the world's production. This has been due to various factors chief of which have been the limited demand for the mineral and at unattractive prices, together with the fact that no Canadian mine had until 1916 been developed to the point of a steady producer.

In 1911, the Mines Branch of the Department of Mines, published a monograph entitled, "Report on the Molybdenum Ores of Canada," by Dr. T. L. Walker, of Toronto University; and while this report contained considerable detailed information regarding the various localities throughout the country in which ores of molybdenum occurred, it was at that time impossible to foretell with any degree of accuracy, the probabilities of Canadian production, or to describe commercial methods of preparing the ore for the market.

In 1915, the Mines Branch, in response to a circular issued by the Colonial Institute of Great Britain, commenced a detailed examination of the molybdenum ores of Canada; and as the Department at this later date were fully equipped to experiment on the problem of concentration, the investigation consisted for the most part in looking for a solution of the problems involved in preparing the ore for market.

The Department secured large samples in carload lots which were shipped to the testing laboratories of the Mines Branch in Ottawa. After much patient research work with the more common specific gravity types of ore concentrating machinery the conclusion was reached that concentration methods based upon specific gravity would not yield commercial results and therefore a solution of the problem would have to be looked for in other directions.

After coming to the conclusion that the older processes of concentrating minerals would not apply, the possibilities of separation by flotation were carefully looked into and for a time it was considered that the modern Oil Flotation Process would probably be adopted. However, during a laborious and detailed examination of this method, there were encountered certain difficulties in the application of the oil process which indicated the desirability of continuing the investigation for an easier method of working. This method was eventually found in what has been called the Water Film Flotation Process, and although commercial results were not immediately attained the process lent itself readily to adjustment, and as the factors governing the separation of molybdenite from its gauge by this method were more completely understood, a type of apparatus was gradually evolved which is at the present time in successful operation at the ore testing laboratories of the Department.

The principle upon which this method is based is the surface tension of water, advantage being taken of the fact that molybdenite resists wetting, while its associated minerals are more or less easily wetted and submerged.

The method of separating molybdenite from other minerals by means of projecting the ore upon a sheet of flowing water has been known for many years, but the first commercial application of the process on a large scale was made by Henry E. Wood, of Denver, Colorado, who patented the Wood Water Film Flotation machine in the United States and Canada.

About the time the officials of the Department had satisfied themselves that water film flotation was the most desirable process for the separation of the majority of Canadian ores, attention was directed to the Wood type of apparatus, and after consultation with Mr. Wood it was decided to install one of his machines at the Testing Laboratories in Ottawa. Subsequently, certain weaknesses in the Wood machine developed in the treatment of some of our Canadian ores and the Department in endeavoring to correct these weaknesses and to improve upon the general adaptability of the machine, have evolved a type of apparatus which has been found to work very satisfactorily under almost all conditions.

While the Department were experimenting for a solution of the separation problem, the search for molybdenite deposits of economic value continued throughout the country. Old deposits were re-opened and developed with more vigor than heretofore and many new discoveries were made, but it was not until the spring of 1916 that the industry as a whole was strengthened by the development of the "Moss Mine" of the Canadian Wood Molybdenite Company, near Quyon, Pontiac County, Quebec. The occurrence of a mineral resembling graphite had been known in this locality for many years, but it was not until January, 1916, that the identity of this mineral was definitely established as molybdenite.

The International Molybdenum Company, of Orillia, with concentrating mill at Renfrew and smelter at Orillia, have been in operation since 1915. During the past year this company have milled approximately 2,419 tons of molybdenite ores of which approximately 26 tons were derived from the United States. According to figures supplied by the management of the company, the average content of the ore milled was 1.23 per cent. MoS_2 with a production of approximately 60,000 pounds of molybdenite. The recovery has been estimated to be 80 per cent. of the total amount of molybdenite received.

This company is under contract with the Imperial Munitions Board for 50 tons of ferro-molybdenum of which they have already delivered in the neighborhood of 30 tons. The ferro-molybdenum must comply with the following specification:

Molybdenum	70% minimum.
Carbon	4% maximum.
Sulphur	0.4% maximum.

The alloy must be arsenic and copper-free.

The method of concentration adopted by the International Molybdenum Company is water film flotation, but the machine developed by the company staff is somewhat differently constructed than either the Wood Machine or the apparatus developed by the Department of Mines. The principles involved are, however, exactly similar, and while the International Molybdenum Company have not produced concentrate of as high grade as the Department of Mines, the recovery of molybdenite is said to be equally as good and the product sufficiently high in molybdenite to meet the requirements of their refinery at Orillia.

The Canadian Wood Molybdenite Company, Ottawa, with mines at Quyon, Que., and mills at Quyon and Hull, Que., are unquestionably the foremost producers of molybdenite ore and concentrates in North America. Since the mine started operations in March, 1916, this company has mined approximately 5,000 tons of ore, and from assay returns supplied by the Canadian Wood Company, together with figures arrived at by the Department of Mines, it is estimated that the ore averaged 1.7 per cent. MoS_2 with a total content of 85 tons of pure molybdenite. Assuming that 80 per cent. of the total amount has been recovered at least 68 tons of pure molybdenite have been recovered from this property during 1916.

Early in the fall of 1916, the Canadian Wood Company commenced the installation of a water film flotation mill at their property at Quyon. This mill with a capacity of 50 tons of crude daily was not completed until some time in December owing to difficulties encountered in securing machinery and supplies. The company have also made an arrangement with the Canada Cement Company, whereby the latter crush and pulverize the ore as it is delivered to them at Hull, Que., and transport it to a 100 ton water film concentrator mill erected by the Canadian Wood Company on the Cement Company's grounds.

British Explosives Factories in 1916

According to the Report of the Home Office Inspectors of Explosives for 1916 the number of new explosives factories licensed during the year was 23, making a total of 48 since the outbreak of war. The inspectors say, however, that the new factories represent but a small proportion of the actual increase of inspection work, since all the important existing factories have been enormously increased in size. They describe the general condition of the factories, having regard to the exceptional circumstances now obtaining, as highly satisfactory, but they have considerable difficulty in impressing on the picric acid manufacturers the necessity for the strict observance of the requirements in regard to cleanliness and freedom from grit in danger buildings. Many cases of excessive quantities of picric acid being present in packing sheds have also come to their notice. The total number of accidents reported with explosives during the year was 641, as compared with 485 in 1915. Of these 363 occurred in manufacture, causing 195 deaths and injuries to 598 persons. The number of casualties was very much higher than has ever been the case since the Explosives Act came into force, but no fewer than 144 of the deaths were due to two accidents—106 on April 2nd and 38 on August 21st—while of the remaining 51, seven were killed in one accident on May 15th and seven in another on September 14th. The inspectors think it is not too much to say that all these 158 deaths might have been avoided if the factory officials concerned, instead of engaging in futile efforts to extinguish the fires, had cleared away everyone from the neighborhood.

Present Status of the Petroleum Development of Canada

By Frederick G. Clapp*

Introduction

Since the beginning of the Great War, oil development in the United States, Mexico and South America, and in many other parts of the world, has taken a great spurt, all wells are being operated to fullest capacity, old fields have been extended and developed inside producing limits and many new fields have been tested. While this has taken place elsewhere, in Canada, however, little new delopment has been undertaken and the oil resources of the Dominion seem to have fallen into disrepute or been forgotten.

Ever since the discovery of petroleum in commercial quantities, the number of uses of both the crude and refined products have been growing, until at present the production is far from sufficient to supply the demand. In view of the fact that the British Empire and her Allies are in the greatest need of oil as fuel in their navies, and that largely increased supplies of gasoline are being required for automobiles, tractors, launches and aeroplanes, it behooves us to take a general survey of the situation, to learn whether the oil resources of Canada have been fully developed, or whether any hope exists of finding these in additional quantity anywhere in the Dominion.

History of Developments

References to the occurrence of petroleum, asphalt and natural gas date back to the earliest history of Canada.

Sir Alexander Mackenzie noted the tar springs of Athabasca River region in his "Voyages through North America to the Frozen and Pacific Oceans," published in 1789-1793, and many subsequent references exist. In 1844 Sir William Logan noted oil springs in Gaspe Peninsula. As far back as 1830, the natives of Enniskillen in Lambton County, Ont., noticed the occurrence of oil on neighboring swamps and called it "gum oil," which, strange as the statement now appears, detracted from the value of the land. In 1857, oil was developed from these swamps at a place known as Oil Springs. Hence, the development of oil in Canada antedates that of the Drake Well in Pennsylvania, generally known as the oldest oil well in America. Drake's find, however, stimulated excitement in Ontario, and by 1860 hundreds of oil derricks had been erected in Lambton County, and a great field was developed.

Shortly after the excitement at Oil Springs, a field was opened at Bothwell in Kent County, and in 1865, the Petrolia field, seven miles north of Oil Springs, was developed. The production of oil in Canada, which began with 11,775 barrels in 1862, increased to a maximum of 913,498 barrels in 1900, and then dropped off to 215,464 barrels in 1915. These amounts are not great, as petroleum production runs, but are more than that in any except ten countries, and enough to stimulate inquiry as to whether the Dominion can do no better than this.

Literature

The subject has been discussed to some extent in many reports of the Geological Survey in Canada, a comprehensive treatise under authority of E. D. Ingall having appeared in 1892, entitled, "Report on Natural Gas and Petroleum in Ontario prior to 1891." Nothing for the entire Dominion appeared up to 1911, so that in that year the writer of the present paper was requested by the Director of the Mines Branch of the Department of Mines to prepare a monograph of the development to date of petroleum and natural gas in Canada, a summary of which appeared in 1912(1), and the reports were completed later.(2)

Since that time several short articles have been written by various authors, treating of special phases of the subject, with the result that an intending operator can no longer plead entire ignorance as his reason for not operating in Canada.

Recent Developments

The distribution of production subsequent to 1912, by Provinces, according to the annual reports of the mineral production of Canada, published by the Mines Branch of the Department of Mines, is as follows:

Distribution of Production(3)

Province	1913	1914	1915
Ontario	225,969	213,080	214,444
New Brunswick	2,111	1,725	1,020
Alberta	......(4)	......(4)	......(4)
Total	228,080	214,805	215,464

The production of New Brunswick has decreased from 2,079 barrels in 1912 to 1,020 barrels in 1915. Figures of the 1916 production are not yet received.

Reasons for the stagnation up to 1913 are not hard to find. The Ontario fields had apparently been fully developed, without hope of finding any new ones in that Province, and it was and is to be expected that the production will gradually drop off to practically nothing at the end of thirty to fifty years. The freakish developments between 1900 and 1912 at Pincher Creek and South Kootenay Pass near the boundary of British Columbia and Alberta had fizzled out after producing only a few barrels of oil, and the geological conditions of British Columbia were believed to be so uniformly unfavorable that nothing was expected from the Province. Though the oil fields of New Brunswick had been under development for several years, the quantity of oil actually taken out had been negligible, and operators had no faith in the Province as an oil producer, although the experts say it has decided possibilities, structurally similar to those of Pennsylvania. The Province of Quebec had fizzled out in 1889 to 1892, after producing only a few barrels of oil and the geological reports did not and have not since offered any promise of oil in this Province. Manitoba and Saskatchewan had not been thought of in this connection. Yukon and the Northwest Territories are said to have plenty of oil, but distance from markets and transportation difficulties are so great as to lend no encouragement to early development. The Province of Alberta remains, and it was here that the oil promoters started their activity in 1913, so that the next two years were very hopeful ones for natives of that Province. The subsequent depression, however, was equally great, when the wells failed to open an oil field.

Governmental Provisions

Searching for oil in Canada may have been stimulated to a certain extent by the oil bounty bill passed by the Government in 1904, and which was continued under the Petroleum Bounty Act of 1909, which provided for the payment of 1½ cents per gallon to the producers on all oil produced in Canada.

Regulations for securing petroleum rights in the Dominion were revised in 1914 so as to provide for the leasing of petroleum rights under an area of not more than 1,920 acres to one applicant for a period of twenty-one years at a rental of 25 cents per acre for the first year and 50 cents per acre for each subsequent year. The machinery must be on the ground within one year and the boring operations started within fifteen months.

Rise and Fall of the Great Alberta Oil Boom

In October, 1913, the Dingman well, named after its original owner, was drilled about thirty miles southwest of Calgary, near Black Diamond postoffice, finding gas in the upper beds of the Belly River Formation, and a little light oil at a depth of 1,556 feet, which analyzed about 90 per cent. gasoline. Despite the fact that such wells are generally freaks, and that the report of the writer on the Petroleum and Natural Gas Resources of Canada advised against drilling without the most detailed geological investigations, many oil companies were organized

*Consulting Geologist and Petroleum Engineer; Managing Geologist of the Associated Geological Engineers, 120 Broadway, New York.

for prospecting in the region, and in May, 1914, a second strike of apparently similar oil in somewhat larger quantities was made by another company at a depth of 2,718 feet. This caused a wild rush of oil men, promoters, and "scalpers" into the region, and many hundreds of companies were organized for prospecting. Only one company, however, was able to secure any petroleum for sale. This was the Calgary Petroleum Products Company, which according to Slipper[5], drilled near a gas spring. The oil in the Black Diamond field, according to Mr. A. W. Dingman, manager, had a light yellow color, possessed a strong unpleasant odor, and a gravity of 9.756 (55° Beaume). Small amounts of oil also were found in the same general region, at a depth of 1,690 feet in a well at Moose Mountain, analyzing, according to E. G. Voss, 20 per cent. gasoline, 50 per cent. kerosene, and 24 per cent. lubricating oil.

The best outline of Alberta operations is found in the reports of the Mineral Production of Canada during the calendar years 1914, 1915, 1916, by John McLeish, of the Mines Branch of the Department of Mines.

Prospecting was also undertaken in other parts of Alberta, and samples or oil were obtained from widespread localities, according to Cunningham-Craig.[6] The area explored extended to the prairie regions, but without success.

No reliable reports have been obtained of the actual amount of oil found in the Calgary excitement, but it was never more than a few barrels per day, and entirely too insignificant to warrant the excitement and over-speculation which occurred. Millions of dollars were wasted through stock selling and reckless drilling and leasing. By 1915, the excitement had greatly diminished, and at present practically nothing is being done. Small amounts of oil have been found in the Dakota, Kootenay and Benton formations, but all are too insignificant to furnish reports of production in the published tables of the Mineral Resources. None of the discoveries can be considered a profitable one, and most of them have been mere showings.

Other Drilling in Alberta

Some other wells have been drilled in Alberta, but no important indications of oil obtained. Probably the well of greatest importance was the one drilled by the City of Edmonton on the Battle River anticline, on the advice of the Associated Geological Engineers, opening up what appeared to be an important gas field, but in which no oil is expected.

The immense seepages of tar and petroleum residue known as the "tar sands," which occur along the banks of Athabaska River and between that and the Peace River country, have proved an alluring basis for oil prospecting, notwithstanding the belief of the geologists who have visited the region that oil would not be encountered near the outcrop of these sands, and that no petroleum in commercial quantities has ever been found in rocks of similar age to those which occur below the Devonian limestone in this region. Nevertheless drilling has been done in the vicinity of Fort McMurray and Fort McKay and in the intervening territory along the Athabaska River. Several of the wells, which were started near the outcrop of the Devonian limestone and at the base of the Dakota or "tar sand," have encountered small pockets of thick tarry oil in the limestone, but up to the present time no oil has been recorded in commercial quantity in the north country. As an example of the futility of some of the efforts, it may be said that in June, 1912, one well at Fort McMurray was drilled in the granite-like Laurentian formation underlying the Devonian limestone.

Not all of the wells in the far north are so situated as to be absolutely futile. For example, a well drilled 80 feet west of the old Geological Survey well[7] at Pelican, on the Athabaska River, struck several good flows of gas; but of less volume than the first well.

In June, 1912, fifteen or sixteen holes had been drilled between Athabaska Landing and Fort McKay, but no oil produced in commercial quantity. A number of companies formed for the exploitation of asphalt claims in this district have headquarters in Edmonton, but as lack of transportation facilities up to the present time prevents the handling of such bulky material, their operations have consisted principally in stock-selling. The building of a railway to Fort McMurray, however, would make these deposits of considerable value for many purposes.

Some samples of oil from wells in the Sweetgrass area, near the International Boundary, show gravity of 0.777 (40° Beaume).

Drilling Outside of Alberta

No important drilling has been lately done elsewhere in Canada, except that some of the New Brunswick wells have been deepened, finding samples of gas-bearing gasoline and rendering an additional argument in favor of the existence of an oil field in that Province. On Graham Island in British Columbia, wells have been under way for several years, although the geological reports have been unfavorable.[8] Drilling near Vancouver, B.C., has been even more disappointing, and no favorable geological conditions exist there. Little or no drilling has been done in Manitoba, Saskatchewan, Nova Scotia and the Province of Quebec.

Analysis of the Situation

Coming to a brief critical survey of the actual situation at present existing in Canada as regards oil development, we find the following facts are paramount:

1. The Ontario fields are on the decline, never to regain their largest production.

2. Nova Scotia and the Province of Quebec have few if any oil prospects.

3. In Manitoba and Saskatchewan, the conditions, little studied as yet, are not encouraging, but deserve some attention.

4. Operations in New Brunswick continue to supply gas and a few barrels per day of oil, and the geological conditions are so favorable that the oil business in this Province, so efficiently started by the Maritime Oilfields, Limited, and the New Brunswick Gas and Oilfields, Limited, deserve to be taken over by a company with sufficient capital to complete the necessary detailed geological studies, and make tests of the favorable parts of all the anticlines and other promising structures.

5. There is some hope that oil will be found in British Columbia, as the geological conditions are believed favorable in certain untested parts of the Province. Detailed studies should be made.

6. The Northwest Territories, including Keewatin, doubtless contain a large amount of oil, somewhere though perhaps too far from transportation lines to be developed and marketed with profit under the unfavorable climatic conditions.

7. The developments to date in Alberta are discouraging. It is safe to say that they have been mainly a series of business blunders and that few wells have been sunk in regions believed by the foremost experts to be favorable for large production. The Province as a whole has not been adequately explored by experienced oil geologists, even in a reconnaissance way, and several regions exist in which time and money could be spent with good promise of success.

Geological Occurrence of Petroleum and Natural Gas

While the oil business has very generally been viewed by the public as a gambling enterprise, and while many companies have conducted it as such, we can now confidently assert that the days of taking overwhelmingly dangerous chances are past. A careful study of local conditions will now enable an expert to judge to a considerable extent what may be expected of any particular property. While it is not possible to absolutely predict whether a well drilled at a particular point will produce oil, we can nevertheless gain a fair knowledge of the conditions prevailing under a property of any size, and firms of consulting geological engineers exist which are prepared and equipped to take full charge of the exploration.

Conclusion

The greatest factor detrimental to development in the past three years is of course the War; yet this is the very thing that ought to have kept operators in Canada alert to push explorations and developments in search of some new field. At this particular time, when the British Empire is so badly in need of both fuel oil and gasoline, when the Navy is dependent on other countries, and the Sarnia, Regina and Vancouver refineries are importing oil from South America, it is certain that no mistake could be made by Governmental authorities or private companies in picking out, surveying and testing the most favorable points in Canada. If it be supposed that the regulations for leasing are too severe, one can reply that other classes of lands exist the drilling rights on which can be acquired in a different way and which deserve attention, and moreover, the regulations are not more difficult than in certain classes of land in the United States.

In the great oil fields of the United States competition for leases and drilling is very strenuous at present, so that the expense of opening a new field is considerable. Why then should Canadians not repeat their oil investments of past years, but more wisely, based this time on scientific predictions and make a patriotic and business-like effort to develop some oil fields, which if found will go a long way towards winning the War, and will place Canada once more on the Oil Map?

(1) F. G. Clapp and L. G. Huntley, Petroleum and Natural Gas Resources of Canada. Summary report, Mines Branch, Department of Mines for 1912 (1913), pp. 48-57.

(2) F. G. Clapp and others, Petroleum and Natural Gas Resources of Canada, Vol. I., 1914, 378 pp., 31 pls., 25 drawings, 1 map; Vol. II., 1917, 404 pp., 12 pls., 23 drawings, 3 maps.

(3) In barrels of 35 Imperial gallons each.

(4) Too small to be reported.

(5) Can. Geol. Survey, Summary Report, 1914, p. 143.

(6) E. H. Cunningham-Craig, Can. Mng. Journal, Jan. 1, 1915, p. 26.

(7) Can. Geol. Survey, Vol. V., p. 1445, 1890-91; Vol. X., p. 19-A.

(8) J. C. Mackenzie, Geol. Survey, Can., Summary Report, 1914, p. 33.

The British Coal Tar Color Industry and Its Difficulties in Time of War.*

By C. M. Whittaker, B.Sc.

The British industry founded by the discovery of Sir William Perkin in 1856 experienced a period of great prosperity in its early days, which was followed by a decline for a number of reasons, one of which, in my opinion, was that money was so easily made in the early days that the owners were content to rest on their oars and enjoy the fortunes they had secured. Though the coal tar color industry had languished, it had never actually become extinct. It may, however, be asserted that the British industry had sunk to its lowest depths about the years 1898-1900; but from then onwards it commenced to recover, until in 1915 its competition was being increasingly felt by the German firms, which, just previous to the war, were subjecting the British firms to a severe price-cutting campaign because the British competition in sulphur and direct cotton blacks was reducing to complete nullity the German conventions in those two classes of colors. This improvement had been brought about by enlightened management, which had gradually and unobtrusively been modernizing their works and their methods. Had not this revival taken place the task of building up an industry on a national scale would have been made infinitely more difficult, whilst the panic in the dyeing trades at the outbreak of war would have been gravely aggravated, and would in all probability have jeopardized the dyeing of the clothing equipment required by the military authorities. The British firms were a considerable national asset at the outbreak of war; had these firms with their trained staffs and experience not been available, it would have gone much harder with color consumers. The fact that a private firm like Read Holliday and Sons, Limited, were in a position to pay a dividend of 10 per cent. for the five years previous to the war, when they faced, unaided, the full weight of the German competition, shows that it was possible for a British firm to make a successful fight against the Germans. It is a favorable omen which is consistently ignored by those critics who are untiring in their gloomy forecast of failure for the efforts presently being made in Great Britain—professional whimperers, as your chairman termed them the other day.

*Paper presented before the Textile Society, Manchester.

I wish to take this opportunity of destroying some of the fallacies concerning British firms which have too long been current and which still persist in some quarters. For the last fifteen years I have been in charge of the experimental dyehouse of Read Holliday and Sons, Limited, now merged in British Dyes, Limited. It was part of my duty to supervise the matching of patterns sent in by customers, to prepare pattern cards and circulars, and to carry out what has been termed "expert" work in the way of visiting customers' dyehouses when desired. During that time 50,000 patterns and samples have passed through the firm's books, and not a single pattern was ever charged for, yet I have heard it definitely stated that during the last three months that one of the greatest mistakes the pre-war British firms made was to charge for pattern matching, whilst the German firms matched them free. The laboratories of Read Holliday and Sons, Limited, were always at the free disposal of those in the dyeing trade who wished to make use of them.

The British firms have also been accused of not issuing pattern cards and circulars. Such an accusation was not true, for not only were they issued in a style comparable with those issued by the Germans, but they were also issued in five languages—viz., English, French, Italian, Spanish and German. I have such a card here.

Here I have a manual which was issued in three languages as far back as 1906. Here you have a pocket manual of dyeing instructions which has run to three English editions; here you have this same book in Italian, and here you have it in Japanese. Yet it is less than twelve months since that the British color firms were asked in an address before a scientific society why they did not use the language, weights and coinage of the foreign countries in which they sold their dyes.

The British are a remarkable people in the way they depreciate the efforts of their own countrymen. The service of the technical experts of the German firms has been repeatedly mentioned without any similar mention of the service of the British firms. Owing to the relative scale of the operations of the Germans as compared with the British firms, the German experts were naturally more numerous. They also had this fact in their favor—that they were often welcomed where the British expert was not welcomed. What progress could be made by a British expert with British firms who told him point-blank: "We would not use your color if you gave it to us?"

People seem to forget that it was Read Holliday and Sons, Limited, who bought Schultzenberger and Lalande's patent for dyeing indigo in a hydrosulphite vat, and it was Read Holliday's staff of technical men who introduced it to the British indigo dyers, and they who broke down the inevitable prejudice against the something new, because dyers are a very conservative race. You can still find old indigo dyers who talk about the hydrosulphite vat as the "Holliday" vat.

Let this fact at least be remembered, that the hydrosulphite vat for indigo was a French discovery, not a German discovery, and that a British firm—not a German firm—worked the patent in Great Britain.

Since 1901 my staff and I have gone out to scores of places to help to solve difficulties which have arisen in the application of dyestuffs in practice, to make first dyeings of new colors with which the particular dyer was not familiar, and to look into difficulties which in many instances have been in no way connected with the dyeing, but with the previous stages of manufacture, but which were attributed to the dyes, because the fault only became apparent after the dyeing. We have even supplied one of our staff for a fortnight to keep a dyehouse going owing to a dyer having been taken suddenly ill and there being no competent understudy available. Such expert service is being given at the present day. One of the most recent cases to which we went was to find out the cause of the stains on some cloth dyed with a product of British Dyes, Limited. We proved to the owner's grateful satisfaction that it was his water-supply which was at fault and not the dyestuff. I could go on repeating these cases *ad lib.*, yet it is always the German experts who are mentioned and never the British expert. Truly, it is time this fallacy received its quietus.

Now let us examine the position at the outbreak of war as regards the coal-tar color industry in Great Britain. The principal firms engaged were: The British Alizarine Company, which confined its products to alizarin orange, alizarin red and alizarin blue—it is largely a co-operative company, as its shares are held for the most part by the large consumers of the above products; the Clayton Aniline Company, which had been absorbed by the Society of Chemical Industry, Basle, though it was located in Great Britain; Levinstein, Limited, Manchester; Read Holliday and Sons, Limited, Huddersfield. The two latter were limited companies, the majority of whose shares were held by the respective families.

The outbreak of war suddenly opened the eyes of the consumers of coal-tar colors in Great Britain to the disconcerting fact that they were largely dependent on Germany for their supplies; then ensued a panic which will ever be remembered by the staffs of the British firms, and which panic subjected them to an almost intolerable strain. The country soon realized that the manufacture of coal-tar colors was a pivot or key industry of the highest importance in which Germany held the dominating position, with Great Britain and Switzerland a long way behind. The realization of this fact was followed by a deluge of articles and correspondence containing the grossest misstatements, which appeared in the newspapers and journals, and were a source of no little amusement to the staffs of the British firms. The relative smallness of the industry in Great Britain was, no doubt, the cause of a great deal of the ignorance displayed. The British firms who were carrying on their industry, conscious of their growing strength and quite inured to the cold shoulder consistently turned to them by scientific societies, were suddenly dragged out into the limelight, and received an amount of attention which was embarrassing.

The cardinal facts of the situation, which were in danger of being lost amidst the controversy, were as follows:

In 1913 Great Britain imported coal-tar colors to the value of $9,147,252.80, representing 42 million pounds' weight of color, of which it was estimated $8,460,000 emanated from Germany. It must not, however, be assumed that all this quantity was consumed in Great Britain, because a considerable quantity of color is bought here for shipment to India, Australasia, South America and other countries. It is doubtful if much more than half a million of capital was employed in the British industry at the outbreak of war. So there you have the basic fact which faced the industry, how to replace an import of $8,460,000 by firms who did not control more than half a million capital. The task was economically and physically impossible of immediate execution in peace times; it was a hundredfold more impossible in the midst of the greatest war of all time.

I will just deal briefly with some of the commonest mistakes which were made with reference to the German coal-tar color industry during the discussions.

The most frequent mistake was in regard to the amount of capital which the German firms were supposed to employ in their industry. It was freely stated by members of Parliament and others that the capital of the German industry was anything from one to two hundred millions. This was, of course, absurd, but such statements did not make any easier the task of those who were endeavoring to establish an adequate British industry. The export value of German coal-tar colors throughout the world was, for the year 1913, $53,340,770; add to this the German home consumption at a generous estimate of $9,400,000, making a total turn-over of $53,340,770. The capital of the German industry was $63,450,000 in 1913, showing that the annual production was approximately equal to the capital. Those who talked about one and two hundred millions capital never stopped to explain how a dividend of from 12 to 25 per cent. could be paid on this capital out of an annual turnover of $63,450,000.

Another point with which I wish to deal is the supposed dependency of Germany on outside countries, particularly Great Britain, for many of the important raw materials of the coal-tar color industry. Such a state of dependency was no doubt existent in the earlier days of the industry; but the modern coke oven recovery plant has largely altered that state of affairs, as the following official figures for the year 1913 of the imports and exports of important raw materials connected with the German industry show. In considering these figures, I would ask you to bear in mind the fact that Germany's export represents the surplus after all the requirements of her home industry have been satisfied. Starting with benzol, toluol, etc., Germany exported 41,287,000 kilogs, and imported only 6,709,600 kilogs. These figures do not give much of an opening for crippling tactics. To these figures ought to be added 7,264,700 kilogs, aniline oil and salts exported by Germany against a negligible import of 156,100 kilogs.

In 1913 Germany imported 4,155,200 kilogs of carbolic acid, and exported 3,601,700 kilogs, an adverse balance of, roughly, 500,000 kilogs. It was well known by the tar distillers that the Bayer Company were making an onslaught on the British market with synthetic carbolic acid, which would have effectively reduced the amount of pure carbolic acid distilled from coal tar in this country. It must also be remembered that Germany will have made enormous quantities of synthetic carbolic acid during the war, so that under no combination of circumstances could its industry run short of carbolic acid after its experience of production during the war.

Passing on to naphthalene, Germany imported 5,248,700 kilogs, and exported 6,151,110 kilogs, in addition to 3,106,400 kilogs of naphthols and naphthylamines. Again the balance is in her favor.

I now come to anthracene, of which Germany imported 1,286,101 kilogs and exported 277,400 kilogs. There the balance is decidedly against her, and it is the only important raw product for color manufacture in which Germany is deficient. It is the starting-point for alizarin and many of the most important vat colors, which latter have added so much to the prestige of the German firms. It must, however, be remembered that bromine enters largely into the constitution of many vat colors, which gives Germany an effective counter against the possible witholding of anthracene.

(To be continued)

Meeting of Society of Chemical Industry

A special meeting of the Canadian branch of the Society of Chemical Industry will be held in Ottawa on the evening of Friday, September 28th, for the purpose of discussing, and adopting, standard methods for the analysis of water. Everyone who is interested in this subject is invited to be present and it is suggested that, in the meantime, a careful study should be made of the standard methods that have been adopted in the United States. These methods, which were prepared by the collaboration of the American Chemical Society, the American Public Health Association, and the Society of Official Agricultural Chemists, can be obtained from the American Public Health Association, 126 Massachusetts Avenue, Boston, for $1.25, postpaid.

Water Powers of Ontario

By H. G. Acres

The greater industrial centres of the Province of Ontario lie along the shores of the Great Lakes, the nucleus of growth having been supplied by agricultural settlement, subsequent development being largely due to the unequalled facilities for inland navigation afforded by these great bodies of water, and by the canalization of their connecting rivers. Up to fifteen years ago the prosperity of the Province rested upon transportation by water, upon the development of the agricultural and lumber industries and upon Pennsylvania coal. Since that time the Sudbury, Cobalt and Porcupine mining districts have been added to the list of provincial assets. Then came the commercial utilization of the immense power resources of Niagara, resulting largely from the rapid advancement of the art of high voltage transmission.

The development of Niagara power has marked an epoch in the industrial history of the Province, not only through the displacement of steam generated power, but by reason of the fact that the availability of large quantities of cheap water generated power has served to transform laboratory experiments into immense electro-thermal and electro-chemical industries.

The drainage system of the Province of Ontario comprises four main divisions, namely, the territory drained by the Ottawa River and its tributaries, that drained by the tributaries of the Great Lakes, that drained by the rivers flowing into James Bay, and that drained by the Winnipeg River and its tributaries.

As the distance between the east and west extremities of the Province is 950 miles, and the distance between the north and south extremities 1,050 miles, the rivers forming the arteries of the drainage system will naturally possess variant characteristics. The extremes are represented, on the one hand, by the gently flowing rivers and creeks of the south-western peninsula, and on the other by the slack-water pools and turbulent rapids and falls of the Laurentian rivers along the north shore of Lake Huron and Lake Superior. Between these two extremes, each possessing characteristics peculiar to themselves, lie the rivers in the limestone region of the eastern counties and the large rivers which reach tidewater by way of James Bay and the Hudson Sea.

From a hydraulic standpoint the more important rivers tributary to the Ottawa are the Mississippi, the Madawaska, the Bonnechere, the Petewawa, and the Montreal, along which the gradient is generally steep, and concentrated natural heads ranging from 20 to 100 feet offer numerous opportunities for cheap development of capacity ranging from 1,000 to 5,000 horse power. The basins of these rivers contain a considerable proportion of lake and marsh and their flow characteristics are susceptible to material improvement through the agency of artificial storage. There are a number of existing developments along the tributaries of the Ottawa of capacities ranging from 40 to 1,000 horse power which are supplying power to local markets.

One notable site of higher capacity is High Falls on the Madawaska where the natural head can be increased to 150 feet and 12,000 horse power developed under natural flow conditions with probably 20,000 horse power under artificial storage.

The Cobalt district is supplied by two plants: one on the Metabitchewan operating under a 312 foot head with 8,000 horse power installed, and one on the Montreal river with 3,800 horse power installed under a head of 33 feet. It is a notable fact that since the advent of hydro-electric power, the use of steam power to operate the mines has been almost wholly discontinued.

The most important undeveloped site in this district is that known as the "Notch" on the Montreal River where a head of 100 feet is available and where about 7,000 horse power can be developed under ordinary low water conditions.

With regulated flow there will be available from the Ottawa River itself, 600,000 horse power between Lake Temiskaming and Carillon. Development on this river is, at present, practically confined to the Chaudiere Falls at the City of Ottawa, where 36,000 horse power is now in use, and where, with complete flow regulation, it is anticipated the capacity will be raised to a minimum of 84,000 horse power.

The most important river flowing into Lake Ontario is the Trent, on which, with its main tributaries, some 75,000 horse power is capable of more or less easy development by reason of the Trent Canal works, now nearing completion. Of this total 45,000 horse power is now developed leaving 30,000 horse power capable of cheap and easy utilization.

Most of the rivers flowing into Lake Erie lack natural control as a result of the combined effects of deforestation, drainage and extensive cultivation and hence their usefulness as sources of power has been largely destroyed.

Tributary to Lake Huron are the Mississaga, the Spanish, the Sturgeon, the French, the Magnetewan, the Muskoka, the Severn, the Saugeen and the Beaver rivers, all of importance from a hydraulic standpoint. A reasonably conservative figure gives the total low water capacity of all the Lake Huron tributaries at about 166,000 horse power of which about 56,000 horse power is at present developed, leaving an undeveloped surplus of 110,000 horse power.

Among the developed sites are two on the Spanish river; one at High Falls and the other lower down the river, with 12,500 and 10,000 installed horse power, respectively. At Wasdell's Falls on the Severn river the Hydro-Electric Power Commission has a 1,200 horse power plant in operation and at Eugenia Falls on the Beaver River has installed a 4,000 horse power plant under a head of 540 feet.

Power House, Electrical Development Company, Niagara Falls, Ont.

Of undeveloped sites three exist on the French River each capable of development to the extent of about 10,000 horse power with storage on Lake Nipissing. The remaining undeveloped power is distributed in blocks of 1,000 to 5,000 horse power; the smaller capacities being predominant.

The rivers tributary to Lake Superior are mostly short and turbulent and natural falls of 50 to 125 feet are common. There is a total potential capacity of about 195,000 horse power of which 20,000 horse power only is developed. Of this developed power 4,500 horse power is used to operate the mines in the Michipocoten district and 15,500 horse power, developed at Kakabeka Falls on the Kaministiquia River under a head of 180 feet, is used in the cities of Port Arthur and Fort William. It is said that the company at Kakabeka Falls has 15,000 horse power of surplus capacity capable of development. At Silver Falls on this river there is about 20,000 horse power minimum that can be developed under a 310 foot head.

The largest of the Lake Superior tributaries is the Nipigon which drops 255 feet in its total length of forty miles and on which there is 100,000 horse power in the main capable of easy development. This river has at its head Lake Nipigon with 1,500 square miles of water surface and receives the runoff from about 9,500 square miles of drainage area. The Nipigon basin is one of the finest pulpwood areas in the world.

From the information resulting from a limited study of the hydrography of that portion of the Winnipeg River lying in Ontario, it is estimated that the total potentiality of the various rivers is not less than 250,000 horse power. Of this total about 22,000 horse power is now in use.

The low natural heads existing as a general rule in the rivers of this district are in a measure offset by the splendid storage facilities offered by Rainy Lake, Lake of the Woods, Lac Seul and the innumerable smaller lakes which constitute the outstanding feature of the Winnipeg River basin. This extensive lake area provides a means of practically doubling the already large minimum flow of these rivers. Under such regulation 75,000 horse power would be available at White Dog Falls on the Winnipeg River, and blocks of 20,000 to 40,000 horse power could be developed at each of several sites on the English River.

There is little credible information regarding the rivers flowing into James Bay, and present development is confined to the Mettagami and Abitibi Rivers. On the former two plants supply 3,500 horse power to the mines and towns of the Porcupine district with 7,000 horse power capacity still available. On the latter, a 19,500 horse power plant is now in commercial operation. The minimum capacity of the James Bay rivers is quoted by the Conservation Commission in its report on the "Water Powers of Canada" as being about 665,000 horse power under natural conditions. With controlled storage 1,500,000 horse power may, with a fair degree of certainty, be assumed physically capable of development.

Falls on White River, north shore of Lake Superior.

In the water powers of the International rivers, the Province of Ontario possesses a natural asset of the first magnitude. The greatest of these is Niagara, where under franchises a total of 405,000 horse power is to be developed, of which 369,000 horse power is at present either in actual use on maximum load or in course of installation to meet immediate requirements. This power is developed by three companies and is distributed through Ontario from Toronto west.

On the old Welland Canal development has taken place to the extent of 12,000 horse power. From the summit level of the canal system water is carried over the Niagara escarpment at Decew Falls, where power is developed under a net head of some 265 feet; 57,000 of

Power Development of Minnesota and Ontario Power Co., Fort Frances, Ont.

the total horse power available being now in active use.

At the St. Mary's Rapids between Lake Superior and Lake Huron a minimum flow will produce 90,000 horse power under an 18 foot head. Half of this belongs to Ontario and at present 17,000 horse power is developed on the Canadian side.

The following summation is derived for the total amount of power capable of development in the Province, and includes a number of smaller rivers not specifically mentioned in the report:

	Total Capable of Development	Developed
Ottawa River and tributaries...	688,000 h.p.	71,000 h.p.
Great Lakes tributaries........	446,000 "	137,000 "
Hudson Bay slope............	250,000 "	22,000 "
James Bay slope..............	1,500,000 "	10,000 "
International Boundary rivers...	2,045,000 "	462,000 "
Total in Province............	4,929,000 "	702,000 "

Pipe Line for Eugenia Falls Development, Beaver River, when under construction.

Of this total developed power about 574,000 horse power is electrical energy sold for light and power; about 69,000 horse power is used for pulp and paper manufacture; and about 59,000 horse power is used for the most part in the form of hydraulic power directly applied.

With the history of hydraulic and hydro-electric development in Ontario must always be associated the epoch making operations of the Hydro-Electric Power Commission in connection with the development and transmission of power, under joint governmental and municipal auspices. It is to be noted in connection with this investment that it is in no shape or form a charge on the general taxpayer, either as regards the Province or the Municipality. Every dollar of the carrying charges, on the investment of the Commission and the Municipalities, comes out of the pocket of the light and power consumers, and the price paid by the individual consumer is so regulated as to provide sufficient income to cover completely all annual interest and sinking fund charges on the combined Commission and Municipal investment, as well as all depreciation, maintenance, operation and administration charges. This statutory requirement is also retroactive, in that all surplus revenue, after meeting the above charges, must be applied to extension of plant, to depreciation reserve, or to reduction of rates and must under no circumstances be used to reduce the general tax rate of any municipality.

Chemical Engineers in Wartime

Much of the success of the present war depends upon chemicals, the supply of chemicals and particularly upon the chemical engineer. Thirty thousand of the latter are already mobilized in the interests and service of the United States Government, and a proportionate number in Canada. Not only is the chemical engineer a prime factor now, during the period when chemicals are playing their part in the fighting on all fronts, but he will be a greater factor after the war.

The increasing importance of chemical manufacture began with the cutting off of the supply of both raw and manufactured chemicals, when German importations ceased, at the beginning of the war. Not only were stocks quickly depleted, causing bewildering jumps in prices, but the chemical manufacturers in the United States and Canada were not equipped either with machinery or with practical workmen, nor even many of the raw goods, to begin manufacture for many months after the war began.

Knowledge of the extent of the chemical industry, therefore, has increased, and the general public has some knowledge of the role played by the experts, whose intricate chemical processes have made the explosives in warfare almost the centre of attraction in any discussion of the possible early termination of the conflict. The advanced processes which have made the asphyxiating gases, and which applied liquid fire to the onslaught of armies, are only small parts of the development of modern chemists, for it is to the advance of commercial chemistry that the minds of chemists are now principally turned. There are problems which are in the solving period, which will be brought before the fifty-fifth convention of the American Chemical Society, September 10th to 12th, and not only is the interest of the chemists of the country centered upon discussions which will be held at that meeting, but there are many who are awaiting the results of that meeting for the furtherance of their business and manufacture. The convention will mark a period of enormous advance in the industry whose production, including dyes, is still far behind the rising flood of demand. One condition needs a solution, the fact that Germany at the time of the declaration of the war, was exporting as many as forty thousand colors, shades, tints, etc., whereas it was necessary for the British and American manufacturers to limit their products to a few hundred.

The Anglo-Persian Oil Company, Ltd., has purchased from the public trustees the undertakings of the British Petroleum Company, Ltd., the Homelight Oil Company, Ltd., and the Petroleum Steamship Company, Ltd., all the shares of which were held by the Europaische Petroleum Union, a German company, in which the Deutsche Bank held the controlling interest. The properties acquired include a large fleet of tank steamers, 15 large ocean landing and storage insulations, with tankage of a capacity of 185,000 tons, 520 smaller inland depots, 535 railway tank wagons, more than 1,110 motor and other road vechiles, and land, houses, etc.

The Interaction of Sulphides in Solution*

By O. S. James

Many elements, mostly metals, are thrown out of solution when the corresponding alkali salt is mixed with their solutions. Thus when an alkali carbonate, cyanide or sulphide is mixed with the solution of any element whose corresponding compound is insoluble, it is usually thrown out of solution combined with the corresponding negative atom, or group of atoms.

Hydrogen sulphide and alkali sulphides are often used in these separations. As hydrogen, when it combines with sulphur, gives off only 9 large calories as against 68 in combining with oxygen, this great surplus of energy tends to produce hydrogen sulphide and in any system in which hydrogen sulphide and water are involved, a great tendency to thrust sulphur on other elements, is noticeable. This seems to be the case regardless as to whether the element is basic or acid.

The amount of heat given out or absorbed on passing hydrogen sulphide through solutions of different metallic salts is some indication of their relative affinities, thus:

Pb+11 Cal. Zn—2 Cal. Mn—12 Cal.
Cd+ 7 Cal. Fe—7 Cal.

Thus lead and cadmium come down in quite acid solutions, but manganese solution which absorbs 12 Cal. only comes down sparingly as even acetic acid easily dissolves it.

The reactions of metallic solutions with water and soluble sulphides seems to depend on the actual amount of affinity for oxygen, its degree of basic quality, and the relative preference it may have for oxygen over sulphur.

As instances of elements which have only a moderate affinity for oxygen, copper and arsenic may be taken as examples. Both sulphides will come down in very strongly acid solutions. But in pure water arsenic sulphide forms a solution which is gradually decomposed on boiling. Magnesium is an element which combines a great affinity for oxygen, with strong basic or metallic characters. It forms a sulphide, which is not only decomposed by the weakest acids like manganese sulphide, but is decomposed very quickly by hot water into magnesium hydrate and hydrogen sulphide.

In precipitating metals from their solutions, when an alkali salt is mixed with the solution of a metal the corresponding compound is usually precipitated. Thus, when ammonium sulphide is mixed with zinc or iron salts, zinc or iron sulphide is thrown down, but when ammonium sulphide is mixed with a salt of either chromium or aluminum the hydrate is precipitated and not the sulphide as one might expect. Some fifteen elements, more or less, act in this manner.

At first sight this seems unique, but a similar reaction seems to take place when potassium cyanide is mixed with aluminum salts and even with stannic salts it is stated that the hydrates appear instead of the cyanides. Also when soluble carbonates are mixed with aluminum or stannic salts, the hydrates and not the carbonates are precipitated.

When first becoming interested in this peculiar reaction my first thought was to make anhydrous aluminum bromide, dissolve it in some solvent not containing oxygen, also dissolve anhydrous ammonium sulphide in a similar solvent, mix the two and find what would result. But aluminum salts do not seem to have any compound free from oxygen in which they dissolve. Chromium salts also were tried and no solvent free from oxygen was found. Perhaps results might be obtained if experiments could be carried on in liquid hydrogen sulphide. Although aluminum and chromium both come down as hydrates when alkali sulphides are mixed with their solutions, their deportment regarding sulphur is otherwise quite different. Thus aluminium hydrate is unaffected when mixed with sulphur and heated to redness. Hydrogen sulphide does not affect it at any temperature. To convert it into sulphide requires a bright red heat and carbon bisulphide, which is the most powerful reducing and "sulphurizing" agent. The sulphide thus formed is easily decomposed by water with the production of aluminium hydrate and hydrogen sulphide.

In the case of chromium the sulphide is formed by heating the oxide moderately in hydrogen sulphide gas. The oxide is not converted to sulphide by heating with sulphur. But the hydrate is, being turned from its light green color to black sulphide. The sulphide is produced when the oxide is heated with sulphur and an alkaline sulphide, when a double sulphide of the alkali metal and chromium is produced. The lowest temperature at which chromium sulphide seems to be produced would be about the boiling point of sulphur, about 445°C. There is another character which shows an intermediate position for chromium is that chromous salts are stated to give a precipitate of chromous sulphide on the addition of alkali sulphide. Chromic sulphide is not easily affected by acids nor alkalies. This seems curious, considering its instantaneous transposition by water. However, it may resemble the sulphides of cobalt and nickel which can be prevented from forming by rather weak acids, but when once formed are not easily dissolved by strong acids.

It did not occur to me that chromium sulphide could be formed in contact with water; until I read a statement in Roscoe and Schorlemmer's Chemistry which says: "Cr_2S_7 is obtained as a brown precipitate when hydrogen sulphide is passed into an ammoniacal solution of potassium bichromate. Sulphide of carbon does not extract sulphur from this compound. It is slowly decomposed by water, and dilute acids decompose it into free sulphur and chromic salts with evolution of hydrogen sulphide."

This suggested to me the idea that chromic hydrate in contact with ammonia might be affected by hydrogen sulphide, so that I passed hydrogen sulphide through ammonia till saturated, precipitated chromic hydrate with ammonia and washed, put the chromic hydrate into the ammonium sulphide, and passed hydrogen sulphide through the solution for many hours. The mixture, which was colorless ammonium sulphide and light green chromic hydrate, gradually turned to a very dark brown color.

Poured through a filter, a blackish filtrate ran through, leaving a dark brown residue on the filter. I washed this with hydrogen sulphide water. Boiling water did not seem to affect this brown compound and cold acetic acid did not seem to decompose it. It dissolved in cold dilute hydrochloric acid to a brown, almost black solution without giving off hydrogen sulphide. This seemed to gradually decompose in the course of two days though not then completely.

Strong hydrochloric acid dissolved it with more immediate decomposition, and on warming, the color changed, at a certain temperature, quite abruptly from brown to green. Mixed with cold strong acetic acid it gradually dissolved to a brown liquid which did not turn green in two days' time, but when boiled with potash, the compound turned green, giving off abundance of ammonia. When the compound was dried at 100°C. it had a decided greenish cast.

I estimated the chromium by direct heating to redness. Also by solution and precipitation as chromic hydrate, weighing as chromic oxide these gave close results 36.7 to 36.8% chromium of the substance dried at 100°C. and 30.9% chromium of it dried in the desicator at usual temperatures.

The sulphur was estimated by solution in nitric acid and precipitation with barium chloride. The sulphur was 7.1% of the substance dried at 100°C. and 6% desicator dried substance.

Also estimated the sulphur by the evolution method used in estimating sulphur in iron and two estimations made this way gave 1.64% to 2.07% sulphur.

When chromic hydrate is left in contact with excess of ammonia it completely dissolves to a violet red color. This is

*Presented before the Canadian Section of the Society of Chemical Industry.

said to have the composition, $Cr_2Cl_2O_2.8NH_3.2H_2O$. Supposing an oxysulphide of this compound were formed, it would have 8.1% sulphur, but only 26.4% chromium, thus having less chromium and more sulphur than the substance under consideration.

Precipitated chromic hydrate with large excess of ammonia leaving it in contact with the ammonia which completely dissolved it and passed hydrogen sulphide through this solution. The color gradually changed and a dirty brown precipitate settled to the bottom, also crusts formed and adhered to the sides of the flask. This brown precipitate had the same properties as that in the first experiment. So as far as one might suppose the substance to contain a sulphide or oxysulphide of a chrom-ammonium base in an impure state; perhaps a solid solution of such a compound in chlor chrom-ammonium hydrate.

Precipitated chromic hydrate was allowed to dissolve in excess of ammonia and this was treated as above with hydrogen sulphide. The color gradually changed and a dirty brown precipitate settled to the bottom, also crusts of the same substance adhered to the sides of the precipitating flask. This brown substance had the same properties as the first mentioned product.

Chromic hydrate, which had been precipitated and remained in a bottle in contact with water for some five years would not produce the above reaction, but when some of this was dissolved and reprecipitated it produced the reaction seeming to indicate that some molecular change occurs at the usual temperatures even in contact with water.

British Society of Chemical Industry

Many interesting and instructive papers on the future of the chemical industry were read at the annual general meeting of the Society of Chemical Industry, held in Birmingham from July 18th to 20th. The president, Dr. Charles Carpenter, in the course of his address said that the importance of the chemical industries in the scheme of national defence and national progress was at last becoming understood and must be taken into account in the refashioning of our educational system.

Henry Watkins, Stoke-on-Trent, in a paper on "Chemical Porcelain," dealt with the future prospects of the trade and pointed out that the English potters for two years now had supplied Great Britain with nearly all that had been needed for scientific work, as also for chemical processes in connection with the war. The cry, therefore, that it could not be done was no longer admitted. We might not at present have succeeded in making anything superior to the German production, but he ventured to prophesy that in much less time than chemical hard paste porcelain had been manufactured this country would be making something superior.

Professor P. G. H. Boswell contributed some references to sands used in metallurgical practice and said before the war unnecessarily large supplies of foreign sands were imported, particularly for lining the hearths of furnaces or steel castings. and for the making of the best qualities of glass; but except in the case of one of two foreign supplies of sand it had always been made clear that this country would be self-supporting in that connection and after the war economic considerations would be the determining factor which would essay whether we should use our native supplies or unnecessarily jeopardize the safety of a key industry by still being dependent on sea-borne material.

Must Be Organized

Other papers were presented and discussed containing warnings that only with a progressive and scientifically organized policy would the British industry be able to hold its own with the world competition after the war. This applies with greater force to the fine chemical industry which, as the first few months of the war proved, is not as firmly established as the heavy chemical industry. Ernest W. Mann, B.Sc., London, in a paper devoted to the future of the fine chemical industry, pointed out that the manufacturing resources of the industry very soon broke down when importations from central Europe ceased.

In the future we should have to compete in the trade not as individuals, but as a nation, and that nation which conserved and utilized its scientific talent to the best advantage would in the long run become pre-eminent in the industry.

At the present time, with German competition eliminated, American competition severely handicapped and competition of the Far East only just perceptible, it was a comparatively easy matter for certain manufactures to be carried on in a small way and yet profitably. But he questioned their chances of success on such lines as now exist in the future.

As an example of the uneconomical methods of manufacture which exist he quoted salicylic acid, which is now manufactured by a dozen or more firms with an entire output barely sufficient to supply home needs, whereas the output of a single German firm before the war was greater than all put together. Speaking of the question of markets, he imagined that there was general agreement that a tariff was essential, for a time, at any rate, to prevent the trade being extinguished by the dumping which otherwise would be inevitable.

He warned the Congress that this tariff should not be high, or it might free the manufacturer from the stimulating effect of external competition, which would only produce an unhealthy hothouse atmosphere.

"Glass" Enameled Steel Tanks

The manufacture of iron and steel tanks for various industrial purposes had made steady progress in the United States and Canada for many years before the war; but the great European conflict brought about a notable development in tanks, kettles, reservoirs and special apparatus required in the chemical industries, the creation of which was forced upon the two countries.

Among the firms in the United States who made determined efforts to meet these new demands is the Pfaudler Company, of Rochester, N.Y. This firm is credited with having originated the process of fusing "glass" enamels to steel, and for more than thirty years they have been building glass enameled steel tanks of large capacity for the production and storage of beverages and other liquids. Widening fields encouraged development, which, at the outbreak of the war, began to extend toward the needs of our new chemical industries to such a degree that when a representative of this journal visited their plant the other day he found many acres of floor space dotted with tanks for chemical work, varying in design, and lined with the various enamels which this company has developed for different requirements. Among these were tanks for handling and storing milk, kettles for fruit canning, and other uses.

Both the electric and the oxy-acetylene processes are used for welding; and other apparatus, including immense electric cranes with which the tanks are handled, are of the most modern. These specially constructed cranes gently deliver tanks up to a diameter of 10 ft. 6 in. into the enameling furnaces, among which are some that are said to be the largest in the world.

Many New Oil Companies in United States

During the first three years of the war eight hundred and fifteen companies, with a total authorized capital stock of $1,016,416,000, were organized in the United States for the development of oil and gas resources. The interest in this form of enterprise has been particularly strong during the last two years and has received added impetus from the entry of the United States into the war, as shown by the record of recent months. The requirements of the belligerents for petroleum and its products for use in connection with hostilities have risen steadily, while the rapid expansion in the demand for gasoline, as the number of automobiles in this country has increased, has been a contributing factor.

Prof. S. F. Kirkpatrick

The selection of Stafford F. Kirkpatrick, Professor of Metallurgy at Queen's University, as the recipient this year of the McCharles prize has met with the general approval of those interested in the mining, metallurgical, and chemical professions.

Professor Kirkpatrick graduated from McGill University in 1899, receiving the M.Sc. degree. After graduation he became connected with the Mountain Copper Company, California, and finally was placed in charge of the technical work. In 1901 he was appointed professor of metallurgy in the School of Mining of Queen's University.

At the time of Professor Kirkpatrick's appointment there was very little activity in the mining and metallurgical industries in Canada but shortly afterwards, in 1903, the silver deposits of Cobalt were discovered and Professor Kirkpatrick immediately took an intense interest in the development of these deposits. He secured some samples and made numerous experiments on the cyanide treatment of the silver ores. The results of his experiments were published and shortly afterwards several of the mills at Cobalt installed cyanide plants to recover the silver from the lower grade ores. During his experiments on the cyanide treatment of the silver ores Professor Kirkpatrick saw that the ordinary method of precipitating the silver was not suited for the cobalt ores and after many attempts he finally succeeded in devising a practical method to precipitate the silver by using aluminum dust instead of zinc which was formerly used. Before the aluminum dust was introduced it was only possible to use the cyanide solutions a few times but with the new method of precipitation there was no difficulty in using the cyanide solutions many times. The advantages of the aluminum precipitation method may be briefly summarized as follows: no fouling of the cyanide solutions, more efficient precipitation, purer precipitate of silver, and a regeneration of the cyanide which dissolved the silver. Precipitation by aluminum dust was immediately put into practice by the Deloro Smelting and Refining Company and the O'Brien mine and later by the Nipissing, Buffalo, and other mines at Cobalt. It is interesting to note that the patents covering the new method of precipitation were made free to anyone wishing to employ the process.

Shortly after the deposits at Cobalt were opened, it was found that the ores contained considerable quantities of cobalt. At that time there was very little interest in Canada in the metal cobalt and its compounds since the production of cobalt was controlled by European countries. The European smelters had been treating cobalt ores for centuries on a small scale but the methods used were not suitable to treat large quantities of ore at a reasonable cost. The possibilities of extended uses for cobalt were unknown, but it was certain that before the metal would be used extensively the price would have to be lowered.

It was about 1905 that Professor Kirkpatrick became interested in the recovery of the cobalt from Canadian cobalt ores and after working for several years on the problem succeeded in completing a method suitable for the treatment of the ores. Briefly, the method consists in first smelting the ore in a blast furnace to remove the gangue minerals, then roasting the product with salt which changed the silver into the form of chloride, in which form it is readily soluble in cyanide solutions. The silver is then precipitated by aluminum dust. After the silver is removed the residue containing the cobalt is heated with acids and other chemicals which dissolved the cobalt and nickel. The metals cobalt and nickel, have similar properties and when they are in solution it is a most difficult operation to effect a separation of the two. Cobalt compounds are used chiefly in the ceramic industries to give a blue color to porcelain ware, etc., and the presence of nickel has a detrimental effect on the color produced by cobalt. For this reason the cobalt compound must be free from nickel. A method was finally devised to separate these two metals by using a solution of bleaching powder which precipitated the cobalt and left the nickel in solution.

Within the last two years a new use has been found for the metal cobalt. By alloying cobalt with chromium, a metal is obtained which possesses great hardness. This cobalt chromium alloy known as Stellite, is used as a cutting tool to replace high-speed tool-steels for turning steel and cast-iron. The quantity of "Stellite" used is increasing rapidly and it has been in use long enough to demonstrate its superiority and value.

The new method of treating silver-cobalt-nickel ores devised by Professor Kirkpatrick was put into practical operation in 1908, and has been used continually ever since.

The McCharles prize, awarded to Prof. Kirkpatrick, was established by the late Æneas McCharles. A fund of $10,000 is provided from which a prize of $1,000 is given to any Canadian, whether student or not, who discovers or invents a new process for the treatment of ores or minerals of any kind; or for any discovery that will lesson the dangers and loss of life connected with the use of electricity; or for distinction in scientific research. The prizes are not necessarily awarded every year, and there appears to have been only one other previous winner of this prize.

Light and Color Theories

A new book, "Light and Color Theories and Their Relation to Color Standardization," by J. W. Lovibond, has recently been published by E. F. N. Spon, of London, England.

By his invention and development of the colorimeter known as the "tintometer," the author has shown himself to be an authority on all questions of color, measurement and mixture. In his earlier work, styled "Color Phenomena," which was published in 1905, Mr. Lovibond described and explained the "tintometer" and his glass standard color scales, and the purpose of the present volume is to make more widely known, methods of analyzing, measuring, and recording the colors of objects which have proved of great practical value in various industries.

The author's method is based upon the reproduction on glass of definite units of the three primary, or, as he prefers to call them, the three "dominant," colors—"pure" red, yellow, and blue. Equal units of each of these if superimposed give a neutral grey, in which no color can be distinguished when viewed by diffused daylight. The use of the term "pure" in this connection seems questionable. The colors are not spectrally pure. In fact, the whole method hinges on their not being so. The "unit" of color is necessarily arbitrary, but this does not detract from the usefulness or accuracy of the method, as a large number of carefully verified standards are now in existence.

In using the author's process the color of an object is carefully matched by the standard color glasses, and the units noted thus: A green cloth is matched by glasses 2 Red, 10 Blue, 6 Yellow. Since equal units of the three colors produce grey, and blue and yellow produce green, this may be analysed as Grey 2, Green 4, Blue 4; i.e., a bluish-green slightly dulled with black. If, as may be the case, the color of the object is brighter than the color of the glasses, the object must be viewed through glasses representing the necessary amount of neutral tint. It is obvious that when once recorded a color can at any time be reproduced.

It must not be assumed that such an analysis will enable a dyer to produce a given shade by using Red, Blue, and Yellow in the proportions found, even if the dyes apparently exactly match the glasses individually. They would also have to be spectrally identical, which is very unlikely to be the case.

In Chapter I. various theories of color are compared, and some of the difficulties raised by the author appear to be based on confusion between the three primary colors (red, yellow, and blue) of the artist and the supposed three color sensations of the physiologist and physicist (red, green, and violet).

In Chapter II. an interesting account is given of the evolution of the author's method, and it is clearly seen that enormous patience and care and great expense has been involved in developing the process to its present state of efficiency and usefulness.

It is essential for comparative color work that a standard white light must be available, as any change in the nature of the light will obviously affect the recorded results. Direct sunlight is not white; it contains an excess of rays from the red end of the spectrum. Light reflected from a blue sky, on the other hand, contains an excess of the short wave length vibrations which constitute blue and violet. The most colorless light is diffused daylight from a cloudy north sky.

The author proposes a new term, "specific color development," to indicate the nature and rate of change of color due to increased intensity. It is a fixed and individual property of the substance, and in this sense is analogous to "specific heat" or "specific gravity." This is not a new statement of fact, but is a novel and convenient method of expressing the law of absorption as applied to the several colors transmitted by or reflected from a substance.

The novel outlook of the author on color problems is also indicated by his method of tabulating all possible colors in space of three dimensions. This is a modified Chevreul color cone. The three dominants, red, yellow, and blue, are plotted along three mutually perpendicular axes, as in solid geometry. Then every point in space on the positive side of the point of origin represents a conceivable color, of which the constituents are given by the three co-ordinates of the point.

It is gratifying to note that the author's sterling and long-sustained work in developing the instrument and its uses have met with such general recognition by scientific societies, by the award of medals at exhibitions, and by the adoption of his standard methods in the industries.

New York Notes

New York, August 21, 1917.

Correspondence of The Canadian Chemical Journal:

In chemical circles in this vicinity there is just one main subject of conversation to-day, and that is, What can the chemist do to help "bust the Huns?" As an outward indication of the close connection of the chemical profession with military activities many well-known chemists are seen around the Chemists' Club and elsewhere in the uniform of either the Army or the Navy and many others who are still wearing civilian dress are devoting their entire time to government work.

The advisory Commission of the Council of National Defense has a Committee on Chemicals with permanent offices in Washington, which is acting in every way so as to place at the disposal of the military establishment just the raw materials and finished products it requires. On this committee are such prominent men as Wm. H. Nichols, of the General Chemical Company; E. R. Grasselli, Wm. Hamlin Childs, Henry Howard, J. D. Pennock, John J. Riker, Horace Bowker, Chas. H. MacDowell, Chas. G. Wilson, Ed. Mallinckrodt, jr., A. D. Ledoux, Dr. Marston, T. Bogert, E. D. Kingsley, F. A. Lidbury and many others equally prominent.

Many of the younger men in the chemical field are also giving their services to Uncle Sam. Mr. Adriaan Nagelvoort, who is well known to most of the readers of this paper on account of his having been for the last two years manager of the National Exposition of Chemical Industries in New York, in connection with which he made numerous visits to Canada, has taken out a commission in the Ordnance Department of the Army. Mr. T. L. B. Lyster, of Niagara Falls, formerly with the Hooker Electrochemical Company, has left for France as Captain in the Engineer Corps.

The chemical industry is not only preparing for the War, but for the "War after the War." The immense and thorough scale on which chemical plants are being established here to-day leaves little room for doubt that when the war is over they will contribute to the world a large part of the chemicals, intermediates and dyes formerly bought from Germany. Speaking on this subject before the Export Conference at Springfield, Mass., last month, Mr. H. Gardner McKerrow said:

"One frequently hears it stated that business knows no sentiment; that manufacturers will buy their supplies where they can buy them cheapest and best,— no matter where they originate and no matter whether they are made by the enemies of civilization or not. I venture to doubt this. I believe that the unspeakable outrages which have been inflicted on the world, on neutral and belligerent nations alike, on non-combatants and innocent women and children, on defenseless towns and historic shrines of art, have so offended the civilized thought of the human race that it will be generations before the nations of the world will be willing to trade again at any price with Germany. It will be generations before she can recover even a moiety of the magnificent foreign trade which she had built up with such conspicuous enterprise in the forty progressive years, till the enterprise of the German people had been struck down and led in chains by Prussian junkerism."

The writer was present recently at a conversation in which a prominent American manufacturer of chemicals and drugs on making just such statements as those of Mr. McKerrow, quoted above, was told by a bystander that such a course applied to his business would result in his being ruined in ten years. "Then, sir, I shall be ruined," replied the chemical manufacturer.

The Grasselli Chemical Company seems to have invaded the field of high explosives, hitherto foreign to their activities. The Grasselli Powder Company has been incorporated in Ohio with $5,000,000 capital to take over the American Explosives Company, the Burton Powder Company and the Cameron Manufacturing Company, all at present active makers of high explosives.

Another persistent rumor concerns the National Carbon Company, the Union Carbide Company and the Air Reduction Company. It is said that a new company will be formed whose stock will be exchanged for stock of these three companies. The new organization is expected to be capitalized at $150,000,000.

There is at present outstanding $20,966,600 of Union Carbide stock, worth, at the present market price of about 200, some $42,000,000. The current value of the National Carbon's common and preferred stock is about $13,000,000. The stock of the Air Reduction Company is "without par value," and is selling just now at about 97. At this rate it would be worth over $12,000,000.

The Air Reduction is the newest of these companies, having been formed about a year ago to take over the American rights to some important European processes for the manufacture of liquid air and oxygen and nitrogen gases, and also to sell welding apparatus. The same processes are controlled in Canada by the Societe de l'Air Liquide. The new company will probably be a powerful factor in the oxygen, calcium carbide, nitrogen and acetylene field.

Consumers of gas in large American cities are likely to have to get used to a different grade of gas from that now in use. The Council of National Defense is taking steps to have the gas of all large cities deprived of the toluol it contains. There is a shortage of toluol for military purposes. The illuminating quality of the gas will not be impaired.

Dr. Chas. F. Chandler, the first President of the Chemists' Club, and one of the best known chemists and educators of America, has been seriously ill at his summer home in Massachusetts. According to recent advice, however, Dr. Chandler is now out of danger.

Dr. Chas. F. Lindsay, of the Imperial Munitions Board, Ottawa, is a frequent visitor at the Chemists' Club.

The Third National Exposition of Chemical Industries, which will be held in New York the latter part of September, is one of the chief topics of discussion among chemists and chemical manufacturers here these days. The "Show" is now an institution and will be larger and more interesting than ever this year. It is to be hoped that the large attendance of Canadians, which was quite a feature of the last two shows, will be maintained this year, for there is a great deal of value to be derived from attendance. New machinery, new products, new processes and old friends will be on hand in large numbers. In some quarters some slight criticism has been made of holding the Exposition this year. It should be remembered that the Chemical Exposition is not in the same class as the usual Exposition, the purpose of which is merely to commemorate some event and serve as an excuse for a pleasure trip. At the Chemical Show ideas are exchanged and information distributed, and there is no time when this need is more keen than at present during the war. The country is in no mood at present for expositions catering only to amusement. However, a gathering which will so largely promote industrial efficiency as the Chemical Show undoubtedly will, is quite another matter.

F. M. TURNER, Jr.

Publications Received

Report of Special Trade Commission to Great Britain, France and Italy.—This commission toured these countries last summer and investigated the conditions affecting trade, their inquiries into the chemical and allied industries being unusually complete. Published by the Department of Trade and Commerce, Ottawa.

Ontario Bureau of Mines, 1916.—Annual report, in three parts covering the activities of the bureau for 1915. Part I. contains the usual statistical information. Part II. is entitled, Lead and Zinc Deposits in Ontario and Eastern Canada, by W. L. Uglow, while part III. is a description of the geology of Kingston and Vicinity, by Prof. M. B. Baker, of Queen's University. Issued by the Department of Lands, Forests and Mines, Parliament Buildings, Toronto.

Preparation of Ferro-Uranium.—By H. W. Gillett and E. L. Mack,. A good description of the methods of preparation, with diagram illustrating the various tests applied to this alloy. Published by the Bureau of Mines, Washington.

Carbon Monoxide Poisoning in the Steel Industry.—By J. A. Watkins of the United States Public Health Service. Describes method of sampling and analysis of samples taken from various places around a steel plant, as well as the indications and results of exposure to various amounts of this gas. Published by the Bureau of Mines, Washington.

Permissible Explosives Tested Prior to January 1, 1917.—By Spencer P. Howell. List of permitted explosives with tolerances and methods of testing. Published by the Bureau of Mines, Washington.

Monthly Statement of Coal Mine Fatalities in the United States.—By A. H. Fay. Also contains list of permissible explosives, lamps and motors tested prior to June 30, 1917.

Limits of Complete Inflammability of Mixtures of Mine Gases and of Industrial Gases with Air.—By G. A. Burrell and A. W. Gauger. Determination of explosibility of various proportions of air and industrial gases. Published by the Bureau of Mines, Washington.

Occurance and Mitigation of Injurious Dusts in Steel Works. By J. A. Watkins. Locates the places where dusts are usually found and gives methods of abatement. Published by the Bureau of Mines, Washington.

Pfaudler Glass Enameled Steel Tanks.—Several catalogues describing the Pfaudler line of mixing tanks, agitators, vacuum pans, evaporating kettles, storage tanks and other forms of apparatus made of steel with a resistive silica enamel fused into the inside of the steel shell. Issued by the Pfaudler Company, Rochester, N.Y.

The C.F.M. Book. Contains over 1,400 pages of scales, engines, pumps, steam goods, electrical machinery, tools, machine shop supplies, automobile and motor boat specialties sold by the Canadian Fairbanks-Morse Company, Limited. A useful book for the many thousands of different articles it contains that are used around the average chemical plant.

A New Fertilizer Compound

The Canadian plant of the American Cyanamid Company at Niagara Falls is the only air fixation nitrogen plant on this continent. The company was established in 1907 and the factory at Niagara Falls, Ont., began operations in December, 1909. The initial capacity of the plant was 12,000 tons of cyanamid per annum which was increased in 1913 to 32,000 tons, and in 1914 to 64,000 tons per annum. The plant is now working at its full rated capacity.

During the periods indicated, frequent improvements have been made in the product, which is used principally for fertilizer purposes by fertilizer manufacturers in the United States and Canada. The cyanamid made in 1915 contained an average of 17.40 per cent. ammonia, and the cyanamid made in 1915 contained an average of 23.18 per cent. ammonia. The present grade of material contains over 25 per cent. ammonia.

One of the carbide furnaces in American Cyanamid Co.'s Plant

During the last several years, the company has worked out a process for the manufacture of a new fertilizer compound which has been given the name "Ammo-Phos." A plant for the manufacture of this material in New York Harbor will be placed in operation this month. This compound has the remarkable property of containing about 60 per cent. of actual plant food, which is three to four times as much as any of the common fertilizers on the market. Ammo-Phos is an ammonium phosphate compound containing a minimum of about 13 per cent. ammonia and a maximum of about 20 per cent., with a maximum percentage of a 47 per cent. available phosphoric acid, and a minimum of about 20 per cent. Hence, any desired proportion of ammonia to phosphoric acid, is obtainable. This product is perfectly dry and stable in composition, and can be mixed with all of the common fertilizer materials as desired. About five-sixths of the plant food in Ammo-Phos is soluble in water, and all but a trace of the balance is soluble in the standard testing solutions. This new product may revolutionize the fertilizer industry, since by its concentration it reduces the expenses of handling, bagging, mixing, freighting, hauling and applying to about one-third of the normal cost for the same quantity of plant food in the present mixtures.

The ammonia used in the manufacture of Ammo-Phos will be derived from cyanamid made at Niagara Falls. The phosphoric acid required will be obtained from phosphate rock mined at the company's properties in Florida, and shipped to New York where the phosphoric acid will be extracted by treatment with sulphuric acid. The ammonia combined with the phosphoric acid, produces Ammo-Phos.

The production of ammonia from cyanamid has been developed to a high degree of efficiency, 99 per cent. or more of the nitrogen of the cyanamid being recovered as ammonia gas. Since the beginning of the present year, the company has been manufacturing sulphate of ammonia from cyanamid ammonia and sulphuric acid, produced at its New York plant. Aqua ammonia of very high purity is also being produced at the New York plant. The company has also developed an ammonia oxidation process, whereby cyanamid ammonia is being converted into nitric acid. This process has had a practical tryout for over a year, and works at nearly theoretical efficiency.

Urea is another product which is now being manufactured on a considerable scale from cyanamid. This chemical is used principally in the manufacture of celluloid. This process, which yields a very high grade of product, will without doubt make Canada and the United States independent of foreign sources of supply for this material.

A low grade of cyanide containing about 30 per cent. of sodium cyanide equivalent, is also being produced at the Niagara Falls Works, and is used for the extraction of gold and silver ores.

With the numerous important uses for its products, the cyanamid industry is no doubt destined to have a far reaching influence upon the growth of the chemical and allied industries in the United States and Canada.

Alfred Burton

Now that the chemical industries of Canada are filling with new life and have acquired an importance that must be maintained as a matter of national policy after the war, it is fitting that we should recognize the services rendered by many a pioneer who bore the heat and burden of the day when circumstances were against them.

Of those officially connected with the Society of Chemical Industry no one has worked more faithfully or more unselfishly than Alfred Burton. He was the first secretary of the Canadian branch of the Society of Chemical Industry, and to his enthusiasm and perseverance is largely due the steady progress of the Society in Canada at a period when both faith and works were demanded to keep life in the organization. Mr. Burton has remained secretary of the Society since its foundation.

The first suggestion of a Canadian section of the British Society of Chemical Industry appears to have been made in April, 1901, by Prof. W. R. Lang, of the University of Toronto, and after a canvas of those interested it was found that about sixty men were prepared to support the move. A provisional committee consisting of Prof. Lang, Prof. W. H. Ellis, Dr. F. J. Smale, Dr. G. W. C. Arnott, H. Vander Linde, J. M. Sparrow and Mr. Burton was formed and on the 6th March, 1902, the Society began its organized life in the chemical building of the University of Toronto, the parent society having approved of the movement. Prof. Lang was the first chairman, or president, followed at various periods to the present time by Dr. Smale, Prof. Ellis, Dr. M. L. Hersey, Dr. W. L. Miller, Dr. A. McGill, W. P. Cohoe, M.A., Dr. R. F. Ruttan, Prof. J. Watson Bain and Dr. Charles Carpenter. Mr. T. H. Wardleworth, of the Imperial Munitions Board, is now chairman of the Canadian section.

The secretariat has been an office often requiring not only much detail work, but great tact and patience and Mr. Burton has proved his fitness and ability in all directions. The unselfish spirit of his work is manifest in the fact that the position of secretary, has always been an honorary one. There is now a Montreal branch and a British Columbia branch, each with a local secretary and local committees; and the membership has grown from the original sixty to 250.

Mr. Burton is a son of the late P. H. Burton and a nephew of the late Stapleton Caldecott, principal member of the wholesale drygoods house of Caldecott, Burton & Company, a firm which maintained in Canada the best traditions of the British drapery trade. Afterwards Messrs. P. H. and Alfred Burton organized the Merchants Dyeing and Finishing Company, now known as the Canadian Dyers and Finishers Association, which was the first business organized to dye fabrics for the drygoods trade. Mr. Burton has recently retired from this company, and may possibly take up some special work connected with the chemical industry, for which his long experience so well qualifies him. He has been invited to act as a foundation member of the Canadian Textile Institute recently organized in Toronto.

C.M.A. Organizes New Industrial Bureau

Organization goes on apace among the Ontario branches of the Canadian Manufacturers' Association in the campaign for the inauguration of industrial bureaus throughout the Dominion. The present effort is to have the first bureau established in Toronto, and have the work spread out from this city.

The special committee of industrial and scientific research of the C.M.A., of which Mr. Thomas Roden is chairman, has held several meetings, and so far eight different groups of industries have unanimously decided to co-operate in the scheme. When the educational campaign is completed a delegation will proceed to Ottawa to urge upon the Government the necessity of providing this bureau. It is stated that the Canadian manufacturers and those interested in this bureau will make substantial contributions to cost, maintenance, etc., while the Government will be asked to provide the building and equipment.

The Potash Problem

EDITOR THE CANADIAN CHEMICAL JOURNAL:

Sir,—I have read with considerable interest the articles relating to Potash that have appeared in the much needed CANADIAN CHEMICAL JOURNAL. On pages 78-9, 93 in the August number, I was more than interested to see an alleged "Report on Chemical Process for Potash Extraction from Feldspar by Dr. J. A. Dawson, Chemist Dominion Laboratories, Ottawa, Ont., January 22, 1915. To Mr. Saul E. Melkman, Montreal, Que." The article was concluded on page 93, as follows: "(Signed) J. A. Dawson, Assistant Chemist, Dominion Laboratories, Ottawa."

With reference to this alleged report that appeared under the apparent nom-de-plume of "Dr. J. A. Dawson," I would request you to publish the following facts:

1. My name is J. A. Dawson. I am not "Dr. J. A. Dawson." I have never posed as, claimed to be, or signed my name, "Dr." I do not know of the existence of any "Dr. J. A. Dawson," nor of any "Dominion Laboratories" at Ottawa or at any other place.

2. I had no knowledge regarding the publication of this alleged report by "Dr. J. A. Dawson" until I received a copy of the August number of THE CANADIAN CHEMICAL JOURNAL.

3. I have never prepared for Mr. Saul E. Melkman any report. The language, the chemistry and the common sense of some statements in the alleged report are no kin of mine.

I am of the opinion that the report was prepared by Mr. Saul E. Melkman from information derived from the following sources:

(a) Mr. Saul E. Melkman; (b) Report on the Feldspar Property at Quatichoo-Manicouagan Bay, Que., by A. G. Spencer, chief chemist of the Canadian Inspection and Testing Laboratories, Limited; (c) Copy of a "Report on Spar Chemical Company Potash Extraction Plant, by E. B. Miller." (d) Certain items of information which I incidentally gave to Mr. Saul E. Melkman, gratis.

So far as my information goes, the following outlines Mr. Saul E. Melkman's association with potash and feldspar: Mr. Melkman is interested in a deposit of orthoclase more or less intergrown with quartz et al., located at or near Quatichoo-Manicouagan Bay, which I believe is in Quebec, on the north shore of the St. Lawrence River, and opposite the Island of Anticosti. Certain samples taken from this deposit have indicated on analysis, approximately 11 per cent. of potash as K_2O.

The Spar Chemical Company, of Baltimore, Md., controlled or had interests in the Thompson and Bassett patents for a process of obtaining potash from certain silicate minerals.

Apparently as the result of a report prepared by Dr. J. T. Singewald, of the staff of geology of Johns Hopkins University, for the Spar Chemical Company, this company entered into negotiations with Mr. Saul E. Melkman for the purchase of, or of certain interests in, the deposit of feldspar mentioned above.

Mr. Saul E. Melkman obtained an option for the purchase of the rights to use in Canada, the process covered by the Thompson-Bassett patents assigned to the Spar Chemical Company.

Mr. Saul E. Melkman next succeeded in interesting certain Canadians to the extent of investigating carefully the claims made for the Thompson-Bassett process.

Among others, I happened to be chosen to attend a demonstration of the process carried out on a semi-industrial scale. Mr. Saul E. Melkman was present throughout this demonstration. In this demonstration, one ton of feldspar from Howard County, Md., a sample of which subsequently upon analysis, indicated 8.64 per cent. K_2O content, was crushed to pass 60 mesh. It was then mixed with nitre cake (sodium hydrogen sulphate), common salt and powdered coke in the proportions by weight, feldspar 2,000; nitre cake, 2,000; common salt, 700; powdered coke, 170. This mixture was heated in two stages in rotary kilns to approximately1, 400° F. Gaseous hydrochloric acid and a solid "clinker" resulted. The sodium sulphate and potassium sulphate formed, were leached out by water and submitted to vacuum evaporation and to crystallization, using a two effect Zaremba evaporator.

The claims made for this process were: (1) That from 80 to 90 per cent. of the potash of the feldspar was converted into potassium sulphate; (2) that potassium sulphate of 90 per cent. purity could be separated from the sodium sulphate. No claim was stated re percentage yield.

With regard to the first claim, so far as this particular demonstration could prove, less than 25 per cent. of the potash of the feldspar was converted into a water-soluble compound. This result was determined by my own analyses of samples of all the original, intermediate, and final products. This result was also confirmed by analyses made by an industrial chemist in his own laboratory, who was present throughout the demonstration, and who obtained his samples under the same conditions as were my own.

With regard to the second claim, no potassium sulphate whatever of even 5 per cent. purity was separated, during the demonstration of the second half of the process. In substantiation of this result we have the statement of Richard K. Meade, who was present throughout the demonstration in question. In the August number of THE CANADIAN CHEMICAL JOURNAL, page 88, in an article under the name of Richard K. Meade, the following statement occurs: "Furman Thompson proposed to employ acid sulphate of soda and salt to attack feldspar (U.S. patent No. 995, 105, and also No. 1,091,034, to H. P. Basset). Muriatic acid and salt cake are obtained as by-products. The Spar Chemical Company, Baltimore, Md., built a plant at Curtis Bay, Md., prior to the war, to produce potash by this method, but their efforts here failed, due largely to the difficulty of separating the sulphate of soda and potash."

The solubilities of the more common sodium and potassium salts in water at 0° C. and at 100° C. are as follows, (Van Nostrand's Chemical Annual):

Solubility in 100 Parts.	Cold Water at 0°C.	Hot Water at 100°C.
Sodium sulphate (Na_2SO_4)	4.8	42.5
Potassium Sulphate (K_2SO_4)	8.5	26.2
Sodium nitrate ($Na NO_3$)	72.9	180.0
Potassium Nitrate (KNO_3)	13.3	247.0
Sodium Chloride ($NaC1$)	35.7	39.0
Potassium Chloride ($KC1$)	28.5	56.6

Judging from these figures, the chlorides and the nitrates should and actually do, lend themselves to separation by fractional crystallization. In the case of the sulphates, however, it would appear possible to separate some sodium sulphate practically free from the potassium salt, but at a certain stage the two salts would separate out together in approximately equal proportions.

The conclusion that appears to have been established with regard to the Thompson-Bassett process, is that the primary products are hydrochloric acid and salt cake containing a small percentage of potassium sulphate. There is also the silicate residue that has succeeded in retaining apparently some 75 per cent. of the original potash.

Mr. Melkman, so far as I am at present aware, did not purchase the rights to use in Canada, the Thompson-Bassett process. Instead, he applied for and, I believe, obtained patents for the so-called Melkman process for potash. Judging from the description in the August number of THE CANADIAN CHEMICAL JOURNAL, this process differs from the Thompson-Bassett process only in the following essential features: (1) the use of hydrogen sulphate in place of sodium hydrogen sulphate, that is, of sulphuric acid in place of nitre cake; (2) a final temperature of 2300°F. in place of 1400°F.

According to the alleged report of "Dr. J. A. Dawson," by this process it would appear that 80 per cent. of the 12½ per cent. of potash in the feldspar, is finally obtained as potassium sulphate.

Whether this percentage yield has been determined by an exhaustive industrial research or has been arrived at by a process of optimistic guessing, who shall say? Is it not enough that "Dr. J. A. Dawson" of the "Dominion Laboratories" is the authority for this unimportant detail?

Now, I would hazard a guess that Mr. Saul E. Melkman has not even submitted his process to the criticism of a competent consulting chemist. I am forced to this conclusion by the following elementary physico-chemical facts. Sodium chloride and sulphuric acid when heated together yield hydrochloric acid and normal sodium sulphate. Sodium sulphate fuses at 888°C., which is 1,630°F. The approximate final temperature indicated in the Melkman process is 2300°F., which is 670°F. above the fusing point of sodium sulphate. I would, therefore, strongly recommend that the very first thing Mr. Saul E. Melkman should do after reading this is that he retain the services of a competent industrial research chemist to find out in the laboratory just what happens when a mixture of orthoclase and quartz ground to pass 200 mesh, is heated with sodium sulphate to approximately 2300°F. Having made this very profitable investigation, there will still remain the entrancing problem of how to get the potash out. Then there is also the problem of disposing to advantage of the hydrochloric acid. The outlet as bleaching powder appears to be practically blocked by the chlorine obtained as a by-product in the electrolytic manufacture of sodium hydroxide from common salt. Of course there is the outlet into the atmosphere which no doubt would welcome an HC1 rarebit as a change from the monotonous, SO_2, CO, and CO_2. I shall await patiently the publication of the results of Mr. Saul E. Melkman's investment in original investigation.

With due realization of the immensity of our own poor judgment and lack of knowledge, we do not seem to be able to evade the obvious,—namely, that the probability approaches negative infinity that the so-called Melkman process for potash will ever be a war-bride except to Mr. Saul E. Melkman. Under the present war conditions, we naturally expect a great plague of financial optimists posing as process inventors who evidently would not hesitate to go to the extreme of publishing an alleged report under the nom de plume of a supposed professional authority apparently employed by the Government of Canada.

If our system of education were such that promoters of pseudo-industrial propositions were sentenced to hard labor in a laboratory of industrial research, there would result a marvellous elimination of the misapplication of human energy in endeavoring to achieve the impossible. I suppose there is money in their madness and the crowd enjoy throwing it into a hole no matter who owns it.

Even in British Columbia, we have our astrologers and alchemists. We do not find feldspar so good a bait as kelp. Now kelp has a secret process of getting potash, iodine, et al. out of the ocean which gets its potash out of feldspar, etc. Moreover the potash in kelp does not have to be heated to 2300°F. to make it behave itself properly. It has already been disciplined by wind and weather. The United States Bureau of Soils in Report No. 100, "Potash from Kelp," gives the following averaged results of analyses made on samples of Pacific coast kelp which had been dried in the oven at 105°C:

Species	No. of Samples	Total Soluble Salts	Potash K_2O	Iodine I	Nitrogen N	Ash of Insoluble Residue
Brown Kelp		%	%	%	%	%
Macrocystis pyrifera.	58	30	12.59	0.23	1.57	5.9
Black Kelp						
Nereocystis luetkeana.........	51	46.9	20.10	0.13	1.90	4.2
Stringy Kelp						
Alaria fistulosa	15	24.4	9.10	trace	2.60	7.5

"The average potash content of upwards of 100 samples of dried Macrocystis and Nereocystis as determined in the laboratory of the Bureau of Soils, is 16.1 per cent., corresponding to about 25 per cent. potassium chloride." According to the United States Bureau of Soils we have at our Pacific door an annual supply of millions of tons of material which, simply by drying, yields a fertilizer containing about 25 per cent. of potassium chloride and a lot of other valuable organic and nitrogenous substances. It would seem more profitable to sell dried kelp when KC1 (80 per cent. basis) is quoted at about $400 per ton, than to waste time selling stock in a cougar kelp company. Yet the cougars seem to prefer the rabbits. With regard to the situation south of latitude 49, Dr. F. K. Cameron (loc. cit. p. 29) states with regard to certain concerns ostensibly developed to utilize the kelp,"—many, unfortunately, appear to be nothing more than stock-jobbing or wildcat schemes, against which the public can not be too strongly warned."

Questioning the annual available tonnage of kelp on the Pacific coast, W. C. Ebaugh in an article on "Potash and a World Emergency" (J. Ind. Eng. Chem., July, 1917, p. 691), states, "Particularly disappointing must have been the results of attempts to recover potash from seaweed or kelp along the Pacific Coast. It was stated that practically limitless tonnages of kelp could be cut annually, and that an inexhaustible supply of potash was thus assured,—but statistics for 1916 show how far realization has fallen below expectation. For example, the plant of the Hercules Powder Company at San Diego has utilized only 1,000 tons of wet pulp per day instead of 1,500 to 2,000 tons, and experience to date indicates that only 22,000 tons a year are available as against an official estimate of 696,000 tons."

Mr. Ebaugh concludes that we must look to the potash silicate minerals for our supply, stating, "that a service of incalculable benefit to mankind will be rendered by the discoverer of a process whereby soluble potassium compounds can be made cheaply from feldspar, leucite, and other silicates containing potash. The problem is not necessarily incapable of solution, but prolonged, persistent, painstaking effort, with ample provision for large scale experimenting, are needed. The Napoleonic Wars gave us cheap soda; will the World War of a later century give us cheap potash?"

We may well derive a moral from the life of the now renowned pioneer industrial chemist, Nicolas Leblanc, who first solved the problem of making soda from common salt. He was born in France in 1742 and commenced the actual manufacture of soda in 1791. Political conditions and other circumstances hindered its growth for a long time, the chief difficulty being the high duty on salt. Leblanc died in the utmost poverty in 1806, his death being due to despair. A monument has recently been erected at his birthplace to his memory.

In the Archaean rocks of Canada, particularly in Ontario, we have probably the largest known high grade potash silicate deposits in the world, containing up to 15 per cent. of potash (K_2O) and 10 per cent. aluminum (A1). We have immense resources of hydro-electric energy. Nature waits the magic of the reincarnated spirit of Leblanc. Should we in Canada be honored by his presence amongst us, may we, particularly our people in the seats of Government, deal with him more kindly than did those of a supposedly less enlightened century.

J. A. DAWSON.

249 Hastings Street East, Vancouver, B.C.

August 15, 1917.

Potash from Canadian Kelp

Mr. G. A. Schawbland has arrived in Prince Rupert from the Queen Charlotte Islands. He proposes to put up a plant there for extracting potash from sea kelp. The plant is designed to handle a thousand tons of kelp per day, and Mr. Schawbland is on his way to order machinery. The concern will also engage in the fishing business.

Foreign Trade Inquiries

1118. **Cobalt Oxide, etc.**—A firm of chemical merchants at Manchester, wishes to get in touch with Canadian manufacturers and exporters of oxide of nickel and cobalt, and molybdic acid.

1125. **Chemicals and Medicines.**—A Cape Town firm specializing with the drug trade are prepared to take up Canadian representation of any chemicals or drug store preparations.

1152. **Chemicals for Cloth-finishing Trade.**—A Glasgow firm would like to represent Canadian exporters of the above.

1153. **Oils and Greases.**—A Glasgow house having good connection with engineering trade is open to accept Canadian agency.

1160. **Ebonite or Vulcanite.**—A Birmingham firm is open to purchase ebonite (vulcanite) in rods and tubes, 3 foot lengths. Also sheets 48-inch by 20-inch and 24-inch by 20-inch.

1161. **Asbestos Manufactures.**—A Birmingham firm wishes to be put in touch with manufacturers of asbestos goods.

1163. **Sheet Asbestos.**—A Birmingham firm inquires for quotations and samples of sheet asbestos.

1175. **Mica and Micanite.**—An Australian firm interested in the importation of machinery and factory plants is desirous of receiving samples and quotations of mica and micanite.

1178. **Graphite.**—A firm of Liverpool paint manufacturers who import large quantities of high-grade powdered graphite, inquire for a Canadian source of supply. Must be free from grit and 80 per cent. carbon. Samples and analysis should accompany communications.

1193. **Oils.**—A Leicester firm is open to purchase all kinds of lubricating oils.

1194. **Oils.**—A Leicester firm would like to hear from exporters of all kinds of lubricating oils.

1195. **Oils.**—A Leicester firm inquires for quotations on lubricating oils.

A French manufacturer of essential oils desires to get into touch with Canadian buyers. Further information from this office.

Recent Incorporations

Of Interest to the Chemical and Metallurgical Industries

Sherbrooke, Que.—MacKinnon Steel Company, Limited, $500,000. G. D. MacKinnon, A. MacKinnon, J. Nicol.

Montreal.—Colgate and Company, Limited, $25,000. J. E. Martin, Clara Thomas, P. Brais.

Ottawa.—Big Duck Lake Mining Company, Limited, $30,000. M. Bryerton, F. Denton, E. M. Miller.

Ottawa.—Dominion Molybdenite Company, Limited, $5,000,000. S. G. Metcalfe, C. Murphy, A. C. Craig.

Toronto.—Nicu Steel Corporation, Limited, $200,000.

Toronto.—The Burns Cement Gun Construction Company, Limited, $40,000.

Toronto.—Nipissing Mines Company, Limited, $6,000,000.

Toronto.—Croesus Lake Gold Mines, Limited, $1,000,000.

Toronto.—Potash Patents, Limited, $250,000. F. J. Hughes, D. P. J. Kelly, V. Stewart.

Toronto.—Bourkes Mines, Limited, $2,500,000. G. R. Sproat, C. Carrick, J. Clark Thomson.

Toronto.—Rand Consolidated Mines, Limited, $5,000,000. A. Fasken, R. S. Robertson, A. B. Nind.

Winnipeg.—Prairie Chemical Company, Canada, Limited, $100,000.

Calgary.—Cadomin Coal Company, Limited, $750,000. D. L. Redman, C. W. Coole, O. H. E. Might.

Golden, B.C.—Chinook Copper Company, Limited, $25,000.

Golden, B.C.—Tarheel Copper Company, Limited (non-personal liability), $300,000.

Revelstoke, B.C.—Dunvegan Mining Company, Limited (non-personal liability), $250,000.

Vancouver.—Pacific Mining and Manufacturing Company, Limited, $1,000,000. A. A. Crowston, W. S. McClure, R. Tiffin.

Vancouver, B.C.—Belmont Surf Inlet Mines, Limited, $2,500,000.

Vancouver.—Burrard Quarries and Construction Company, Limited, $100,000.

Vancouver.—Pacific White Lead Company, Limited, $300,000.

Victoria, B.C.—Gordon Bay Mines, Limited (Blue Grouse Claims), (non-personal liability), $400,000.

Extra provincial license (Ontario) has been granted to the Electric Steel and Engineering, Limited, capital not more than $2,000,000.

The following corporations have been granted licenses to operate in Ontario.

Armstrong, Whitworth, of Canada, Limited, capital not more than $40,000. E. T. Malone, K.C., of Toronto, attorney.

Toronto Mining Company, Limited, Toronto, $155,000.

Buffalo Mines, Limited, is permitted to decrease its capital from $1,000,000 to $750,000.

Interesting Facts About Tungsten

The metal tungsten is now playing so important a part in steel making and allied work that some special details supplied by the B.T.H. Co. are well worth publishing. Tungsten is an essential ingredient of high-speed steel, and previous to the war Germany had practically a monopoly of the supply. This is no longer the case, a powerful British company having been formed to develop the industry for Imperial use exclusively. Tungsten is an exceedingly refractory metal with a melting point higher than that of any other metal, its fusing temperature being about 3,050 degrees Centigrade. It is that characteristic that makes it suitable for electric lamp filaments. It is so hard that it will scratch glass, and is unaffected by most acids, while it does not rust, and tungsten drawn wire is stronger than the strongest steel piano wire. Until the electric furnace made possible the production of pure tungsten from the ore it was not available for commercial purposes, and it is only within recent years that methods have been evolved for producing pure metallic tungsten, and more recently for drawing it into wire.

Tungsten as ordinarily supplied is exceedingly brittle, and it was long considered impossible to make it ductile so that it might be drawn into wire. However, untiring research in the B.T.H. laboratories was eventually crowned with success, and the seemingly impossible became an established fact. In the early stages of the development of drawn tungsten wire its production was attended with the greatest difficulty. At first a piece a few feet long was a wonder, but now a piece a mile long, and of absolutely uniform diameter, is commonplace. A filament of drawn tungsten wire can now be made far more accurately and of more uniform quality than the old carbon filament. It is acknowledged that the discovery of the process of rendering tunsten ductile is one of the greatest scientific discoveries of recent times. Since tungsten has been available in ductile form its uses have greatly multiplied. It is coming into general use as a contact material for electrical apparatus, for special electrical furnaces and for other purposes where a high melting point is essential. Another interesting use for tungsten is for targets in X-ray tubes.

The tungsten used for filaments is mined in Cornwall, and the whole of the processes necessary, from extracting the metal from the ore to rendering it ductile and making it into continuous filaments for electric lamps, are carried out in the Mazda lamp factory in Rugby.

Interesting News Items

The Hamilton Steel Wheel Company, Hamilton, Ont., will build an extension to their plant at a cost of $25,000.

The French Government is about to introduce a bill creating a new office of Under-Secretary of State, charged with the task of developing and extending the use of the country's water power resources.

The owners of the Aberdeen Mines Syndicate intend to erect a concentrator this autumn at their copper workings at Mamette Lake, near Merritt, B.C.

Building permits were issued by the Toronto City Architect to the British Forgings, Limited, for additions to plant in the Ashbridge's Bay industrial district, to cost $70,000, and a building at corner of Keele Street and St. Clair Avenue, for the Swift-Canadian Company, to cost $10,000.

Henry K. Wampole & Company, Perth, Ont., will erect a $10,000 factory.

Fire did damage to the extent of about $5,000 to the tempering sheds of the Dominion Steel Foundry Company.

The Reliance Investment and Developing Company, Limited, are preparing plans for the erection of a fireproof clay products plant. Approximate cost, $100,000. Manager, A. E. Hilder.

The National Portland Cement Company, Durham, Ont., have reorganized with the following new directorate: Hon. Dr. David Jamieson, president, Durham, Ont.; Gilbert McKechnie, secretary-treasurer, Durham, Ont.; R. H. McWilliams, manager, Durham, Ont.; John E. Russell, Toronto; R. E. Hamilton, Grand Valley; N. Colville, Orono; E. A. Smith, St. Thomas; Wm. Calder, Durham.

According to a statement made by Willis Chipman, Toronto, the sewage disposal works in East London will soon be completed and the system ready to be formally taken over by the city.

The Canada Cement Company's Lehigh mill, which has been closed down since April, owing to scarcity of labor, is about to begin operations again. This mill uses over 3,000 horse power.

The Lake Superior Corporation is reported to have contracts, which will keep the steel plant running at full capacity until July, 1918, signed with the Canadian Government, at prices ranging around $70 a ton. With the recent blowing in of the new 75-ton furnace, the steel plant now has a daily capacity of 2,000 tons. The greater part of this will be shell steel, since the Canadian Government has issued orders to the management to make steel rails only on absolute necessity for the national railways.

The International Harvester Company, of Hamilton, Ont., will build a foundry at Chatham.

The Canadian Rubber Company are building a $45,000 addition to their Montreal factory.

The Carnation Milk Company, Aylmer, Ont., intend erecting a $45,000 storage building and reservoir.

Negotiations are now on at Prince Rupert looking to the taking over of the G.T.P. shipbuilding plant by the Union Iron Works, of San Francisco, for the construction of steel freight carriers.

The Mattagami Pulp and Paper Company have nearly completed the 150-ton sulphite plant which they are erecting at Smooth Rock Falls, Ont. It will be in operation in a very short time. Mr. S. R. Armstrong is general manager, and Mr. Jos. G. Mayo, formerly with the company, has again joined it as assistant to Mr. Armstrong.

The discovery of a deposit of manganese dioxide between Altawan and Govenlock, on the Lethbridge-Weyburn line of the Canadian Pacific Railway has been reported to the Canadian Pacific Railway officials at Regina.

The Western Canada Lime Company, New Westminster, B.C., has achieved considerable success since its opening. Plant has been handicapped by lack of available labor, but its product, pulverized lime rock, has been very popular.

The Polson Iron Works, Toronto, have taken out a permit for the erection of a one-story boiler shop, at the foot of Sherbourne Street, to be built of steel and galvanized iron, and to cost $60,000.

The Nicholson Tile Company, Port Hope, Ont., are making a $40,000 addition to their plant.

A. F. Bernstein, Vancouver, contemplates erecting a $500,000 smelter and steel plant at Port Coquitlam, B.C.

Grease, valued at nearly $400,000, has been recovered from the sewage of Bradford, England. This was derived from the wool scouring establishments.

A meeting of the shareholders of the Electric Steel and Engineering Company, Limited, Welland, recently incorporated with a capital of $2,000,000, was held in Toronto. Directors were elected as follows: E. Carnegie, Welland; Colonel Leonard, St. Catharines; A. J. Young, of North Bay and Toronto; Alex. Longwell, Toronto; E. Bourne, Cobalt.

The New Hazelton Gold and Cobalt Company, New Hazelton, B.C., contemplate a mine extension.

J. R. Booth, Ottawa, the well known lumber and paper man, is going to build a $15,000 acid plant.

L'Air Liquide Society, Boler Street, Toronto, are building a two story factory.

The West Gore antimony mine is increasing output as the result of the opening up of a new oreshoot.

Prospecting for molybdenite in the vicinity of Quyon, Que., is being carried on by several parties and numerous locations have been staked.

Asbestos mining companies in Quebec are increasing operations to meet the demand. High prices are now offered and properties that have been idle will soon be working again. The regular producers are materially increasing their output.

The largest supply of available water power in the world is located in Canada. It is twice the available supply of the United States.

On a per capita basis, Canada has at the present time, more mills, factories, machine shops and foundries being operated on a 24-hour basis than any other country in the world.

Personals

Mr. R. J. Cole, C.E., of Syracuse, N.Y., was recently in Hamilton, looking into conditions for the erection of a large coke plant in that city at the foot of Depew Street, for the Semet-Solway Coke Company.

Mr. E. G. de Coriolis, of Arthur D. Little, Limited, Montreal, has been elected a member of the Canadian Society of Civil Engineers.

Prof. J. C. Field, of the University of Toronto, is visiting several industrial bureaus in the United States for the Canadian Manufacturers Association.

Prof. J. C. McLennan, of the University of Toronto, is in England, engaged in some expert work for the British Government. For his work in chemical research he has just been honored by the new Order of the British Empire.

Mr. A. W. Phillips, for the past year general superintendent of the Aetna Chemical Company's Canadian smokeless powder plant at Drummondville, P. Q., has resigned this position to accept immediately the superintendency of the Canadian Electro-Products Company's synthetic acetone plant at Shawinigan Falls, Quebec.

Mr. B. F. Repton, general auditor of the Dominion Steel Corporation, has been appointed to the post of comptroller of the Canadian Car & Foundry Company, and supervisor of the Canadian Steel Foundries, Limited.

Mr. H. R. Silver, manager of the Dominion Molasses Company, Halifax, N.S., has been appointed a director of the Acadia Sugar Refinery Company.

Chemical Plant Equipment

The Buffalo Foundry & Machine Company, whose hospitalities on the occasion of the recent convention of the American Institute of Chemical Engineers at Buffalo will be gratefully remembered by the visiting members, are preparing to show at New York a wide range of equipment for chemical plants. This company have now ready for occupation a metallurgical and chemical laboratory for their own works on a university scale. It is eveidently the intention of the company to provide the best that modern science can give for those embarking in the chemical industry.

An Expanding Chemical Industry

The chemical works of A. Mendleson's Sons at Albany, N.Y., at the beginning of the war occupied a block of buildings containing 100,000 square feet, and representing the growth of the business since its establishment in 1870. The demand for their products has increased to such an extent since then that extensions were planned and the property of an entire block adjoining their old works was purchased, the buildings razed and the entire block is now occupied by new buildings for the manufacture of chlorinated lime, caustic soda, etc. The new buildings, four stories high, were opened for operation about a month ago. It is a factory of modern equipment, and this equipment does not end with consideration of financial profit, but extends to the social betterment of the employees, the company having provided lunch and recreation rooms, and a system of pensions for its superannuated employees in which the outside staff shares with the factory hands.

Explosion in Munitions Plant

The most serious accident that has happened in any Canadian chemical plant since the making of munitions was started, occurred at the works of the Curtis & Harvey Company, Limited, at Rigaud, Que., on the 18th August. The marvel was that with two hundred and fifty men working in and around the buildings and a total of four or five thousand hands employed by the company, so few fatalities resulted from the fifty explosions which followed the first. While several were injured, only one man, so far as reported, was killed, and this was Gordon Shortrede, an expert who had been brought out from England as foreman of the works. The loss in material, buildings and plant is estimated at $2,000,000. The village of Dragon, some distance from the works and containing about forty houses, was practically wiped out by the explosions and the fires which followed, and tons of metal were hurled around the country for nearly a mile. For example, a piece of boiler plate weighing over a ton was found half a mile away, and it is remarkable that none of these fragments killed any of the inhabitants. Two farm houses more than a mile away were blown down. Through the heroism of a telephone operator, a rescue train was called from Montreal and was soon on hand.

Though the cause of the accident will probably remain obscure it is fairly certain that it was due to some omission or carelessness in the operation of the plant. At the coroner's inquest, George Dufresne, the foreman in the nitrating department, said that he had been working in the plant since December and had had no previous experience in the making of trinitrotoluol. At 9.00 a.m. he had noticed that No. 6 nitrator was acting strangely. He explained that there were six large nitrators in the plant, 12 feet deep by 9 feet in diameter, which were used to agitate the toluol and the nitre and sulphuric acid. At the time of the accident, two were empty and four were filled. The charge in No. 6 had been finished and the contents were ready to be emptied through a pipe into another tub, where the acid was separated. "I saw white smoke coming out through the cover," said Dufresne. "This was followed by fire, and I knew then that everything was going. There were nine men in the plant, and I told them to run for their lives. I sent two men to warn the others. The explosion soon followed." Witness said that there had never seemed to be any defects in the vats other than what could be immediately corrected. There was no possibility of the explosion being caused by outside interference, as no outsider was allowed to look into the nitrator. Timothy Curtis, vice-president and general manager, said that in the ordinary course of events the material did not offer any danger. There was danger in case the acid got too hot, but the principal danger was from the acid fumes. He thought the fire was caused by spontaneous combustion through the decomposition of the chemicals.

The reconstruction of these works depends on contracts to be concluded with the United States government.

Speaking recently of the development of British industries during the war, Dr. Addison, the Minister of Munitions, said Great Britain's capacity for steel production had increased fifty per cent; the home production of aluminum had increased nearly as much, while the production of spelter had doubled. Enough tungsten was now turned out to meet home requirements and supply much to the Allies. He also announced "that a process had been discovered by which great quantities of potash could be obtained. The development of the scheme, which would enable us to provide every ounce of potash that the glass trade required as well as very largely to meet the needs of agriculture, was now in operation." Canada's achievements in the same way have not been insignificant. The revival of molybdenum production, the expansion in steel making, in zinc, and nickel production and the increase in output of copper and many other minerals has been remarkable, and will be permanent, especially the electrolytic smeltlng of metals. At the outbreak of war Canada's output of shells was 340 eighteen pound shrapnel shells a week. This year, until last month, there were 650 factories making shells and the weekly output was 400,000 eighteen pound shells and the same number of high explosive shells making a total of 800,000 shells per week. As war orders are dropping off these plants are being turned upon industrial work.

Abyssinian Potash Mine

English papers report that in Abyssinia there is now in actual operation a large potash deposit of the same nature as that at Stassfurt, Germany. The company working it states that there are available 850,000 tons of the salt deposit averaging 55 per cent. of potash, and there are hot springs that are adding to its deposit.

It was discovered by an Italian resident who got a thirty-five year concession from the Abyssinian Government. Its location is in a barren district about forty-six miles inland from the little Red Sea settlement of Fatimari, just back of the Island of Baka, which is given on the maps. Fatimari is about seventy-six miles south of Massowah.

Until 1914 practically nothing was done by the concessionaire to develop the potash mine. Shortly after the outbreak of war an Italian company was formed, known as the Compagnia Mineraria Colonaile, which company soon had eight thousand men employed in mining the potash, making a railway to the coast and building a port at Fatimari. One of the members of the company is the proprietor of a large chemical industry in Italy, and he agreed to take one thousand tons of potash per month, the estimated total output of the mine, at a price of 1,000 francs ($193) per ton.

The railway will handle about seven thousand tons per month, and it is expected that some of this potash will be shipped to America with other freight, such as hides, coffee and Red Sea produce, the return cargoes being furnished by American goods.

Index of Advertisements

A new alloy is being used in France for use in the building of motor cars and aeroplanes. The composition is reported to consist of 82 parts aluminum, 1 part silver, 18 parts copper and 5 parts cadmium. Water has no corrosive effect on this composition, and it is claimed that its tensile strength is three times that of bronze. Lightness is its chief characteristic.

War Chemicals

In the British House of Commons recently, Dr. Addison, Minister of Munitions, told of what had been accomplished by Britain in producing munitions and chemicals relating thereto. He said that "T.N.T., which formerly cost 42 cents per pound was now being made for 17 cents. After nine weeks' fighting in France this spring the supply of shells had only decreased by 7 per cent.

"To meet the needs of railway transport the resources of the empire had been tapped, and more than 2,000 miles of track had been supplied, besides nearly 1,000 locomotives, apart from hundreds by the Railway Executive Committee.

"Twice as many airplanes were turned out in May as was the case in December last. During the last six months 1,500,000 steel helmets have been supplied to the troops. Waste is being prevented. Cartridge cases cost $1.75 each. They can be refitted at a cost of 8 cents each. A scheme is being developed for the production of nitrates.

"We have now the plant available for supplying from this country all we need of the following articles: Potash, entirely dependent on Germany before the war); scientific instruments; optical glass (we only produced 10 per cent. of our requirements before the war); machine tools of all kinds; sulphuric acid; superphosphates; tungsten."

Ramsay Memorial Fund

It is announced that the executive committee of the Ramsay Memorial Fund, after prolonged and careful consideration, have resolved to aim at raising $500,000 and to devote that sum to two objects: (1) Provision of Ramsay Research Fellowships, tenable where the necessary equipment can be found; (2) establishment of a Ramsay Memorial Laboratory of Engineering Chemistry in connection with University College, London.

Aminol, one of the new French explosives, used this year on the western front, is said to be one of the safest yet adopted. It is made up of 90 per cent. ammonian nitrate and 10 per cent. nitro-naphthaline, the latter being melted and the former incorporated. All of these substances are very stable, and when mixed will resist rough usage and will not even explode with an ordinary detonator, but require special caps. An explosive of this species would have much to recommend it to the engineers in carrying out their work, through the long tunnels. In mining operations explosives must be safe in handling and must not give off gases or smoke, but in war mining the more smoke and the more suffocating the gases the better, and the force of such large quantities set off in clay ground would cause vastly greater displacements. The 600 tons used in the mines laid for the battle of Ypres were three times those used to blow up Hell Gate rock in New York Harbor in 1885 where nine acres of rock were shattered.

Ammonia Explosion Injures Ten

Ten employees of the Steel Company of Canada, Hamilton, Ont., were injured, some of them very seriously on August 3rd, when an ammonia container, sent in with a carload of scrap iron, came under the big shears that are used to cut up scrap iron. When the shears struck the container there was a big explosion, and many of the employees in that part of the plant were struck by flying pieces of iron. A rescue party was also overcome with ammonia fumes. No damage was done to the plant. All the injured are foreigners.

Humphrey's Glass Works, Trenton, N.S., plan to erect a $150,-000 glass factory.

Plans being prepared for a $25,000 factory addition for North American Chemical Co., Goderich, Ont.

The erection of a $1,000,000 sugar factory is planned at Leamington, Ont.

Enemy Needs Fertilizers

The Prussian Government's industrial and agricultural representatives have joined in an offer of large premiums for the discovery of further deposits of phosphates in Germany, which can be used in the manufacture of artificial fertilizer. Some small deposits exist on the Jahn River, and are being worked extensively, but this product is utterly inadequate to cover the German requirements, some 50,000,000 marks worth of which was imported annually before the war. The inadequacy in the supply of phosphates and nitrates, and even potash in which Germany has a world monopoly, but which cannot be mined in sufficient quantities owing to a shortage in labor, is largely the cause of the decrease in Germany's agricultural production.

New Chemical Industry in Toronto

One of the new chemical plants in Toronto making fine organic chemicals is the Delta Chemical Company. This company was organized last October by Mr. J. C. Ballantyne, late fellow of the Mellon Institute, Pittsburg, and a graduate of the University of London, England, and Mr. W. B. Honeywell, '17 Faculty of Applied Science and Engineering, University of Toronto.

These gentlemen started the manufacture of benzoic acid, sodium benzoate and kindred products a few months ago and are now in a fair way to capture from Germany their monopoly in Canada of these articles.

Examine Nitrogen Plants

It was reported in Washington recently that the United States Government is sending experts to examine the nitrogen plants of the Air Production Company. It is known that the United States Government has appropriated $20,000,000 for the erection of nitrogen plants, $4,000,000 of which is available immediately.

The laboratory of the Internal Revenue Division of the Treasury at Washington reports the discovery of a process for manufacturing glycerine from sugar.

Under the process, which is a secret, the cost of this substance, a heavy factor in the manufacture of explosives, will be reduced to slightly more than one-fourth of its present cost.

Glycerine is at present manufactured almost entirely from fats at a cost of 90 cents a pound, which is six times its cost of production before the war. Extraction of the product from sugar will insure production, at 25 cents a pound or less, according to the estimate of officials.

Canadian Resorcin

Before the war, resorcin, a chemical used as an intermediate in the production of dyestuffs, and also used in medicine as a skin tonic, etc., was one of the many products counted as a monopoly of Germany. Bruce Walton, a former student at Toronto University, and recently with the Harris Abattoir Company, experimented for a year or two on a little plant of household dimensions, and then having made sure of being able to produce resorcin of quality, started a new works at 15 Saunders Avenue, Toronto. A company was formed under the name of Allied Chemicals, Limited, with C. E. A. Carr, as president, and A. W. Crouch, of the Dearborn Chemical Company, vice-president, and the new works are now turning out quantities of resorcin that is accepted by the trade as comparing favorably with the German product. The Canadian resorcin is being put on the market through T. E. O'Reilly, Limited, dealers in chemicals, Temple Building, Toronto.

The earnings of the United States Steel Corporation for the second quarter show a considerable advance over the first quarter as do the net earnings. The comparative figures being: Gross earnings, first quarter, $123,121,018, and for the second quarter, $144,294,076. The net earnings for the second quarter were $90,579,204.

In the course of the reorganization of the Durham Cement Company, now the National Portland Cement Company, Mr. McWilliams, the new manager, stated that the experiments for making potash conducted there under the direction of Mr. Grauel, proved a costly failure for the cement company, which dropped about $20,000 in the attempt to manufacture the potash on a commercial scale.

The Consolidated Mining & Smelting Company, of Trail, B.C., now treat about 40 tons of zinc ore per day by the electrolytic process.

The Canadian Copper Company plan increasing the capital stock to the extent of 1,000,000 shares, of which 833,333, will be held for conservation and the balance for corporative purposes. They will also issue $2,500,000 ten years 6 per cent. mortgage bond. They are building a new $200,000 blast furnace and converter at Copper Cliff, Ont.

The Canada Stove and Foundry Company, of Ville St Laurent, Montreal, have installed an enameling plant in their stove works. Later on the company may develop this department to include chemical work.

The Canadian Leatherboard Company will erect a $250,000 leather board establishment at Chambly Canton, Que.

The Cooper Medicine Company, of Dayton, Ohio, plan a Canadian branch to be located in Toronto.

The Mueller Manufacturing Company, of Sarnia, are again taking up the project of a brass rolling mill to cost $200,000. James, Loudon & Hertzberg, consulting engineers, Toronto, have the plans in charge.

The Dupont Fabrikoid Company have started their works at New Toronto.

The Ajax Rubber Company propose to erect a $300,000 factory at London, Ont., and are seeking from the city council a guarantee of bonds to the amount of $450,000.

To Ship Nickel in Two Years

The statement was made at the offices of the British-American Nickel Corporation that within two years the company will be shipping to Great Britain refined nickel from its refinery being erected at the Murray mine near Sudbury. This statement was made in rebuttal of a despatch from New York that it would be at least four years before the company would start refining. It is reported that new and rich ore bodies of nickel and copper, recently discovered, will make it possible to increase the output of ore nearly fifty per cent.

Chemical and Metal Markets

The quotations below represent average prices for the quantities indicated at the time of going to press. Larger amounts, of course, may be obtained at lower figures.

In the opinion of many the present easing of prices in the metal market indicates that prices of the staple metals have passed the high water markets of war conditions. Pig iron, which had gne up from $12.50 to a point as high as $60.00 per ton is now $57.00 or $58.00, though acid pig, because of its limited production is still quoted at $65.00. Bessemer steel billets are $5.00 a ton less than a month ago. Although there has been an unsettled feeling in the United States arising out of the United States Government's announcement of the regulation of prices, there is not expected to be any abrupt drop in iron and steel, since it is announced that the Government will fix the price of steel at $65.00 a ton. The fact that the United States Steel Corporation has ten million tons less on order than a month ago is taken to be only a transient condition. Canadian merchant's bars are quoted at 4 to 5 cents per pound. When the war orders drop off the iron and steel producers of Canada have commercial orders of such extent awaiting execution that they will be kept going at their present enlarged capacity for a good many months.

Bar silver is an exception to the general tendency in other metals, having risen 4 or 5 cents per pound. Lead from Trail, B.C., is quoted at $13.50 to $14.00 per 100 pounds, and spelter at $11.00 per 100 pounds; copper castings, $32.00 to $34.00.

In the chemical market the sensation of the past fortnight has been the embargo reported in the United States on the export of sulphur. The alarm was not justified by the official proclamation, which does not amount to an embargo, but is the establishment of a system of licenses in place of the unrestricted export hitherto ruling. The license system is not likely to hurt the Canadian trade in any case, for nine-tenths of the exports of sulphur from the United States to Canada are consumed in the pulp and paper industries,and the great daily papers of the United States are now dependent on Canada for most of their news print paper. The utmost that is likely to happen is that the Canadian pulp and paper manufacturers will be put on rations for their supplies of sulphur. After the requirements of the pulp industry, the next important need of sulphur—so far as quantity is concerned—is in the manufacture of insecticides, such as the fruit spraying mixture of lime and sulphur, and the immediate demands for this season are now supplied. However, the scarcity of vessels by which iron pyrites for sulphur could be imported from Spain, and the fact that Italy and Japan need all their own supplies, would make the situation critical were the United States government to be exacting in their license regulation, and it is not surprising therefore that sulphur has gone up $1.00 per 100 pounds and may possibly remain at that dvance, that is $4.50 for ground and $5.00 for rolls.

Prices for chemicals in general have remained firm in both the United States and Canada and manufacturers appear to be well sold up. Bleaching powder has been easy, but even that is becoming firmer. Soda ash and caustic soda are both firm, although those are about the only chemicals coming over in large volume from Great Britain.

When the waves of excessive heat spread over this whole continent in the summer those who had speculated in buying up chloride of lime last year learned a new lesson in handling this material. The steel drums in which chloride of lime is now shipped were eaten through by the effects of the heat, and large quantities of the material were rendered practically useless, to the heavy loss of the buyers. Because of the quantity spoiled in this way chloride of lime may again be up to 5 or 6 cents in a month or when cool weather favors its keeping quality.

The scarcity of wool in Canada, which now limits the production of the woolen mills, is causing a temporary easing off in the price of wool and dyeing chemicals, and the shortage of labor for the cotton mills is having a like effect on chemicals for the cotton industry.

Toronto, August 29, 1917

Inorganic Chemicals

Alum, lump ammonia	100 Lbs.	$6.50
Aluminium Sulphate, high grade, bags	100 Lbs.	4.00
Ammonium Carbonate	Lb.	.25
Ammonium Chloride, white gran.	Lb.	.21
Aqua Ammonia .880	Lb.	.12½
Bleaching Powder, 35% drums	100 Lbs.	4.50
Blue Vitriol	100 Lbs.	11.00
Borax, crystals	Lb.	.18
Boric Acid, powdered	Lb.	.23
Calcium Chloride, crystals fused	100 Lbs.	2.50
Caustic Soda, ground, Bbl	Lb.	.11
Chalk, light precipitated	Lb.	.10
Cobalt Oxide, black	Lb.	2.10
Fuller's Earth, powdered	Lb.	5
Glauber's Salt, in bags	100 Lbs.	1.50
Hydrochloric Acid, carboys, 18°	Lb.	3½
Lead Acetate, white crystals	Lb.	.30
Lead Nitrate	Lb.	.30
Lithium Carbonate	Lb.	2.10
Magnesium Carbonate, B.P.	Lb.	.40
Mercury	Lb.	2.15
Nitric Acid, 36° carboys	100 Lbs.	8.75
Phosphoric Acid, S.G. 1750	Lb.	1.00
Potassium Bichromate	Lb.	.60
Potassium Bromide	Lb.	2.25
Potassium Carbonate	Lb.	1.50
Potassium Chlorate, crystals	Lb.	.85
Potassium Hydroxide, sticks	Lb.	3.00
Potassium Iodide, bulk	Lb.	4.25
Potassium Nitrate	Lb.	.50
Potassium Permanganate, bulk	Lb.	6.00
Silver Nitrate	Oz.	1.00
Soda Ash,bags	Lb.	5
Sodium Acetate	Lb.	.30
Sodium Bicarbonate	100 Lbs.	3.25
Sodium Bromide	Lb.	.80
Sodium Cyanide, bulk, 98-99 per cent	Lb.	.90
Sodium Hyposulphite, bbls	100 Lbs.	2.50
Sodium Nitrate, crude	Lb.	.10
Sodium Silicate	100 Lbs.	4.00
Sodium Sulphate	Lb.	4
Strontium Nitrate, com	Lb.	.55
Sulphur, ground	100 Lbs.	4.50
Sulphur, roll	100 Lbs.	5.00
Sulphuric Acid, 66°Be, carboys	100 Lbs.	3.00
Tin Chloride, crystals	Lb.	.65
Zinc Oxide	Lb.	.32
Zinc Sulphate, com	Lb.	.18

Organic Chemicals

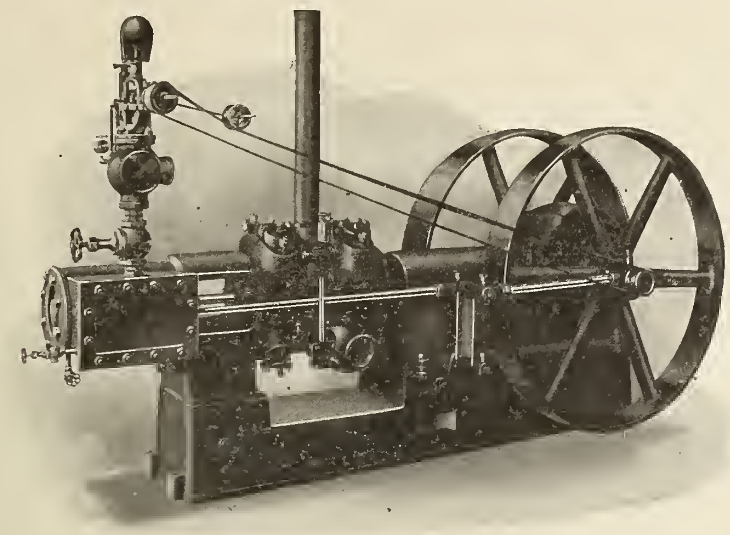
Acetanilid, C.P.	Lb.	$ .85
Acetic Acid, 28 per cent. in bbls	Lb.	.7¼
Acetic Acid, glacial, 99½% in carboys	Lb.	.75
Acetone	Lb.	.60
Alcohol, methylated	Gal.	1.75
Alcohol, grain	Gal.	7.50
Alcohol, wood, 95 per cent.. refined	Gal.	2.25
Benzoic Acid	Lb.	9.00
Carbolic Acid, white crystals	Lb.	1.00

Chemical Markets—*Continued*

Carbon Bisulphide	Lb.	.30
Chloroform, com	Lb.	1.15
Citric Acid, domestic, crystals	Lb.	1.40
Ether, 725	Lb.	.80
Glycerine	Lb.	.95
Oxalic Acid	Lb.	.65
Salicylic Acid	Lb.	2.25
Sodium Benzoate	Lb.	4.50
Tannic Acid, commercial	Lb.	2.00
Tartaric Acid, crystals	Lb.	1.25

Metals

Aluminium	Lb.	$ .57
Antimony	Lb.	.18
Brass, yellow ingots	Lb.	$ .22
Cobalt	Lb.	2.25
Copper, casting	Lb.	.32
Copper, electrolytic	Lb.	.33
Lead	Lb.	.14
Magnesium	Lb.	2.50
Nickel	Lb.	.48
Platinum, pure	Oz.	105.00
Silver	Oz.	.86
Spelter	Lb.	.11
Tin	Lb.	.64
Mild Steel	100 lbs.	5.50
Common Bar	100 lbs.	5.25



Steam-Driven, Single Stage, Straight Line Air Compressor, dust-proof construction, equipped with "Circo" Silent Leaf Inlet and Outlet Valves, Splash Lubrication, Speed and Pressure Governor and A-39 Unloader. This type is convertible to belt drive very quickly. Bulletin K-302. We have many other types and sizes from 50 to 6500 cu. ft. capacity.

Compressed Air Indispensable in Chemical Industry

Compressed Air has many uses in Industrial Chemistry and is a most valuable servant for such work as:—

Agitating, Elevating and Transferring Acids, Oils and Solutions of all kinds.

Blowing and Spraying.

Compressing Carbonic Acid Gas, etc.

Cleaning Engines, Generators and other machinery by Air Jet.

Operating Air Hoists and Lifts.

Pumping water and other liquids by the Air Lift System.

Scaling Condenser Tubes.

Testing and Calking Tanks and Pipe Lines, etc.

We manufacture equipment for the above and many other applications of Compressed Air.

Our Engineering and Sales Departments are at your service to assist in solving your compressed air problems, or quote you prices or furnish information useful to you in any way in connection with the production and use of Compressed Air, without obligating you in any respect. Write our nearest office.

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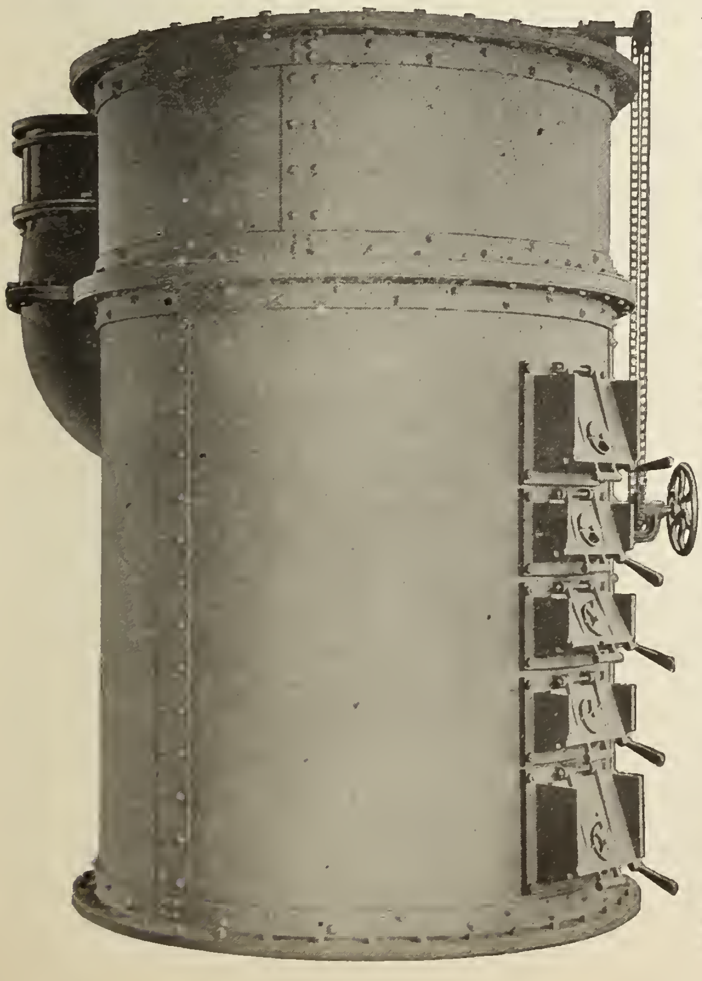

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NOW BUILT IN CANADA!

¶ Has three times the capacity of a rotary burner.

¶ Requires a minimum floor space—a 7-ton Burner taking only 42 sq. ft. room. It is absolutely self-contained—no accessories required.

¶ Burns every pound of sulphur—not an ounce wasted—oxidation to rich pure SO_2 is complete and can be controlled without expert attention or need of scientific apparatus.

¶ The Vesuvius Burner requires no steam heat, no power to drive, very little attendance, and no repairs. Cleaning—once every two weeks—requires less than two hours.

These Claims are backed up by the Burners already in use. Ask us for further particulars

The Waterous Engine Works Company, Limited

BRANTFORD - - CANADA

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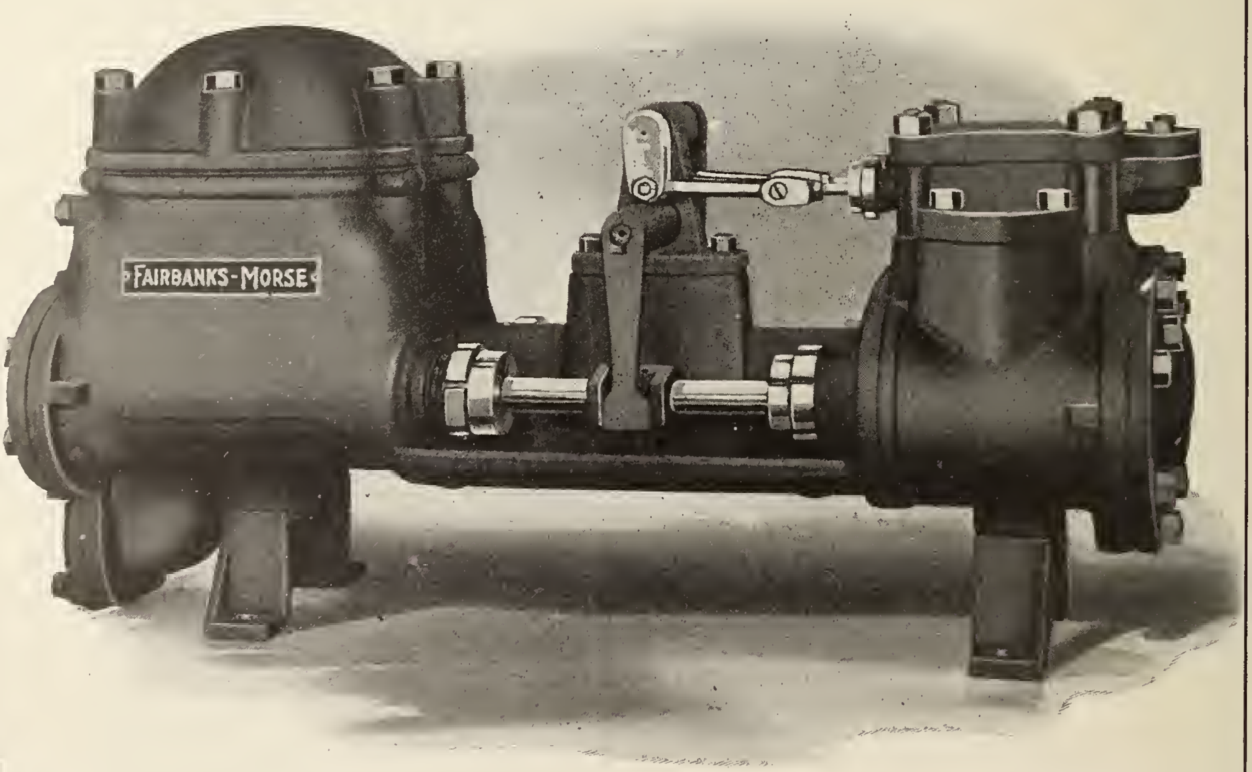
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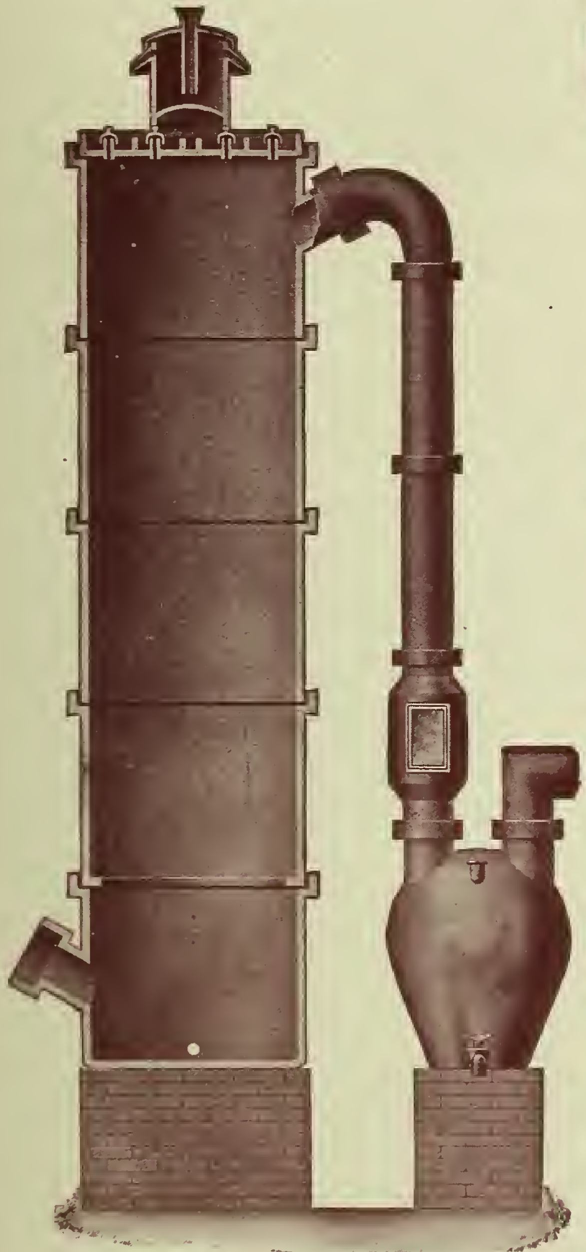
Acid-Proof, Vitrified, Salt-Glazed

CHEMICAL STONEWARE

**Our ware will withstand the action of Acids, Alkalies and Chemicals.
Hot or cold, strong or weak.**

Our ware is not the cheapest—*But it must be right* **Our ware is not Fancy**—*But it is guaranteed*



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Made in all Sizes and Designs
With all Kinds of Packing and Fittings

LOW ACID-PROOF TANK
We make Acid-Proof Tanks in any design or capacity
Outlets and partitions as required

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These Tourills have large cooling surface, which gives greatest Absorbing efficiency

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Made in any capacity from 50 to 250 gallons
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IT IS THE BODY ITSELF

We are equipped to furnish any kind of chemical stoneware, standard or special—90% of our output is to specification. Special orders are filled promptly. We use recording pyrometers in all kilns, and know that all ware is evenly vitrified throughout, as we burn up to 2,700 degrees. Moreover, every piece is vitrified throughout—NOT MERELY GLAZED.

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MAURICE A. KNIGHT Office and Factory Kelley Ave. **East Akron, Ohio**

High Quality American Glassware at a Moderate Price

QUALITY

FRY RESISTANCE GLASS resists the action of both alkalis and acids. Flasks and beakers containing liquid heated to 500° F. can be plunged into water at room temperature without being fractured. All strains have been removed by scientifically controlled annealing thus developing the full strength and resilience of the glass, so that no extra precautions need be taken in handling. Each piece is uniform in shape and thickness.

PRICE

The moderate price at which this high quality glass is being offered has been made possible by the most efficient factory equipment designed especially for this purpose, embodying new labor-saving devices; by making a big quantity of one article at a time for dealers' stock, thus avoiding the expense incident to handling small lots, also by utilizing the dealers' already established channels of distribution.

Style G. **(Fry) Beakers, Griffin, low, wide shape, with lip.** The most popular shape.

Capacity, cc	60	90	150	250	350	500	700	1,000	1,400	2,000
No. in original case	216	156	156	168	84	84	72	48	24	12
Price each	**$.12**	**.13**	**.15**	**.17**	**.21**	**.25**	**.30**	**.40**	**.55**	**.82**

Style E. (Fry) Flasks, Erlenmeyer form, with medium size necks. Each size flask takes the same size rubber stopper.

Capacity, cc	60	120	150	180	250	350	500	700	1,000	1,400	2,000
Stopper No	2	3	4	4	5	5	6	7	7	9	9
No. in original case	276	180	252	144	132	132	72	48	36	24	24
Price each	**$.12**	**.13**	**.14**	**.14**	**.15**	**.19**	**.21**	**.29**	**.34**	**.42**	**.50**

Style F. (Fry) Flasks, Florence form, with flat bottom and vial mouth. The body tapers to the neck, so that the flask is easily drained Each size flask takes the same size rubber stopper.

Capacity, cc	60	120	180	250	350	500	700	1,000	1,400	2,000
Stopper No	2	3	3	4	5	5	6	6	8	9
No. in original case	192	108	144	96	84	72	36	36	24	18
Price each	**$.12**	**.13**	**.14**	**.15**	**.19**	**.21**	**.29**	**.34**	**.42**	**.50**

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CANADIAN
CHEMICAL JOURNAL
A Canadian Journal devoted to Metallurgy
Electro-Chemistry and Industrial Chemistry.

Vol. 1, No. 6 TORONTO, OCTOBER, 1917 20c. a copy; $2 a year

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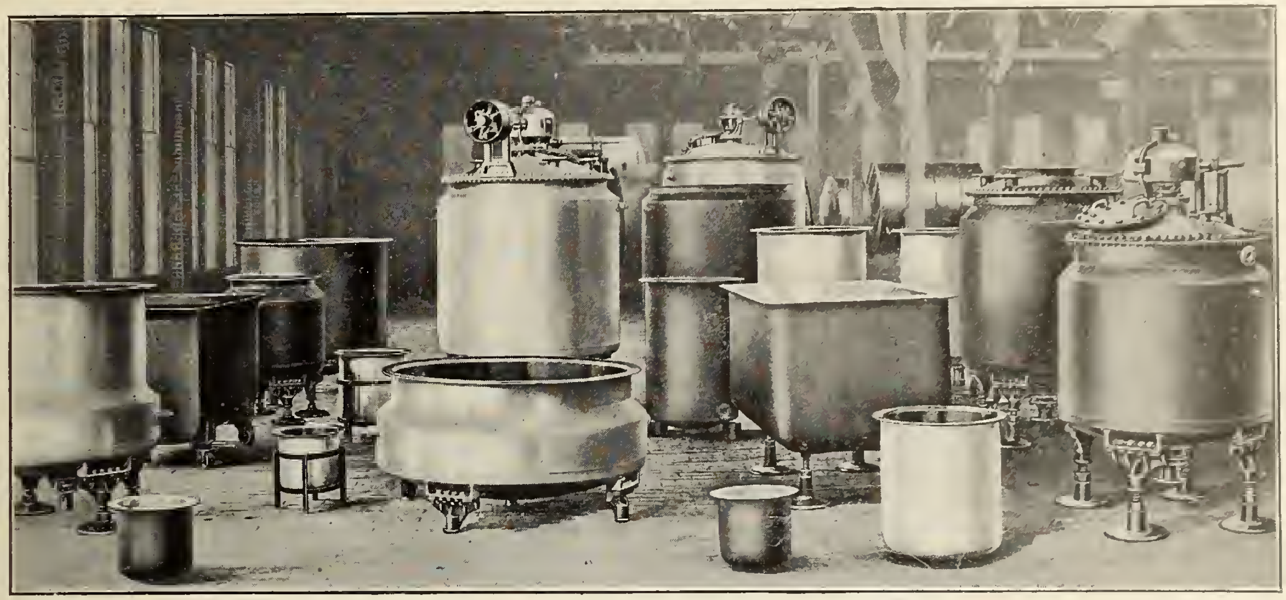

A Group of Characteristic Types

CANADIAN CHEMICAL JOURNAL

A Canadian Journal devoted to Metallurgy Electro-Chemistry and Industrial Chemistry.

Vol. 1 TORONTO, OCTOBER, 1917 No. 6

CANADIAN CHEMICAL JOURNAL

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NOTICE

The Editorial Department of The Canadian Chemical Journal exercises every practicable care to ensure the correctness of the contents of the Journal. In the case of signed articles it is to be distinctly understood that the authors of such articles are alone responsible for the statements which they may contain of fact, opinion or conclusion.

Principal Contents

Back Number Wanted

If any of our readers will forward a copy of the July number of THE CANADIAN CHEMICAL JOURNAL, in good condition to this office, an allowance of three months will be made on their subscriptions.

The University and The Industry

BEHIND and precedent to the success of any chemical industry is the training and selection of the chemists engaged in it. Much has been written during the past twenty or thirty years of the intimate connection between the German Universities and the German chemical industries. That this intimacy has been of the greatest advantage both to the university and to the manufacturer is admitted without question, yet the lesson has not yet been fully learned and applied either by the universities or by the manufacturers in the British Empire.

The article by Dr. Levinstein, which we print in this number, would be important at any time, but is especially so at present, when, so far as chemical manufactures are concerned, the Empire is at the parting of the ways. The Levinstein Company, founded by Dr. Levinstein's father, has manufactured dyes for many years, but, like all other similar corporations in England and on this continent, it obtained from Germany most of its materials, "intermediates." On the outbreak of the war, the British Government appealed to the Levinstein Company for the khaki dye for the uniforms of "Kitchener's Army." The company also supplied the dye used by the United States firms who made uniforms for the French, Italian and other allied troops. Thanks to the skill of the chemists and to the ability of the management, the "intermediates" were made in England and the dyes were always ready before the cloth was finished.

Before the war artificial indigo was manufactured in England by a German corporation. Shortly after hostilities commenced the German manager of this firm destroyed all the notes and directions. The British Government asked the Levinstein Company to undertake the manufacture of indigo so necessary for sailors' uniforms, etc. In a few weeks the company had developed a new and superior process of making indigo, synthetically, in quantity adequate to meet all demands.

The opinions, on matters chemical, of the head of a firm with a record such as this cannot but command respect and interest.

The Advisory Council

IN the last number of this JOURNAL (page 98) there was given to the public, for the first time, the names of the members of the Advisory Committee on Chemistry of the Advisory Council for Scientific and Industrial Research. The members of this chemical committee have been selected, avowedly, on the ground: (a) of their geographical location; (b) of eminence in their respective departments of chemistry.

It would be ungracious to criticize the names included in the committee's membership, but the names which are not included, "give furiously to think." It is, to say the least, unfortunate that the principle of geographical selection, which is so extensively applied in political matters, with notoriously undesirable results, should operate in connection with scientific affairs. Consider the absurdity of the statement that two or three men "represent" in any real meaning of the term, the chemical activities of Eastern Canada, or Western Canada or even any single province of Canada. Every chemist knows that, at the present time no person can "represent" as a real expert, more than a single small branch of chemistry.

Let us consider how the committee will necessarily work. A very important question just now is how to reduce the price of salvarsan. Suppose that this question is submitted to the committee. Obviously the opinions of a steel chemist, of an electro-products chemist, or of a grain chemist will be of no value. Actually they will not have any opinion on such a subject and the question will be decided by the one or two members, if any, who may happen to have the needful knowledge. No question so important as this should be decided by one man.

The present committee numbers eighteen. It is obviously too large for prompt collective action, as anyone with experience in such matters knows.

A great improvement would be made if the membership were increased to say, forty or fifty. The committee would then be much more nearly representative. This large committee should be divided into sub-committees consisting of not more than three members each engaged in the particular branch of chemistry concerned. Should a question arise which concerned more than one branch of chemistry it would be a simple matter to have it considered by the several sub-committees affected and to have the report drawn up jointly by the chairmen of these sub-committees.

Our Daily Bread

THE subject of bread is of special interest at the present time. It is no longer a question of the housewife forcing a reluctant miller and baker to make flour and bread of fictitious whiteness by the use of alum, bleaching agents, or intensive bolting. The point of importance is to utilize the wheat supply for human beings, to the greatest possible extent. The point at issue is as to the proportion of the wheat grain which the human organism can utilize.

The history of this question may be summarized as follows: When chemical analytical methods had sufficiently developed, it was soon demonstrated that as compared with white flour, the whole wheat grain contained a larger proportion of certain important food elements, such as nitrogen. The first round was thus won by the whole wheat people.

Further scientific knowledge indicated, however, that chemical analysis takes us only a short distance towards the solution of the problem. The next question being what proportion of the material can be digested by the organism. Appropriate experiments demonstrated that white bread is more completely digested than whole wheat bread. Round two went, therefore, to the credit of the "white breadders."

A further problem now arose concerning "roughage." The intestines cannot function correctly unless they are provided with a proper quantity of indigestible material of suitable quality. The problem may, therefore, be put in this form. Does whole wheat bread contain "roughage" of desirable quality in the correct quantity?

So far the terms "white" and "whole wheat" flour have been used, but it is important to point out that at any place it is difficult, and in most places impossible to purchase whole wheat flour or meal. The substances marketed under such names as "whole wheat" or "Graham" flour are almost always mixtures of white flour and bran, in variable proportion. The properties of such mixtures are quite different from those of real whole wheat meal. Bread made from the former is much inferior in taste and nourishing value to that made from the latter; in short, any conclusions drawn from the behaviour of such "Graham" flours are quite fallacious if applied to that of real whole wheat meal.

Finally, there is the most important question of the presence and relative quantities of vitamines in the different portions of the wheat grains.

The fact that the debate, as to the respective merits of white and "brown," or "Graham" bread has proceeded during a period of upwards of sixty years, proves one thing conclusively, viz., that the knowledge at present available is insufficient to decide the question at issue. Unfortunately, the discussion has frequently been carried on by people much more distinguished for their partizanship than for their knowledge of chemistry and physiology.

The order of the British Food Controller, made some months ago, prescribing the universal use in the country of (approximately) whole wheat meal, places the entire subject in a radically new position. There is now provided, for the first time, an enormous wealth of definite physiological data. Soon after the order became effective, complaints were made that, in certain cases, symptoms of diarrhœa had developed. In consequence of these complaints the British Government has recently appointed a strong committee to enquire into the whole question. It is to be anticipated that the committee will soon publish a report which will go far to settle the entire controversy.

The paper by Mr. A. J. Banks, in this issue, is timely and is to be regarded as an admirable, exparte statement from the white flour millers' point of view. THE JOURNAL takes pleasure in publishing the paper, but is not committed to Mr. Banks' conclusions.

Canada's Mineral Resources

The war has probably done more than other agency in recent years in stimulating the development of all natural resources and while the immediate object of their utilization is tragic beyond the power of words to express in destruction of life and the long accumulated wealth of civilization, nevertheless the developments now taking place will undoubtedly tend not only to a more rapid restoration after the war, but to a future growth in the utilization of natural resources that will surpass all previous records.

The extent to which Canada's mineral resources may be expected to contribute to the world's wealth becomes a question of immediate interest and speculation.

Reviewing the record of our mineral production in the past we find a story of rapid growth and in many instances of remarkable development. Our country is known to possess and is in fact actually producing a variety of mineral products probably not surpassed by any other nation. While true it is that for some mineral products we have not yet developed our latent wealth sufficiently to supply our own requirements, yet for other products such as nickel, asbestos, cobalt, etc., we have already for years been producing the greater proportion of the world's requirements. The explorations and investigations by our Geological Survey, Department of Mines, and Provincial Mining Bureaus, have revealed some of the latent possibilities of exploitation of our mineral resources and have placed on record numerous occurrences of minerals and ores. Such investigations cannot, of course, be expected to lay bare our mineral wealth for immediate realization. This can be accomplished only by patient and continuous prospecting, search, and experimentation and the free investment of capital under expert and trained guidance.

The total value of the mineral production of Canada in 1916 is officially recorded as $177,201,534, as compared with a value in 1906 of $79,286,697, and a value in 1896 of $22,474,256.

Approximately 60 per cent. of the total value in 1916 was due to the metals and metalliferous products and 40 per cent. to non-metalliferous products. Among the metals the most important from point both of quantity and value are, copper, nickel, gold, and silver; next to these may be mentioned, lead, zinc, iron and cobalt with antimony, molybdenum and platinum making smaller contributions. Aluminium is produced from imported ores. Metallic magnesium is being produced at Shawinegan Falls, chromite the ore of chromium is being produced in important quantities and high grade manganese ores are also being mined. Tungsten ores are being developed and tin has been found although not apparently in commercial quantities.

Our production of gold, silver, copper, nickel, lead, cobalt and molybdenum has already surpassed the requirements of the home markets while that of zinc is rapidly approaching it. In the case of iron, while we are at the present time large importers, we nevertheless possess large known resources of low grade ores which will ultimately be made the basis of a growing industry and in our neighbor, Newfoundland, a part of British North America, we have available one of the largest known iron ore deposits of the world.

In the past we appear to have been slow in the development of our metallurgical operations though no doubt with good commercial reasons. However, we were long content to export our ores of metals for smelting and refining abroad some of them going to England, Belgium and Germany. Our metallurgical developments have been greatly accelerated during the past three years, so that we are now producing, or about to produce most of our metals in a refined condition.

Amongst non-metalliferous products the table of production contains forty or more separate items of which coal stands out pre-eminently as the most important in value of output, and probably also in extent of known reserves. Next to coal comes in order of value of production, cement, asbestos, clay products, stone quarry products, natural gas, lime, pyrites, while closely approaching these are salt, gypsum, magnesite, graphite, petroleum, mica, arsenic and quartz with many other important but less extensively produced products.

It is impossible in a brief review such as this to cover the whole range of our mineral resources in respect to their future possibilities, but a few specific cases may be mentioned for purposes of illustration both as to what has already been accomplished and as to latent resources.

NICKEL.—Canada's production and resources in nickel have received wide publicity, the annual production is now over 80,000,000 pounds, while known ore reserves are placed at close to 100,000,000 tons of ore carrying about three per cent. nickel with the best of prospects for finding a very much greater tonnage.

COPPER.—Is not only an important by-product of the Sudbury nickel ores, but is also found in great sulphide deposits in British Columbia and the Yukon. The annual production is about 120,000,000 pounds and the known resources are constantly being added to.

Gold and silver are being obtained from numerous localities from the Atlantic to the Pacific, the annual production being nearly 1,000,000 ounces in gold and 25,000,000 ounces in silver. Porcupine gold camp and Cobalt silver camp in Ontario are probably the most important in the public eye. Of the two the Cobalt camp has possibly been the most spectacular with its enormously high grade ores in extremely narrow veins, but it is quite within the bounds of possibility that a dozen such camps as that of Porcupine may be discovered in the great Pre-Cambrian area of Northern Ontario, Manitoba, and Saskatchewan.

COBALT.—The cobalt-silver camp was so named because of the cobalt contents of these ores. While with nickel and arsenic, cobalt is only a by-product in these ores its recovery has been sufficiently extensive to drive all other production from the world's markets and to stimulate the development of new uses for the metal.

MAGNESIUM.—The production of metallic magnesium and the production of large quantities of magnesite are attracting attention to Canada's resources in this product.

MOLYBDENUM.—Numerous occurrences of molybdenite ore had long been known, but these had never proved extensive in development. As a result of the demand created by the war, new deposits have been found and opened up and such large ore bodies found that Canada will probably become immediately the world's largest producer of this metal.

Lead and zinc ores are found and mined extensively in British Columbia and have been mined to a less extent in Ontario and Quebec. As with other metalliferous ores these have been found in numerous localities on which little or no development has been done. Both metals are now being recovered by electrolytic refining.

Coal mining, already the most extensive of Canada's mining industries will probably be greatly extended in the future in order that Canada's full requirements may be supplied to a greater extent from domestic sources. At present we import notwithstanding our enormous resources as much coal as we mine. The present annual production is about 15,000,000 tons.

The production of non-metalliferous products offers many opportunities for development not only in increasing the output of mines and quarries, but in preparing the products for market and in the building up of chemical and manufacturing industries thereon. Hitherto a very large portion of Canada's production of non-metalliferous products has been marketed in a crude form while the requirements of our own manufactures have in too many cases been filled by supplies of the same products obtained in a refined condition from outside sources. The development of such secondary industries as the production of calcium carbide, cyanamide, sulphuric acid, alkali products, sodium cyanide, artificial graphite, graphite crucibles, metallic magnesium, ferro-silicon, ferro-molybdenum, molybdic acid, ammonia-molydate, ammonia sulphate, toluol, benzol and other coal tar products, are but indications of coming industries based on our mineral resources.

National Exposition of Chemical Industries

The following is the programme of events at the National Exposition of Chemical Industries at the Grand Central Palace which is near the Grand Central Terminal Station, New York.

Monday, September 24th

Afternoon—Opening Addresses:

Dr. C. H. Herty, Chairman Exposition Advisory Committee and editor Journal of Industrial and Engineering Chemistry.

Dr. Julius Stieglitz, President American Chemical Society.

Dr. C. C. Fink, President American Electrochemical Society.

Dr. G. W. Thompson, President American Institute Chemical Engineers.

Evening—Motion Pictures:

1. Hydraulic Power Development (4 reels).
2. Making a Giant Steam Turbine (Gen. Elec. Co.): (a) Handling Pig Iron; (b) Filling the Cupola and Pouring Castings; (c) Machinery and Assembling the Castings.
3. Generation of Electric Power (2 reels).
4. Transmission of Electric Power (1 reel).
5. The Fixation of Atmospheric Nitrogen by Electricity at Niagara Falls (American Cyanamid Co.) and Feeding the Soil with the Products.
6. The King of the Rails or The Evolution of Transportation (Gen. Elec. Co., 3 reels).

Tuesday, September 25th

Afternoon—Motion Pictures:

1. Carpet Weaving (1 reel).
2. Manufacture and Use of Wool and Its Products (2 reels).
3. Cotton as a Source of Wealth—Growing and Manufacturing Its Products (3 reels).
4. The Manufacture of Leather and Its Products: (a) Tanning; (b) Working up Leather; (c) Manufacturing of Shoes.
5. The Manufacture of Glass (3 reels).

Lecture: Dr. Alexander Silverman, University of Pittsburg, "Glass Manufacture."

Evening—Addresses:

Dr. M. T. Bogert, Chairman Chemical Committee, National Research Council, "The Operation and Work of the National Research Council for the National Weal."

Dr. F. W. Taussig, Chairman United States Tariff Commission, "The Tariff Commission and Its Operation."

Dr. Grinnell Jones, Chemist to United States Tariff Commission, "The Tariff Commission and its Operation with Reference to the Chemical Schedule."

Motion Pictures

Production of Spelter and Manufacture of Lead Products: (a) Mining Zinc and Lead Ore in Oklahoma; (b) Smelting for Lead and Zinc at Joplin and Henrietta; (c) Production of Sublimed Lead Pigment from the Ore by the Fume Process; (d) Manufacture of Carbonate of Lead for Paint Pigment; (e) Manufacture of Lead Paints, accompanied by descriptive discussion, by John R. MacGregor, assistant general sales manager, Eagle-Picher Lead Co.

Wednesday, September 26th

Afternoon—Meeting of the Technical Association Pulp and Paper Industry.

Motion Pictures:

1. Manufacture of Linen Bond Paper (1 reel).
2. The Cordage Industry (5 reels).
3. Manufacture of Paint (3 reels).
4. The Soap Industry (1 reel).
5. The Manufacture of Perfumes, "The Spirit of the Flowers." (1 reel).

Evening—Addresses:

Mr. W. S. Kies, vice-president National City Bank, "The Development of Export Trade with South America."

Dr. L. H. Baekeland, Member Naval Consulting Board, "The Future of the American Chemical Industry."

Motion Pictures:

1. The Coal, Coke and By-products Industry (The Barrett Co., 2 reels): (a) Coal Mining Operations; (b) Old and New Methods of Coking Coal; (c) Recovery of By-products; (d) Use and Results from Ammonium Sulphate as a Fertilizer.
2. The Asphalt Industry (Barber Asphalt Paving Co.): (a) Removing Asphalt from Trinidad and Bermudez Lakes; (b) Transportation of Raw Asphalt; (c) Refining and Manufacturing; (d) Building Roads and Streets; (e) Manufacture of Prepared Roofings and Other Products.
3. The Petroleum Industry—Shooting the Lake View Gusher.

Thursday, September 27th

Afternoon—

Symposium on National Resources for Chemical and Allied Industries.

Speakers—Mr. C. H. Crawford, assistant to president, Nashville, Chattanooga & St. Louis Railway; Mr. V. V. Kelsey, chemist, industrial agent Carolina, Clinchfield & Ohio Railway; Dr. T. P. Maynard, mineralogist-geologist, Central of Georgia Railway; Dr. E. A. Schubert, mineralogist-geologist, Norfolk & Western Railway; Mr. J. H. Watkins, geologist, Southern Railway.

Evening—

Meeting the American Institute of Chemical Engineers.

Motion Pictures: The Metal Industries—(1) Silver, "The Treasure of the Incas," (2 reels); (2) Gold, "The Basis of Business," (1 reel).

Friday, September 28th

Afternoon—Motion Pictures:

1. Asbestos as Fire Protection (1 reel).
2. Building of Roads and Their Maintenance (DuPont de Nemours Co., 2 reels).
3. Farming with Dynamite (Du Pont de Nemours Co., 1 reel).
4. The Sugar Industry (4 reels).
5. The Flour Industry (2 reels).

Evening—Meeting New York Section, American Chemical Society.

Saturday, September 29th

Afternoon—Motion Pictures:

1. The Manufacture of Portland Cement (1 reel).
2. Triumph of the Ultramicroscope: Seeing Invisible Colloid Particles.
3. The Milk Industry (2 reels).
4. Preparation of Condensed Milk (3 reels).

White v. Grey Bread

By A. J. Banks, F.C.S.*

To-day, bread, long and rightly regarded as the staff of life, occupies the premier position in our thoughts and deliberations. The crops of the world are curtailed, a note of interrogation hangs over those now in course of production; freight, on land and water, is still a troublesome factor, and the rapacious appetite of the Teutonic tin-sharks still turns toward our tonnage; hence, statisticians point with grim certainty to the diminishing supplies fast reaching the vanishing point of efficiency, when estimated in terms of the requirements of our Allies plus those of home consumption.

At the outset I must confess it seems to me to be somewhat strange to find a number of people—and, apparently, a growing number of people—discussing, in the present year of grace, the question of the relative values of ordinary white flour and that containing added wheat offal.

White flour is by no means a new product; it has grown in popularity by reason of its inherent value, and its especial fitness to satisfy the palate and supply our major-food requirements. White flour occupies its present position as a result of a process of natural evolution or selection, and not as the result of extensive advertising campaigns. Public opinion anticipated by many years the conclusions arrived at by direct scientific research.

Lawes and Gilbert, research chemists, who paid particular attention to agricultural problems, stated many years ago that the poorer classes in England almost invariably prefer the white bread. These people found that the coarser, more branny, bread passes through them before their systems have extracted as much nutriment as it ought to yield them.

Lawes and Gilbert also emphasized the importance of the state or condition as well as the chemical constitution of foods; in other words, digestibility and aptitude for assimiliation are not less important qualities than the composition.

The work of our medical schools and laboratories shows that the absorption of the nutrient matter of our food stuffs is the result of the gradual erosion and solution of the mass by means of the digestive ferments or secretions of the several parts of the digestive system. Working from the outside inwards, the rate of progress and completeness of the action is materially affected by the coarseness of the food particles, the finer portions of which expose a much greater surface area than the coarser pieces. Moreover, when the latter are of an insoluble, indigestible, and harsh character, they act as local irritants, hastening the involuntary muscular action of the alimentary canal, and causing the food to be discharged before it has undergone complete exhaustion.

Over sixteen years ago Professor Harry Snyder, of the School of Agriculture of the University of Minnesota, made a very lengthy series of investigations in flour and bread. The results were published by the Department of Agriculture, Washington, D.C., in 1901.

They deal with whole-wheat flour, flour made from the greater part of the kernel, and the modern patent roller product. Portions of the same wheat were used in the milling of each of these grades. In condensed form Snyder's results showed:

Flour	Protein			Carbohydrates		
	Total %	Available %	Assimilated %	Total %	Available %	Assimilated %
Standard Patent White Flour	11.99	10.2	85	75.36	73.5	97.5
Entire Wheat	12.26	9.9	80	74.99	69.3	92.25
Whole Wheat	12.65	9.8	77	73.67	66.3	90.00

*Mr. Banks is Chief Chemist of the Ogilvie Flour Mills Co., Montreal.

Protein is the index of strength production, whether it be in vegetable or animal food; and whilst the whole wheat product showed the highest percentage of protein it gave in chemical digestion experiments, as well as in actual trial upon human beings, the lowest efficiency of the series. In fact, each addition of parts of the berry other than the true flour yielding portion, or endosperm, produced a product of a less nutritive quality than that of ordinary white flour. The lower digestibility of the flour grades containing some portion or the whole of the branny covering being due to the fact of a considerable portion of the apparently nutritive matter being contained in the coarser particles which resist the action of the digestive juices and escape digestion.

Snyder concluded that "the nutritive value of the flour was not increased by milling the wheat so as to retain a larger proportion of the bran and germ, as in the entire wheat (82%) or whole wheat flours."

In another investigation on the digestibility and nutritive value of bread, Snyder compared a good white flour with the same flour to which some very finely ground bran was added. The comparison of the total and digestible nutrients, and total and available energy in the same flour with and without bran, showed as follows:

	Protein			Carbohydrates			Energy per gram	
	Total %	Digestible %	% of Total	Total %	Digestible %	% of Total	Total Calories	Available Calories
Straight grade with Bran added......	15.35	13.19	85.9	72.23	67.46	93.4	3876	3395
Straight grade without Bran......	15.06	13.69	90.9	73.57	71.88	97.7	4040	3721

Professor Snyder rightly states, "the inference from these results is that the addition of finely ground bran decreased the digestibility of the product; and, though the bran contained a larger proportion of protein than the flour without the bran, in consequence of its lower digestibility the nutritive value of the former was actually less;" and the further conclusion was reached that "the value of flour depends upon the amount of bran removed, and that bran, even if finely ground, is not suitable for human food."

Snyder's conclusions simply confirmed popular opinion, and even at the present time despite the many greatly improved facilities of a mechanical nature to aid the production of flour grades of greater purity, and despite the advance in the intellectual growth and higher technical skill of operatives in flour mills and commercial bakeries, all contributing to the manufacture of products of better quality, the evidence points most conclusively to there being but a very limited demand for the whole wheat loaf.

Quite recently Prof. Snyder submitted a statement to the Bakers' Conference at Chicago. Dealing with the matter of grinding more of the wheat kernal into flour, and less into feed, he rightly expressed the view that "the advocates of grey bread argue that by the addition of seven to eight per cent. of the present mill by-products of wheat to their flour, the wheat crop and flour supply would be made to go that much further. The theory that grey bread will relieve the situation is based upon the assumption that pound for pound it is equal in food value to white flour bread, and that the present uses of the wheat by-products give little or no return as human food."

Prof. Snyder referred to the Bulletins of the Office of Experiment Stations of the United States Department of Agriculture. Bulletin 101, page 33 states, the available heat of combustion of standard patents or straight grade flour is 3,650, and of entire wheat (82% extraction) is 3,445 per unit. One hundred units of flour furnish 365,000. It will take as many of grey (81–2%) flour with 344,500 available units to furnish 365,000 as 365,000 ÷ 344,500 equals 106 nearly.

Bulletin 156, page 37, arrives at a value of 107.7, whilst a third estimate gave 106.7.

From the above data Snyder draws the conservative estimate of 106 parts of grey (or 81–82% extraction) flour being required to equal in energy 100 parts of the white, standard patent, or straight grade flour.

In England the annual per capita consumption of flour is one sack (280 lbs.), and this on a basis of 72 per cent. extraction is equivalent to 6.5 bushels of wheat.

In the United States statistics show the yearly per capita consumption of wheat to be 5.2 bushels.

In view of the fact that in Canada corn products are consumed more freely than in England and much less freely than in the United States we may perhaps with safety regard the Canadian annual per capita consumption of wheat as 6.25 bushels; which on a basis of 72 per cent. extraction is equivalent to 270 lbs. of white flour.

To obtain the same amount of energy from an 81 per cent. extraction we should require to consume a little over 286 lbs. of the grey product.

It is therefore very manifest that in making an 81–82 per cent. flour extraction we simply add to the bulk of the flour produced; but we do not increase its nutritive value.

In the feeding of stock experience fully demonstrates that bran is of lower value than wheat middlings. The starch of the flour being more valuable in the middlings feed than the woody matters of the bran.

Reverting again to Prof. Snyder's able exposition of the United States Bulletins, it is estimated that "if man consumes the white flour, and a cow consumes the bran and other wheat offal over 90 per cent. of the total energy of the wheat is utilized jointly. If, however, man consumes 82 per cent. flour, and a cow gets the restricted wheat offal from this flour, only about 84 per cent. of the energy of the wheat is secured. The same relative amounts of available protein are utilized.

In olden times when wheat was simply roughly screened from stones, straws, and the larger and harder masses of dirt, and then ground upon stones, it was necessary to use a very large quantity of wheat in order to produce a barrel of flour of but moderate quality color, whilst the keeping quality or stability was very defective. The high oil content imparted an agreeable nutty flavor and aroma whilst the flour was fresh, but oxidation quickly brought about more or less rancidity and induced changes in constitution of an undesirable kind.

Theory pointed to the fact of this condition being due to the somewhat rapid method of flouring, and to the desirability of retarding it so as to admit of the separation of the flour granules from the branny covering, and the patent steel rolls with intermediate sifters or separators of branny stocks were introduced. These did not, however, supply all the requirements for the growing demand for flour of clean appearance.

It was found that the actual condition of the wheat fed into the grinders had much to do with the general purity of the flour produced, and innumerable complicated and expensive machines were devised, cunningly calculated to separate all kinds of extraneous dirt and weed seeds.

At a later period it became clearly evident that the various screening, washing, scouring, brushing and drying devices acted not merely as purifiers of the berries, but that they had also a distinctly marked and beneficial effect upon the manipulative qualities of the dough made from such flour, and consequently facilitated the production of purer and better bread.

The scientific researches of our medical and botanical schools, and especially those dealing with bio-chemical problems have been of particular service in directing lines of thought in connecion with such matters as enzymic activity, catalytic effects, and the properties of colloids, all of which are in strong evidence in the manufacture of flour, and, particularly so in the preparatory stages, or wheat cleaning operations. This branch of the industry has become so important that the wheat cleaning and conditioning plant of a modern mill occupies almost as much space, and requires as much complicated and expensive machinery as that of the actual flour mill itself.

These additions and refinements are the outcome of an insistent, ever-present, and growing public demand for flour of better and purer quality, and they indicate with unmistakable emphasis and force that the daily experience of countless thousands proves the greater palatability, the more nutritious and satisfying qualities, and, consequently, the greater utility of well-milled white flour.

It is sometimes urged that white flour aids a tendency to constipation, and this as a result of the removal of the wheat germ and branny stocks that contain certain phosphorus compounds which, physiologically, exercise a distinctly laxative effect. This may be so in some few cases, but it is by no means the general experience, and it must be borne in mind that white bread owes its position to its superlative feeding quality. It is consumed as a food, and not taken in a medicinal sense.

The inclusion of low-grade and branny stocks adds materially to the acidity, the indigestible or waste matter, the mineral or ash content, the tendency to rancidity and the instability or poor keeping quality of the product. The latter feature is particularly noticeable under hot and humid conditions of storage such as appertain in closed freight cars and defective storage warehouses.

In the ordinary non-hysterical course of events we should seek to benefit by the experience of others, and to that end it may be well to mention that never was there a gastronomical research so vast and so full of lessons of the most vital importance as that afforded by the feeding of the eleven million people of Belgium and Northern France who have for nearly three years lived almost entirely upon bread.

It is stated that in certain sections, notably Antwerp and Brussels and vicinity, the people emphatically protested against "grey bread," and the quality of their flour was maintained on a basis of about 75 per cent. extraction. In other sections the protagonists of the whole wheat fallacy had their way, for a time, and 85 to 90 per cent. flour was the rule, although the people wisely protested." But, "last autumn there was a rude awakening from the theory that bread made from whole wheat flour is, for many people, more healthful than white bread." The teachings of the research schools had been completely ignored, and a as result it became necessary to institute a medical commission to enquire into the alarming condition of the public health. It was discovered that the children, naturally the first to feel the effects of the diet, were suffering from rickets, tuberculosis and childish diseases. The authorities pronounced the condition due to malnutrition resultant from an unsatifying, unnourishing ration, and it is now costing the Commission for Relief in Belgium $1,250,000 a month to repair the damage caused by a diet of "grey bread," and to save the children by feeding them an extra, specially prepared, ration abounding in necessary nutriment.

Vanilla Extract

The laboratory of the Inland Revenue Department of Canada has just issued a report on the results of analyses of 125 samples of vanilla extract, purchased in 1916. The results show that 53 samples were found to be genuine; 54 samples were sold as being artificial; 3 were doubtful; 3 were lost by breakage and 12 were adulterated, i.e., they were sold as being genuine vanilla bean extract but actually were artificial.

Universities and Chemical Research

Herbert Levinstein, Ph.D., M.Sc., in Manchester Guardian

It is perhaps opportune at this stage to examine the relationship of academic chemistry to industry, especially in regard to the manufacture of dyestuffs, with the object of ascertaining what kind of research can be carried on in university institutions with most profit to the country.

Classification of Research

In the first place, at least three different kinds of chemical research may be distinguished, viz.: (a) Pure scientific research, having no utilitarian object whatever but directed solely to widening the frontiers of human knowledge. (b) Scientific research into the fundamental principles or problems which underlie or condition industrial processes. (c) Technical research or investigations directed to obtaining immediate results of practical value, such as the improvement of processes or the manufacture of new and useful products, generally by the application of known principles.

Whilst there must be much overlapping between these different types of research their confines are in the main fairly distinct. Only in regard to the second type of investigations may misunderstanding arise, for while they may be regarded as "technical," since they have an ultimate utilitarian aim, they are more properly classified as "scientific research," since they are directed to increasing our knowledge of fundamental principles. In what follows the term "technical research" is used in the restricted sense for investigations of the third kind, and does not include those of the second. While research work of the first two types can be carried out with great advantage in university laboratories and should be encouraged in every way possible by scholarships and special grants from local funds, private munificence, and Government aid, this is not true of research of the third type, which can only be successfully carried on in laboratories directly attached to chemical works, where the investigations in progress can be brought into close and intimate touch with manufacturing conditions.

The case for a grant of public money to the universities for the purpose of technical research, which has frequently been advocated, is probably based on the following assumptions:

1. That there are a large number of young chemists at the universities who could, under the guidance of their professors, make important industrial discoveries, and whose work is now wasted.

2. That manufacturers in this country are apathetic, ignorant, and incapable of carrying out original investigation.

The Works Chemist

Although the shortcomings of British manufacturers in the past century cannot be denied, the conditions in recent years have largely changed. Even before the war there was no superabundance of young properly-trained chemists in this country. The contrary was in fact the case. There may have been apathy and ignorance on the part of some manufacturers with regard to the functions and uses of highly-trained chemists, though certainly the firm with which I am connected cannot be accused of these faults. For many years past we have found a great difficulty in getting chemists with the qualifications we require, men who, after taking their degree, have spent one or two years in carrying out research work in organic chemistry. Students with these qualifications have always been hard to get. There has never been a time in recent years when at Crumpsall we would not have been willing to engage any such young chemists of ability who applied to us. But they were not to be had. The universities did not produce them. It appears to me, therefore, that unless the universities can supply a sufficient number of highly-trained scientific workers, as it is their business to do, there is no point in asking them to carry out industrial work, which is the business of manufacturers. It cannot be maintained that research work of the technical kind cannot be effectively carried out in the works. Speaking of the place I know best, at Crumpsall we have for many years past carried on work of this kind, and have produced many new dyes which have come into quite general use. Indeed, it must be clear that without the capacity and equipment for technical research the Crumpsall works could not have withstood the fierce competition it had to face before the war from Germany. Since the war, of course, this department has been largely extended, and with a well-trained scientific staff under capable and energetic direction looks forward to a future of great usefulness and service. It is not necessary, as far as the Crumpsall works is concerned, to ask Government assistance in establishing a technical research department. It has already been done. But a strong case can be made for Government assistance for the further development of a department which has existed for years, which, in addition to published patents, has a large amount of unpublished and most valuable information in its archives, and has proved its value to the country at a time of national stress and difficulty. Such a department of industrial research for the dyestuff industry provides an outlet for a large number of trained university chemists, and will do much, if supported, to extend the study of chemical science at the universities and to promote scientific research in their laboratories.

There is a feeling among some of the most brilliant university professors that in the future they ought to be less academic in their teaching and research, and to contribute more directly than in the past to the progress of chemical industry. No one will welcome such co-operation more than the writer, nor will value more heartily the support of our distinguished leaders in pure science. On the other hand, it seems to me that the suggestion of directly endowing universities for technical research, in the narrow sense, rests largely on a misapprehension of the true functions of the university and of the relations that are desirable between the university and the manufacturer.

(Concluded in next issue)

Platinum

Fall in the World's Output

The London Times reports that the world's production of platinum has seriously decreased during the last three years, chiefly owing to the interrupted output of Russia, which formerly furnished 95 per cent. of the world's supplies. Russia's contribution is reported to have been last year only 86,000 oz., as against an average of nearly 300,000 oz. a year before the war. On the other hand, the output from the Republic of Colombia, the world's second largest producer of platinum, rose to 25,000 oz. last year from a former average of about 12,000 oz.

The United States produces platinum in California as a by-product in gold dredging, in Oregon from beach workings and hydraulic workings, in Nevada from the platinum-bearing gold ore of the Boss Mine, and also from the Rambler Mine in Wyoming. There is also a considerable production of platinum by refiners of copper matte and gold bullion, both imported and of home production, which amounted last year to over 2,500 oz. Platinum and palladium are recovered in the United States refineries from the nickel-copper matte imported from Sudbury, Ont. Deposits worthy of further study have quite recently been discovered in Spain. The Colombian deposits are at the headwaters of the San Juan river, which flows into the Pacific north of Buenaventura, and in the Upper Atrato river, flowing into the Caribbean Sea.

Further exploration of these localities is said to be worth consideration. In Minas Geraes, Brazil, small quantities of platinum have been produced, but no considerable platinum deposits are believed to exist. Iu South-East Borneo, however, the streams contain platinum, and there appears to be an opportunity for more detailed prospecting than has been done so far.

Occurrences of Platinum in the British Empire

Platinum occurs in several districts in New South Wales, but mining for this metal is relatively unimportant. The average production during the last five years has been about 400 oz. a year. The deposits are of comparatively recent discovery, and if the demand for the metal is maintained increased attention may be given to them. Small quantities of platinum have been produced in Gippsland, Victoria, but no production has been recorded recently.

In Canada last year the recovery of 23 oz. of platinum was recorded, but the output may have been considerably greater than that actually reported. There has been much activity in the Similkameen and Tulameen districts of British Columbia, which are the chief localities of platinum production in Canada. Small quantities have also been recovered in the past from the gold gravels of Quesnel division, Cariboo district, British Columbia. A few ounces of platinum a year are usually won by the Burma Gold Dredging Company at Myitkyina, Burma.

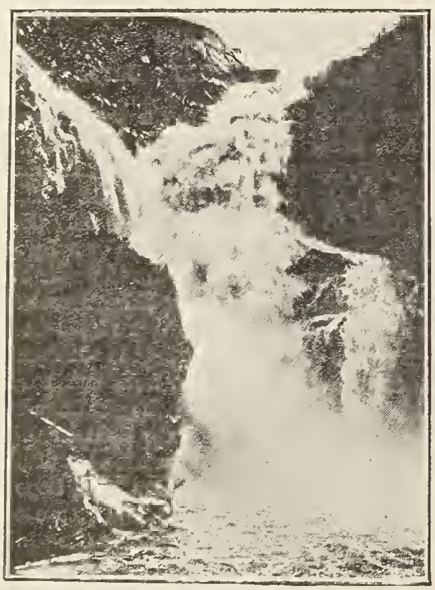
Water Powers of Canada

FOURTH ARTICLE

Province of Quebec

According to official estimates the known water powers of Canada amount to 17,000,000 horse power, of which 5,600,000 horse power are within the boundaries of the Province of Quebec. Of course, there are numbers of powers unmeasured in the unexplored districts of Northern Canada, of which Quebec has its share; and to the measured waterfalls much power may be added by regulation of flow and by storage reservoirs.

An example of storage works is the new dam on the St. Maurice River and costing $1,500,000, and enormously increasing the hydraulic power of the river by the flooding of 300 sq. miles of land, 240 miles north of the St. Lawrence.



Ouiatchouan Falls, Que.

In a report to the Water Powers Branch of the Department of the Interior, Ottawa, Mr. F. T. Kaelin, Assistant Chief Engineer of the Shawinigan Power Co. gives a sketch of the hydraulic powers of the province. These he divides into the powers of the Ottawa River District, those of the Montreal District, the Three Rivers District, The Quebec District, and those of the miscellaneous rivers north of the St. Lawrence.

In his sketch of the Ottawa District, Mr. Kaelin says: In the Ottawa District, where a portion of the Ottawa River and a number of its tributaries run their courses in this Province, there are many falls and rapids, most of which are still undeveloped. The Quinze River, which is eighteen miles in length, and really a portion of the Ottawa River, flows near the Cobalt mining district, and has its course broken by fifteen rapids from which its name is derived.

There is considerable demand for power in this region, and of the 90,000 available horse-power on the Quinze, none whatever is developed at the present time. There are also several valuable water-powers on the Kipewa River, which is a discharge of Lake Kipewa, where the Federal Government has already built storage dams affording regulation of the waters flowing from a watershed of over 2,000 square miles, thus making available some 50,000 horse-power on this river.

Many valuable power sites are to be found on the Ottawa River, from Lake Temiskaming to the City of Ottawa, most of which however are situated in inter-provincial waters, a fact which should not be an objection to their development in due time. Other powers of considerable capacity are situated in branch channels of the Ottawa, wholly in the Province of Quebec, north of Allumettes and Calumet Islands.

The Lievre River, one of the principal tributaries of the Ottawa River, has a drainage area of 4,000 square miles containing a number of great lakes, and has a series of falls and rapids. The total available horse-power is estimated at 85,000, of which less than 10,000 h.p. is developed to date

A still larger tributary of the Ottawa River is the Gatineau River, with a length of 225 miles and a drainage basin of 9,500 square miles. The Gatineau enters the Ottawa River at Ottawa, and its falls and rapids are capable of generating 225,000 h.p., none of which is utilized at present, although some developments are contemplated in the near future with a view to starting a pulp and paper industry, for which the locality is ideal.

Amongst other important tributaries of the Ottawa, may be mentioned the Coulonge River, with important falls only a few miles from the railway; the Rouge River and the Riviere du Nord, with already important industries utilizing water power. The Carillon Rapids on the Ottawa River, between Quebec and Ontario Provinces, is capable of developing 160,000 h.p. It is important on account of its proximity to Montreal. There are several smaller rivers in the Ottawa District whose falls and rapids could be turned to great industrial use. The three important storage dams already constructed at the headwaters of the Ottawa, and partly regulating the flow of the river, ought to be an important consideration for future developments on this river.

Montreal District

The Montreal District embraces that portion of the St. Lawrence and its tributaries on both shores between the Rivers Ottawa and St. Maurice. The only large water powers in this region are on the St. Lawrence, although there is considerable available power on various tributaries, some of which is already developed. The Cedars Rapids, situated about 35 miles from Montreal, on the St. Lawrence, and having a fall of thirty feet, are capable of generating a total of 160,000 horse-power. At present, developments are being carried out by the Cedars Rapids Manufacturing and Power Company, producing already 90,000 horse-power. The present installation comprises nine turbine units of the vertical type, each developing 10,000 h.p. of which 60,000 h.p. is being transmitted to Alumimum Works at Massena, and the remainder to Montreal.

On the opposite side of the St. Lawrence, the Canadian Light and Power Company's plant at St. Timothee is furnishing about 20,000 h.p. to Montreal mainly for the Tramways. This development when completed will consist of ten 5,000 K. W. generators, 50,000 in all.

A development on the Soulanges Canal, close to Cedars

Rapids, furnishes 13,000 h.p. for consumption in Montreal, in addition to sufficient power for lighting the canal and operating the locks.

The St. Lawrence River, between Lakes Saint Francois and Saint Louis, affords other power sites, but the need of protecting navigation and providing sufficient water therefor, renders their development a delicate problem to solve. One of the well-known solutions offered, is a diverting canal starting from Lake Saint Francois and carrying the waters to lake Saint Louis, thus obtaining a head of some 80 feet, with possibilities for over 100,000 horse-power.

Still nearer to Montreal, on the St. Lawrence, is Lachine, annually visited by thousands of tourists and pleasure seekers, for the purpose of shooting the rapids. The total horse-power of these rapids is estimated at 400,000, of which only a portion is available for development. There is an existing power plant on the Lachine Rapids which supplies 13,000 horse-power to Montreal, and another company has leased a part of the northern portion of the rapids, but the project is still in the preliminary stage.

At Chambly, on the south shore of the St. Lawrence, about sixteen miles from Montreal, there is a hydro-electric plant on the Richelieu River, providing Montreal with 20,000 h.p. for light and power purposes.

Numerous small developments near Montreal supply power for flour mills, rolling mills, textile and other factories.

Moreover, Montreal not only receives electrical energy from the afore-mentioned local points, but also from Shawinigan Falls, situated nearly 100 miles distant on the St. Maurice River, in the Three Rivers District, and at the present day, an aggregate of 126,000 h.p. is supplied to Montreal by falling waters from different plants.

Of the still available power around Montreal, 240,000 h.-p. can be easily developed as the demand arises.

In the more distant future, some of the falls and rapids which do not lend themselves to such easy development, may also be harnessed and turned to industrial uses.

Three Rivers District

Leaving Montreal, and following the St. Lawrence in an easterly direction for seventy-five miles, we arrive at the City of Three Rivers, where the St. Maurice River ends its course.

The St. Maurice has a length of 300 miles, and its drainage area, including many large lakes, totals 17,000 square miles. It flows through richly timbered areas, and an enormous amount of lumber is carried down by it annually to the pulp and paper and lumber mills upon its banks. Its course is broken by a dozen falls and rapids which will be capable of developing 650,000 h.p. when the upper St. Maurice dam, previously referred to, is completed. The most southerly water power on the St. Maurice is situated at Le Gres Falls, fifteen miles north of Three Rivers, where 60,000 h.p. is available, none of which is utilized at present.

Shawinigan Falls, twenty-one miles from Three Rivers, is the scene of the next hydro-electric plant on the river. This constitutes an ideal place for water power development, nature seeming to have intended it for that purpose. Not only is there an available high head and a large quantity of water with fairly constant flow, but the river widens into a lake just above the falls, and after making a sharp bend forms a second lake 145 feet below. This brings the upper and lower water-levels within a short distance of each other, thus providing an extemely economical location for the power plant at the bottom of the slope between them.

The entire water rights of Shawinigan Falls are owned by the Shawinigan Water and Power Company, which sells a portion of the water to local manufacturing concerns for their own use and operates its own large plant with the remainder. This plant is capable of generating 155,000 h.-p. Some of this power is used at Shawinigan Falls for the reduction of aluminum, magnesium and other metal products and for the manufacture of carbide, cotton and other goods, but the larger portion is transmitted to Montreal, Three Rivers and various smaller towns, factories and mines in the district.

The flourishing town of Shawinigan Falls, with a populaton of 8,000 to 10,000, owes its existence entirely to the presence of the hydro-electric power there. This town is served by both the Canadian Pacific and the Canadian Northern Railways, and with its abundance of water power, constitutes an ideal locality for the manufacture of products involving electro-chemical processes.

Situated twelve miles above Shawinigan Falls, on the St. Maurice, is Grand Mere Falls, with a head of 75 feet. This power site is controlled by the Laurentide Company, but when developments are complete the output of the generating plant will be far in excess of the power required by their paper mills. The available power at Grand Mere amounts to 100,000 h.p., all of which will be developed upon completion of extensions to the plant now under way.

About 103 miles from Three Rivers, on the St. Maurice, at La Tuque, there is a 70 foot water fall capable of generating over 75,000 h.p. The pulp mills at La Tuque are using 3,500 h.p., in the manufacture of Kraft pulp and turpentine, thus leaving over 70,000 still available.

There are a number of water powers on the St. Maurice north of La Tuque, which still belong to the Crown, and are available for future development.

Considering that all the large powers on the St. Maurice are within easy reach of Three Rivers, it is at once apparent what a unique location as regards manufacturing facilities is enjoyed by that city.

There are other important rivers discharging into the St. Lawrence in the vicinity of Three Rivers, namely, the St. Francois on the south shore; and the Maskinonge and Batiscan Rivers, on the north shore. The first rises in the hilly district of Beauce County, some 160 miles from its mouth, and drains an area of about 3,900 square miles. The storage dam at the head-waters, now being built by the Provincial Government, will greatly enhance the numerous water powers on this river, and thus be the cause of much improvement to the pulp and paper industries of the prosperous towns of East Angus, Sherbrooke, Windsor Mills and Drummondville.

The Batiscan river, with numerous undeveloped sites, is crossed by several railways which ought to facilitate the utilization of the water-power resources. The Grand Chute on this river has an available output of 5,000 horse-power, part of which is developed, supplying light to the City of Three Rivers.

Proceeding down the St. Lawrence below the Batiscan are found the St. Anne river, the Jacques Cartier and, close to Quebec, the Chaudiere. On all these rivers, important pulp and paper mills are established, and there are still numerous other falls awaiting utilization, details of which are not available.

City of Quebec District

Although a vast amount of water power is available in the region directly to the north of Quebec City, a comparatively small quantity only has been developed. The electrical supply for Quebec City is at present only partly obtained from a number of nearby small developments, mainly on the north shore of the St. Lawrence. The larger water powers in this district are practically to be found upon rivers flowing to or from Lake St, John, and especially upon the Saguenay which connects Lake St. John with the St. Lawrence.

On the south shore of the St. Lawrence River is the Chaudiere, with a drainage area of 2,500 square miles and discharging into the St. Lawrence a few miles above Quebec. It affords several important falls only partly developed; the Montmorency, with about 400 miles watershed, well known for its picturesque falls of 184 feet which supply some 4000 horse-power; and finally the Seven Falls of the lower St. Anne river, now being developed for a proposed output of 15,000 horse-power.

The junction of the Saguenay with Lake St. John is situated about 120 miles due north of Quebec City, which is connected with the various places on the shore of the Lake and the Saguenay, by the Quebec and Lake St. John Railway. This district is famous for the variety of sport in the nature of hunting, fishing and boating, which it has to offer, and is consequently scattered with a number of holiday resorts. Lake St. John has an area of 350 square miles and a tremendous volume of water flows therefrom, down the Saguenay.

The interval from the lake to what is properly the Saguenay river, is called Grand Discharge with a smaller stream known as little Discharge, which starts from the Lake and connects with the Grand Discharge, some nine miles down. The total height from the lake level to the head of the Saguenay, and the mouth of the Shipshaw river, i.e., to tide waters is, in round figures, 300 feet. All this head, with the necessary large capital expenditure that it would involve, could be developed in two sections; the first under a head of 100 feet, and a second under a 200 foot head. Such developments could produce a continuous supply of 300,000 horse-power, and with a comparatively small amount of storage in lake St. John, could more than double that output.

All the water rights were sold fifteen years ago by the Quebec Government at Grand Discharge, and a powerful company, known as the Quebec Development Company, is at present the owner. Development schemes have been under study for several years, and are likely to mature at an early date. The Government is taking a keen interest in the matter and proposes to co-operate with the company by facilitating the impound of water in Lake St. John with a view to regulating the flow.

In this district, other important falls are being utilized in the manufacture of pulp and paper namely on the Riviere au Sable and Chicoutimi river, both being discharges of Lake Kenogami. On the Shipshaw river, an interesting hydro-electric plant supplies power electrically to the Jonquiere pulp mills. Many other falls on the Shipshaw river (1,000 square miles watershed) are still in their natural state.

Returning now to Lake St. John, we find an abundance of power sites on both the large and small tributaries. These tributaries, in diminishing ratio, are the Grande Peribonka (12,000 square miles), the Mistassini (10,800 square miles), the Ashwapmuchuan (4,000 square miles),; then the lesser tributaries, the Metabetchouan, the Ouiatchouan, the Petite-Peribonka, etc. etc. The biggest falls on these rivers are seldom over 50 feet, being generally less, with the exception of the picturesque Ouiatchouan, 236 feet high, where a pulp mill is installed. The above mentioned falls, although not individually capable of as great power development as others better known in the Province, would nevertheless offer very good combinations. Undoubtedly, hundreds of thousands of horse-power await utilization within a radius of 25 miles from the lake.

It will now be apparent that a vast amount of power is obtainable in the Lake St. John region, most of which could be transmitted electrically to Quebec City, if desired, or used on the spot for electro-chemical processes and other purposes. This district is also richly timbered, and should prove attractive to those interested in the pulp and paper industry.

Miscellaneous Powers

On the north shore of the St. Lawrence, between the Saguenay and the Atlantic Ocean, the country is scattered with large water powers which, like the district itself, are entirely undeveloped.

The principal rivers in this region are the Hamilton, Netashkwan, Romaine, St. John, Manitou, Manikuagan, Outards, Bersimis and Portneuf, and the total amount of available power is well over a million horse-power.

Fast flowing rivers are comparatively scarce on the south shore of the St. Lawrence, the River du Loup, the Magdalen River, being the only ones east of Quebec with available water powers. The mouth of the River du Loup is almost opposite that of the Saguenay, and its Falls at Fraserville are capable of developing 3,500 h.p., of which 500 h.p. is at present utilized.

The Magdalen River, which joins the St. Lawrence much farther east, has a series of rapids and falls with an available power of 50,000 h.p., none of which is developed yet.

The remaining waters power of Quebec Province are scattered over the James Bay Slope, where such large rivers as the Harricanaw, Nottaway, Rupert and Eastmain run their courses. The available water power in this region is estimated at nearly a million horse-power.

Government Policy

There are various ways of improving the value of water powers not yet developed, and as such improvements are to the advantage of the country in general, the Government of the Province of Quebec has inaugurated a far reaching policy promoting the conservation of water powers.

Among the most necessary steps to enhance the value of our water powers, may be mentioned:—

1. A more complete and reliable measurement of the flow of our rivers and streams at the different periods of the year.

2. The establishment of more meteorological observation stations which would give us a better idea of the precipitation in different parts of the country, and therefore the quantities of run-off.

3. The survey of water powers and possible storage reservoirs and the preparation of profiles of the water courses. Where a number of small water powers exist on the same river, their consolidation should be encouraged as much as possible, to ensure a development capable of utilizing all the available power. In this way each power plant would be able to generate as far as is practicable all the power available on that portion of the river between itself and that plant above it. If Companies select their own power sites without having due consideration for the future, much power may be rendered unavailable for other generations, whilst they themselves are not materially benefitted.

Future Uses Of Power

The enormous amount of undeveloped water power in the Province of Quebec arouses conjecture as to how this power will be used in the future.

It is evident that some water powers are more suitable than others for certain purposes, hence it is obvious that water powers within 200 miles of the larger cities and the St. Lawrence River will be used mainly by the rapidly growing manufacturing industries, for the production of light and heat, and the electrification of steam railways.

Electro-chemical and thermo-electric processes for the production and refining of various metals, such as aluminum, magnesium, the various steel alloys, carbide, potash, cyanides, etc., constitute another extensive field for the use of our water powers.

One of the most important future uses will be the production of nitrogenous products, so essential to the fertilization of our food lands.

When the soil in the great prairies of the West has become impoverished, the greatly increased population will still depend upon the continuance of food-producing qualities of the soil. and artificial fertilizers will become essential, it is then that our enormous water powers away near James Bay and Labrador, will prove a never-failing source of elements necessary for the replenishment of the soil, and in reality it is on our water powers that future generations will largely depend for their food supply.

The British Ministry of Reconstruction has decided to act in close cooperation with a committee of the chemical industry in the solution of the serious problems which must be associated with the change over from war to peace trading conditions.

The Nitrogen Industry and Its Prospects

Summary of a Report to the U.S. War Department on the Nitrogen Industry with Recommendations

By Charles L. Parsons, Chief Chemist Bureau of Mines, U.S. Department of the Interior

I have made a very careful study of the processes used throughout the world for the production of nitric acid, and, in the employ of the War Department, I have made a trip to Italy, France, England, Norway and Sweden, visiting many plants producing nitric acid. I have had conferences with leading engineers in those countries on the situation. It will require some weeks still to make my complete report, with full detailed estimates and costs, on the various processes employed as applied to American conditions, but the details of these processes are now sufficiently in hand to warrant formulating my conclusions as to the proper procedure to be followed.

The conclusions are based on the maximum requirements for munitions purposes of the United States Government of:

In time of peace.......... 20,000 tons of nitric acid
In time of War........... 180,000 tons of nitric acid.

With these quantities as a maximum and a sufficient supply of sodium nitrate in storage to meet the requirements of the Government for a period of six months to one year, no serious emergency problem confronts the Government. The increase in the output of ammonia from by-product coal since 1915, if oxidized to nitric acid, is alone more than sufficient to meet this requirement. The oxidation of ammonia, including that produced from the destructive distillation of coal, presents no serious difficulties, and the necessary plants using the emergency procedure adopted in Germany could, in case of need, be quickly installed to meet the Government requirements. Such installation would involve much cruder procedure, such as lower efficiency of oxidation and absorption of the nitrous oxides in soda lye, than would be adopted after careful experimentation and experience in the operation of the most efficient plants, but it would nevertheless furnish the country with the nitric acid required.

In my opinion the following methods include the only ones which need to be considered in the final choice of the procedure to be employed by the Government in providing a source of nitrate supply. There are many other proposed methods, modification of methods, and investigations under way, but they have proved either inapplicable when tried industrially or they have not been sufficiently tried on a practical scale to warrant the Government in considering them in this first analysis. Some of them may later be successfully developed and research on the fixation of nitrogen should be continuously carried on under Government auspices.

Following are the methods considered herein:

I. Nitric acid may be obtained directly from the air, with no raw material except that contained therein by directly burning the nitrogen and oxygen of the atmosphere by means of the electric arc.

II. Nitric acid may be obtained from the oxidation of ammonia.

The processes to be considered are:

(a) Arc process in which nitrogen and oxygen are directly burned to nitric oxide under the influence of the electric arc.

(b) Haber process, in which nitrogen and hydrogen are directly combined to form ammonia.

(c) Cyanamid process, in which carbon, and lime are first heated in an electric furnace to form calcium carbide. The carbide is then treated with pure nitrogen to form cyanamid, and, in turn, the cyanamid is hydrolyzed by steam in special autoclaves to produce ammonia.

(d) By-product ammonia, obtained as a by-product in so-called by-product coke ovens by the destructive distillation of bituminous coal.

(e) Cyanide process, not yet commercially developed but carrying great promise of cheap combined nitrogen. This process embraces the direct combination of nitrogen, carbon, and sodium to form sodium cyanide by heating together an intimate mixture of carbon, soda ash, and nitrogen in the presence of finely divided iron.

All of the processes producing ammonia involve the further oxidation of that ammonia to nitric acid. The ammonia may be oxidized by means of heated (electrically or otherwise) platinum by presenting as large a surface as possible of glowing platinum to the proper mixture of ammonia and air, under which conditions the nitrogen in the ammonia burns to nitric oxide. The methods to be considered for the oxidation of ammonia are:

(a) Ostwald-Barton method, now used in France and England; and probably also in Germany.

(b) Frank Caro method, now used to produce 100,000 tons of concentrated nitric acid in Germany, and experimentally installed with modifications in two small plants in this country.

(c) The oxidation in solution of ammonia or dicyanamid to ammonium nitrate, as yet carried out only in an experimental installation in Sweden, and being installed in two plants now in process of erection—one near Goteberg, Sweden, and the other and larger plant near Berlin, Germany.

The Arc Process

The arc process was the first commercial process to be developed for the fixation of nitrogen. It is now installed in southern Norway, employing 250,000 kilowatts of electricity developed from the cheapest large installation of hydroelectric power in the world. This is the only large installation of the arc process, but small installations of an experimental nature have been made in other countries.

By the arc process, nitric acid is produced by the direct combination of the oxygen and the nitrogen of the air to form a dilute gaseous mixture of nitric oxides with air. The nitric oxide is converted into nitric dioxide and is absorbed in water in immense granite towers to form nitric acid. The method is one of the most inefficient known as regards production in relation to power consumed. Nevertheless, on account of the very cheap horse power available in Norway and the fact that the raw materials cost nothing and are always at hand, nitric acid can there be produced by the arc process at a cost less than by any other commercial process.

Incidental to the production of nitric acid, a large excess of heat is developed, which can be, and is in part, converted into steam, which may be, and is, used for concentrating the weak nitric acid obtained in the absorption towers to the strong acid required for munition works. The excess of steam is so large that many other methods for its application have also been devised. As the labor costs also are low, when once under way the operation goes on almost automatically. As the formation of nitric acid is direct and involves only the nitrogen and oxygen of the air and water as raw materials, no complicated processes involving intermediate products are necessary, as is more or less the case with all other processes.

In spite of these manifest advantages, however, it appears to be the general opinion of the European engineers with whom I came in contact that even with the cheap horse power enjoyed by the Norwegian plants, they might have had to discontinue their operations except for the stimulus given by the present European war. Even as it is, the Norsk Hydro Company, operating the arc plants at Nottodden and Rjukan, has been obliged to install large ammonia-producing plants in order that they might convert their nitric acid to ammonium nitrate and thus render it transportable to markets where it was needed.

The cost of horse power used for the production of nitric acid in Norway is less than $5.00 per horse-power year. The best estimates in my possession indicate that with horse power at $10 per horse-power year, the cost of finished strong nitric acid at the plant would be as cheap as by any other process now in operation. However, the low cost of producing nitric acid by the arc process is outweighed by so many other disadvantages that, in my opinion, the process is entirely inapplicable to the uses of the United States Government, and this opinion appears to be shared by all who have given careful thought to the subject. The cost of installing the Arc process is high and it involves the use of an amount of horse power that seemingly is not available on the American continent within reach of the points where the nitric acid would have to be used.

Nitric acid is not economically transportable. As strong nitric acid it can be transported only if tank cars made of aluminum can be obtained, and aluminum is a metal that, for this purpose, has many disadvantages besides cost. The nitric acid might be transported mixed with sulfuric acid in iron tank cars, but this involves th e erection of large sulfuric acid factories near to the nitric acid plant and a large addition in freight rates. Freight rates on such nitric acid as is transported are very high and must always remain high on account of the dangers involved.

Nitric acid does not readily lend itself to the production of fertilizer material, although it may be neutralized with lime to form calcium nitrate or with ammonia to form ammonium nitrate—both of which may be transported and either of which might be used as a fertilizer. However, calcium nitrate and ammonium nitrate are not applicable to the manufacture of the mixed fertilizers that are demanded by the American farmers.

The great difficulty that has faced the Norwegian plants from the beginning, namely, a market for their products, would in peace times be a serious obsticle to the operation of a large arc plant in the United States. An arc plant at its best involves the use of 2.33 horse-power years per ton of weak nitric acid. This means that a water power development of at least 50,000 horse power would be necessary for the peace requirements of the Government, and a development of 440,000 horse power would be required for war purposes. These figures are minimum figures on the basis of the relatively high efficiency reached in Norway. No installation should be considered by the Government of less than 75,000 horse power for peace requirements or 550,000 horse power for war requirements. If the Arc process is to be used it would be advisable to arrange for the production of explosives at the point where the arc plant was located. This would of course involve the transportation of all other raw materials needed, such as benzol, toluol, alcohol, acetone, glycerine, sulfuric acid, cotton, and other materials too numerous to mention, to the plant and the transportation of the finished explosives therefrom to the place of consumption. As these materials are highly combustible and for the most part carry high, freight rates, it has been found necessary the world over to locate the plants intended for the production of munitions near to the point where the munitions are likely to be consumed.

An arc plant of sufficient size to meet the requirements of the Government in time of war would probably have to remain idle for the main part during times of peace, owing to the difficulty of disposing of the nitric acid that the plant would produce if in operation. On account of the large amount of horse power required and the consequent extent of the necessary plant and tower absorption capacity, the cost of installing an arc plant to meet the war time requirements of the Government would be several times the total appropriation made for the purpose by Congress.

Advantages

1. Cheapest cost of nitric acid if power can be obtained at $10 per horse power year or less, and if the power is efficiently utilized in a large plant run continuously to capacity.

2. Large amount of waste heat available for producing steam for the concentration of nitric acid and for other purposes.

3. Free raw material.

4. Direct production of nitric acid without intermediate products.

5. Small amount of labor involved.

Disadvantages

1. Large amount of horse power required per ton of nitric acid—at least 500,000 horse power for the Government requirements.

2. Greater dilution of nitric acid when first produced—30 to 35 per cent. acid as against 50 to 55 per cent. acid by other processes.

3. Large cost of installation both for horse power and for plant—probably four times the present Government appropriation to meet the Government's war time requirements.

4. Three-fourths of plant probably idle in time of peace, with consequent large idle investment involved.

5. Nontransportability of the nitric acid produced.

6. Difficulties of disposing of the nitric acid not needed for munitions.

Haber Process

The Haber process is the chief process now used in Germany for the production of ammonia. Ammonia may be oxidized to nitric acid. The process has grown very rapidly in the last three years. It was first commercially installed in Germany in 1913 with a plant capacity of 30,000 tons of ammonium sulfate. Seemingly, it actually produced in that year some 20,000 tons of ammonium sulfate. This grew to 60,000 tons in 1914; 150,000 tons in 1915; and 300,000 tons in 1916, and it is authoratively stated that with new works now under construction by the Badische Company, the 1917 output of ammonia by the Haber process will be equivalent to over 500,000 tons of ammonium sulfate.

The Badische Company, which owns the Haber plants and process, has developed the industry without government aid other than the sale of its product, and appears to be very certain as to the ability of this process to compete, when the war is over, with all other processes for the fixation of nitrogen and also with Chile saltpeter in the fertilizer markets. On the other hand, the cyanamid industry in Germany has been developed during the war with the aid of government subsidies. The Badische Company had developed in Germany an arc process known as the Schoenherr process which is a close competitor of the Birkeland-Eyde process developed in Norway. The Badische Company and the Norsk Hydro Company pooled their interests and the Schoenherr process was installed, together with the Birkeland-Eyde process, at Rjukan, Norway. The two are now working together side by side in Rjukan, and are owned by the Norsk Hydro Company—the Badische Company having sold their interests in the arc process as soon as they had developed the Haber process.

By the Haber process, nitrogen from the air and hydrogen obtained from water are directly combined to form ammonia under the influence of finely divided iron. The production and purification of hydrogen made either by the reducing action of coal or iron upon steam involves one of the chief items of cost in the Haber process. The fact that the combination of nitrogen and hydrogen takes place at temperatures above 500° C., and at pressures of 125 to 150 atmospheres involves some danger and many other technical difficulties which have, however, seemingly been overcome in Germany. The technical control of the Haber process is of such great importance and requires so high a degree of training and skill that it is reported if the Badische people were to lose their present technical staff of experts, familiar with the process, many months would be required to train another staff capable of applying the process in practice.

The Haber process is not at present in use outside of Germany on account of the lack of detailed information regarding plant construction and operation and also owing to the very large royalty demanded by the Badische Company for its use by other concerns. It is, however, more than probable that the Badische Company will itself install and develop the process outside of Germany when the war is ended.

Trustworthy information regarding the costs of production of ammonia by the Haber process indicates that pure anhydrous ammonia can be produced in liquid condition for a cost slightly less than 4 cents per pound. It is improbable that any arrangement could be made for the United States Government to use the Haber process pending the conclusion of the European war. It is probable that when the war is ended, the Haber process will be installed or will be available for installation in the United States. It is the cheapest process for the production of synthetic ammonia. It is independent of cheap power—the power being a small fraction of its cost. If desirable, it could be readily installed in moderate sized units in connection with ammonia oxidizing plants at any munitions plant.

Advantages

1. Cheap ammonia.
2. Ammonia in water-free liquid condition ready for immediate oxidation without purification.
3. Availability of raw material (air, water, and coal).
4. Possibility of erecting comparatively small plants wherever needed.
5. Easy availability of product for transportation and for fertilizer.

DISADVANTAGES

1. Inability to procure technical details, use of method, and trained technical force without the assistance of the Badische Company, except as the result of many months and probably years of experimentation. This is largely owing to the difficult engineering problems involved in the use of pressures as high as 150 atmospheres and temperatures of 500° to 600° C.
2. High repair and renewal costs.
3. Undoubtedly high royalty that would be demanded if the Government were to install and operate this process itself. Inability to come to terms with the Badische Company as to the use of its patents is reported to have been the sole reason for the non-adoption of this method by two large American corporations and one Norwegian corporation.
4. Patents and processes controlled in America by one corporation.

Cyanamid Process

The Cyanamid process has been developed in many parts of Europe, but in the Western Hemisphere only at Niagara Falls, Ont. It requires cheap power for its successful operation and has obtained its greatest development owing to the fact that it requires only about one-fifth the horse power per ton of fixed nitrogen per year that is required by the arc process. In other words, from a definite horse power installation the Cyanamid process produces about five times the amount of combined nitrogen that is produced by means of the arc process.

The raw materials required are coal for lime burning, anthracite coal or coke for the production of calcium carbide, limestone essentially free from magnesia, fluorspar, and nitrogen obtained from liquid air. The process involves:

First, the production of calcium carbide in a large electric furnace from lime and coke or anthracite coal.

Second, the fine grinding of this calcium carbide out of contact with air, and the heating of a portion of the ground mass to a red heat to start the absorption of the nitrogen which is then added, as long as it is taken up by the carbide, to form cyanamid. The cyanamid is in turn ground and given a special treatment to remove acetylene gas in order to avoid explosions later. The cyanamid, mixed with sodium carbonate and lime, is then treated with steam in large autoclaves to convert the nitrogen of the cyanamid into ammonia gas. The process will thus be seen to involve a number of steps and to be somewhat complicated.

$$CaO+3C=CaC_2+CO$$
$$CaC_2+N_2=CaCN_2+C$$
$$CaCN_2+3H_2O=2NH_3+CaCO_3$$

The cost of ammonia from cyanamid, with power at $8 per horse-power year in a plant to be constructed by the Government would cost 1 to 2 cents per pound more than by the Haber process. On the other hand, royalties for using the Cyanamid process would undoubtedly be less. The technical problems involved are understood by many engineers both in this country and abroad, the manufacture of calcium carbide and cyanamid being established in many plants, and the basic patents having only some four years to run. Peculiarly favorable conditions exist for its installation in certain sections of the South. If a hydro electric plant is to be installed by the United States Government, and the electrical power so developed must be used for the fixation of nitrogen, the cyanamid process has advantages over all other processes now developed and should be adopted as the best means of utilizing hydro-electric power for the fixation of nitrogen.

In Germany in 1913 there were produced 30,000 tons of cyanamid. The growth has not been so rapid as in the case of the Haber process although the process has been subsidized by the German Government to assist in its development. However, the 1917 German production will be not far from 400,000 tons. The cyanamid interests in Germany have also endeavored to induce the German Government to establish a nitrogen monopoly which will insure the continuation of the cyanamid industry in Germany in competition with the Haber process and ammonium sulfate from coke ovens after the war. The German nitrate monopoly has not been established by the Reichstag chiefly owing to the opposition of the owners of the Haber patents.

Ground cyanamid is a very dusty, disagreeable product and in order to be used for fertilizer has to be treated with oil or by a special granulating process that controls the dust and enables the material to be more successfully used as a fertilizer. Cyanamid should be and probably is an excellent fertilizer if applied directly to the soil. It has not, however, found favor with American fertilizer manufacturers and is not well suited as an addition to the mixed fertilizer demanded by American farmers. It is, however, successfully used in Europe where much cheaper labor enables the farmer to spread his fertilizer, if desirable, one constituent at a time. To meet the Government's requirements of 20,000 tons and 180,000 tons of nitric acid, through the medium of cyanamid, would require the continuous use of 11,000 horse power and 99,000 horse power, respectively.

If cyanamid is to be converted into the most popular form of fertilizer material, namely, ammonium sulfate, it would cost approximately 1 cent per pound to convert the nitrogen present into the form of ammonia before it could be absorbed to form sulfate. It is the necessity of converting the combined nitrogen into ammonia, if the cyanamid process is used as a source of nitric acid, that makes up a considerable portion of the difference in cost between cyanamid ammonia and Haber ammonia.

ADVANTAGES

1. Most available method if hydro electric power is to be used.
2. Moderate horse power requirements.
3. Ready transportability.
4. Product salable in time of peace for fertilizer.

DISADVANTAGES

1. Number of operations and plant installations required to produce nitric acid, viz., carbide, cyanamid, ammonia from cyanamid, ammonia oxidation, and nitric acid concentration.
2. Patents and processes controlled in America by one corporation.
3. Process an extremely dusty and disagreeable one, involving unpleasant conditions, if not hardships, on the labor.

4. Large labor factor involved.
5. Comparatively high cost.

By-Product Ammonia

The nitrogen stored up through the medium of plant life of past ages as a constituent of bituminous coal is in part recovered as ammonia when bituminous coal is converted in by-product ovens into coke. This source of ammonia is to-day the chief source of combined nitrogen in all countries, including Germany. Ammonia produced by the destructive distillation of coal when pure is the same as any other ammonia and can be readily oxidized to nitric acid.

The recovery and utilization of ammonia in by-product coal has been recognized by economists for decades to be one of the most important developments for conserving the wealth of the nation. In Germany two-fifths of the coal used is carbonized in by-product coke ovens, and all of the coke produced is produced in plants fitted for the recovery of by-products including ammonia. In this country less than one-tenth of the bituminous coal burned is coked in by-product ovens. Of the coke produced in America, over one-half is still produced in bee-hive ovens in which the gas, ammonia, and all other by-products are ruthlessly destroyed. There has been nevertheless a rapid increase in the installation and operation of by-product ovens and an increase in ammonia production that would not have been thought possible two years ago. By the end of the present year, we will be producing at least 116,000 tons of ammonia per annum—an equivalent of 450,000 tons of ammonium sulfate. Six thousand tons of this ammonia in time of peace, or 55,000 tons in time of war, would meet the Nation's requirements of nitric acid for military purposes, as estimated by the War Department. The growth of our ammonia production from by-product coke has been extremely rapid and is still on the increase. More than fifty million dollars worth of by-product coke ovens have been contracted for within the past twelve or thirteen months and are now completed or in process of erection.

The installation of the by-product coke process means a larger supply not only of ammonia but also of benzol, toluol, phenol, naphthalene, and other products absolutely essential for munitions purposes and required in time of peace for our present and future dyestuffs industry. Benzol, toluol, and phenol are only secondary in importance to an ample supply of nitric acid for war purposes.

The use of the by-product coke process also means the production of large quantities of gas for power purposes. Indeed, if the destructive distillation of coal is conducted in special producer gas ovens the output of ammonia can be increased five- to six-fold, and power comparable with cheap hydroelectric power can be obtained at the same time. This method is now utilized in Germany on an immense scale for producing cheap power and increased ammonia output.

That bituminous coal used should be treated in by-product ovens is recognized the world over. It is becoming increasingly practicable to do this, and the consumption of coke for domestic purposes as well as for the production of iron and steel is rapidly increasing. The general use of coke instead of coal throughout the country would do away with the smoke nuisance and all of its concomitant loss to property. It would produce, besides other by-products, approximately 1,000,000 tons of ammonia in this country alone. The day is far off before this highly desirable result will be reached, but it should none the less be striven for. Already legislation abroad requires the use of coke instead of bituminous coal for certain industrial purposes. By-product coke ovens, however, cannot be installed by the United States Government for the purpose of producing ammonia. The ammonia should be simply a by-product incidental to the production of coke for industrial purposes. Under war conditions, however, the output of ammonia from by-product coke vens could, by Government regulation, be greatly increased. his has been accomplished in Germany, the by-product coke ovens furnishing Germany to-day with over one-third of the nitrogen consumed in that country. Germany has had an increase from 100,000 tons to 154,000 tons nitrogen from this source since the war began. The possibilities for an increase in America are much greater than in Germany.

Ammonia from by-product ovens has to be purified before it can be oxidized for nitric acid. The eost of purification is, however, very small and, where purification apparatus is installed at the original ammonia absorption plant, adds but a small fraction of a cent a pound to the cost of crude ammonia liquor.

The use of by-product ammonia for the production of nitric acid for munitions purposes has the great advantage that it is already available and that the plants, being situated in numerous parts of the country, could furnish ammonia to several small oxidizing plants. Accordingly, the country's source of munitions supply would not be at any one place and subject to capture and destruction.

The use of by-product ammonia has the great disadvantage that the present selling price of ammonia from by-product coke is high and, unless considerable price concessions could be obtained by the Government, it could not afford to utilize this source of raw material for nitric acid. The actual cost of pure ammonia, considered as a by-product from the coking of bituminous coal, is much less than by any other method now producing this substance.

Cyanide Process

The Cyanide process is not yet a commercial success and for that reason alone perhaps should not be included here. It has, however, such possibilities that I feel called upon to discuss it.

From a chemist's standpoint the process is to-day a success. There is no difficulty whatever in the chemical relations. When sodium carbonate, ground coke, or carbon in any form in eontact with finely divided iron are heated to redness and nitrogen or even air passed through the mass, nitrogen in quantity is fixed as sodium cyanide. The reaction takes place readily. No power factor of any consequence is involved and it appears certain that if the mechanical difficulties are solved, nitrogen will be fixed in this form cheaper than by any other known synthetic process.

There are also large quantities of waste nitrogen available in connection with the sodium carbonate plants of the country where the sodium carbonate required would also be available, and there are large amounts of nitrogen that could be obtained without cost in a sufficiently pure condition at the wood-pulp plants using the sulfite process.

When the sodium cyanide is once formed it can be readily converted into ammonia as is the case with eyanamid, but the process has the advantage that in the conversion the sodium carbonate can be recovered to be used over again. The iron ean also be repeatedly used in the process. Small installations are now working successfully in the country but the mechanical difficulties of production on a large scale are yet to be solved. Four large American corporations are engaged on the problem with ample funds for its solution.

The process has the further advantage that it would also make eheaply available cyanide which is so greatly needed by our mining industries.

Nitric Acid from Ammonia

All processes for the synthetic production of nitric acid, except the Arc process, involve the oxidation of ammonia. The processes commercially in use involve the direct oxidation of ammonia gas in the presence of air in contact with metallie platinum. In Germany, according to the latest published figures, approximately 100,000 tons of nitric acid are annually produced through the Frank Caro process, which involves passing mixtures of ammonia and air through electrically heated platinum nets of 80 to 100 mesh. The platinum is heated to a dull red heat and serves as catalytic agent under whose influence the ammonia, instead of burning to nitrogen and water, as normally would be the case, causes the nitrogen to form nitric oxide.

In the Kaiser process, also used in Germany, the air is heated before its mixture with the ammonia, and under these conditions it is claimed that no electric heating of the platinum net is necessary. The Kaiser process does not appear to have reached any large commercial development.

The Landis process installed in a small experimental plant at Warners, N.J., passes the gas downward through the net instead of upward, as is customary in the Frank Caro process, and, according to the Landis patents, cools the gases before they are allowed to come in contact with the net instead of heating them as is done in the Kaiser process. The platinum net process is also understood to be installed in a small plant in Long Island City and is being installed in Syracuse, N.Y., by the Semet-Solvay Company in co-operation with the Bureau of Mines.

The Ostwald-Barton process first developed at Villevord, Belgium, and brought there to a commercial success at the time of the opening of the war, is now installed in two large plants—one at Angouleme, France, and the other at Dagenham, England.

The principle of the process is essentially that originally patented by Ostwald, but the catalyzer is distinctly different from that used by him although it consists of metallic platinum. The details of the preparation of this catalyzer are kept secret, but it is known to have a very small cross-section and is placed at the end of a 60-mm. tube so that the products of combustion passing through the tube heat the mixed ammonia and air by radiation as they approach the catalyzer. By this means no external heat is necessary. The reaction when once started continues without interruption for weeks. It is simply necessary, by means of blowers, to force the mixture of ammonia and air through the catalyzer.

The present commercial efficiency and output by the Ostwald-Barton process is higher than by any other concerning which exact figures have been obtained. It is higher than the published figures for the Frank Caro process, but as figures for that process have been published only on a minimum basis, it is impossible to state whether as high an efficiency of conversion and capacity of catalyzer has been reached by that process as by the Ostwald-Barton.

The process for the oxidation of ammonia are seemingly free from any complicated patent situation. The Europeans engaged in ammonia oxidation admit freely that they have no important patent rights to sell, but they claim that they have plans, specifications, and details of processes, the purchase of which would be cheaper than the necessary experimentation to work out the details.

By the oxidation of ammonia, nitric oxide gases are obtained of much higher concentration than those produced by the Arc process. Accordingly, much less tower space is necessary for their absorption and much stronger acids can be directly obtained by concentration. Although in the Arc process the concentration of 30 to 35 per cent. nitric acid to strong acid is required, in the oxidation process an acid of 50 to 55 per cent. strength is easily obtained directly from the towers, and the concentration thereof is accordingly a simpler matter.

Oxidation of Ammonia in Solution

A method has been developed in Sweden, details of which are unknown, for the oxidation of ammonia or cyanamid direct to ammonium nitrate in solution. The ammonium nitrate can then be easily concentrated by evaporation and can be converted to nitric acid if desired. The process seems worthy of very careful consideration and will be in commercial operation this coming summer—a plant being now in process of erection near Gothenburg, Sweden. A second and much larger plant is also being erected near Berlin, Germany.

As cyanamid is not necessarily converted into ammonia, as any form of ammonia, such as Haber or coal-tar ammonia, can be directly used, and as no heating of any kind is required, it is claimed that this process will produce ammonium nitrate much cheaper than any other. It is particularly important because nitrate itself is becoming one of the most important of all explosives, and the many complicated reactions necessary for its manufacture would be avoided if this process becomes a commercial success, as the engineers engaged in its exploitation confidently expect. The fact that the German engineers have seen fit to install a large plant near Berlin speaks well for the probability of its successful application.

The Nitrogen Situation

Without going into full details of the nitrogen situation in this preliminary report, a short summary of some of its most important features appears to be desirable. The subject will be treated at greater length and with definite data in the final report.

The present conditions are, of course, abnormal. Importations of sodium nitrate into Germany have been entirely cut off, and Germany consumed a large fraction of the output of the Chile mines before the war. The importations of sodium nitrate into the United States have doubled, owing to the tremendous amount of munitions being manufactured for export. The importations of sodium nitrate into the allied countries have also greatly increased, owing to war demands. The production of synthetic nitrogen in Germany and the increase in the production of by-product nitrogen in Germany have much more than offset the lack of Chilean importations. The following summary of conditions in Germany, taken from the Frankfurter Handelsblatt of May 29, 1916, is significant.

German Consumption of Nitrogen, 1915, in Metric Tons

	Tons	equal Metric Tons	
Sulfate of Ammonia	460,000	92,000	Nitrogen
Norwegian Nitrate of Lime	35,000	4,500	"
Cyanamid	30,000	6,000	"
Ammonia—Haber Process	20,000	4,000	"
Total		106,500	"
plus Nitrate of Soda	750,000	116,000	"
Grand Total		222,500	"
Grand Total in tons of 2,000 lbs.		245,000	"

German Production of Nitrogen, 1917, in Metric Tons

	Tons	equal Metric Tons	
Sulfate of Ammonia	700,000	140,000	Nitrogen
Norwegian Nitrate of Lime	......	......	
Cyanamid	400,000	80,000	"
Ammonia—Haber Process	500,000	100,000	"
Total		320,000	Nitrogen
Total in tons of 2,000 lbs.		352,000	
Nitrate of Soda		None.	

In spite of having more than half of her nitrogen supplies cut off by the war, Germany has greatly increased her nitrogen output, increasing her own production of nitrate resources from 116,000 short tons to 352,000 short tons of nitrogen. This has been made necessary not simply or chiefly for war munitions but largely for agricultural needs, Germany's population being dependent now on its own food supplies which in turn are greatly increased by nitrogenous fertilizer.

Conditions in the United States in case of war which cuts us off from foreign countries would be far different. We are a food-exporting country and the larger part of our fertilizer is used on the cotton crop, the growth and exportation of which would be greatly curtailed. A comparatively small part of our fertilizer requirements are used on food crops, and being a food- and cotton-exporting nation our nitrogen requirements for agricultural purposes would largely decrease instead of increase. Even in the case of the present war, which has increased foodstuffs exportation but decreased cotton production, the fertilizer consumption of the country has decreased rather than increased. This would be much more the case if our people were cut off entirely from food and cotton exportation.

In view of the fact that Germany has invested millions of dollars in synthetic nitrogen which will continue to produce synthetic nitrogen after the war; that Germany is producing more than twice the amount of combined nitrogen that she formerly imported in the form of Chilean saltpeter; that accordingly the German market for Chilean saltpeter will be essentially non-existent after the war; that the present large American and allied consumption for munitions will cease; and that during the war the American production of ammonia from by-product coke ovens has increased to a point in excess of our apparent normal consumption, it seems certain that the price of combined nitrogen for industrial and agricultural purposes must greatly decrease when the war is over. This, I think, is recognized and expected by all of those engaged in the production of combined nitrogen.

In view of the facts above enumerated, it is evident at once that the peace time requirements of the Government for nitric acid could be supplied from coal-tar ammonia with little effect on the market for the material and practically no effect on the country's nitrogen resources. It seems equally certain that in the case of such a war by-product ammonia could furnish 180,000 tons of nitric acid per year for at least one or two years without seriously affecting the nation's agriculture. This is particularly important when it is remembered that over 60 per cent. of the nitrogenous material used in fertilizer, consisting of organic nitrogen from cottonseed meal, tankage, dried blood, etc., would not be decreased at all but would rather be increased through the cutting off of exports of cottonseed meal.

Furthermore, it is well known that several of our largest corporations are engaged in active plans for installing synthetic nitrogen plants of various kinds to meet their own industrial requirements and that in all probability the Haber process will enter into active industrial competition for our ammonia markets in American plants as soon as the war is over. Plants for the oxidation of ammonia can be quickly erected in crude form as they were erected and utilized in Germany, should the need arise.

I accordingly feel that no serious emergency problem confronts the United States that could not be met with reasonable celerity in time of war, and that our first problem, after securing a reasonable reserve of Chilean saltpeter, is to familiarize ourselves with the most efficient method for the oxidation of ammonia and to train the necessary men to construct and operate ammonia oxidation plants.

Cost of Nitric Acid

The cost of nitric acid, per se, whether as weak nitric acid or as concentrated nitric acid, is lowest by the arc process with hydro-electric power delivered to the furnace at a cost of $10 per horse power year, or less. The difficulties of its transportation, the large amount of power required, and other economic reasons, as already explained, make the arc process inapplicable to American conditions.

The cost of nitric acid obtained by the oxidation of pure ammonia is independent of the source of the ammonia and must therefore depend upon the cost of ammonia gas in the gas holders ready to be passed to the oxidizing apparatus.

Cost of Ammonia

The cost of ammonia has at the present time no relation to its selling price. The actual cost of collecting, absorbing, and purifying ammonia from the gases developed by the destructive distillation of bituminous coal—in other words, the cost of ammonia considered as a by-product is less than by any other process. The selling price of by-product ammonia is entirely a question of competition with other nitrogenous products and has been fixed in the past almost wholly by the market price of sodium nitrate with which it enters into competition. Even should ammonia be placed on the market by the Haber process at a price as low as 4 cents per pound, by-product ammonia will still be sold in competition therewith at a profit to the producer. Its cost price is largely a matter of bookkeeping. Its selling price will in the future as in the past depend upon the competition of other sources of combined nitrogen. The Haber process can produce and is producing ammonia synthetically cheaper than any other synthetic process now industrially applied. The Cyanamid process stands next in order.

If mechanical difficulties now confronting the cyanide process are solved, it will produce ammonia cheaper than either the Haber or the Cyanamid process and in close competition with the actual costs of saving by-product ammonia. The details of costs by all of the above methods will be considered in the final report.

Summary of Conclusions

I. The Government should obtain its nitric acid by the oxidation of ammonia. It should begin the erection of an ammonia-oxidation plant of moderate capacity at an early date in order to train men and obtain experience in the most efficient method of precedure.

II. The Government should proceed slowly in the matter of the erection of plants for the production of ammonia, as developments in the cyanide process and the availability of the Haber process may render valueless within a short time any large expenditure for the production of cyanamid. This is doubly true in view of the fact that present appropriations are not nearly sufficient to install water power and erect the nitrogen fixation plants necessary to meet the government requirements as estimated by the Ordnance Department.

The adoption of the above procedure involves:

1. Purchase by the Government of a reserve supply of sodium nitrate of at least 200,000 tons.
2. The purchase of ammonia on the open market.
3. The reservation of a supply of platinum.

"As platinum is an essential for the oxidation of ammonia, and of the utmost importance in the production of sulfuric acid and other supplies required for munitions; as there are no platinum reserves in the United States save a small amount obtained in the electrolytic purification of copper, gold, and silver ores; and as platinum is one of the precious metals with a value above that of gold, I especially recommend that legislation be asked which will conserve the platinum obtained each year by the United States mints, putting it in the vaults if necessary and issuing treasury notes against it as in the case of gold. Platinum would then be available for immediate use in case of need for the production of nitric acid by the oxidation of ammonia and for the production of sulfuric acid so important in case of war. This platinum would be available without cost to the Government and could, if desired, be used as a reserve for circulation, because even if applied to the purposes above mentioned there would be comparatively little actual loss of the metal itself."

4. The construction of a hydro-electric plant only if the Arc or Cyanamid process is to be used. The oxidation of ammonia requires very little power and the Haber, Cyanide, and By-product Ammonia processes are all independent of cheap power cost. The development of water power, however, cannot but be of benefit to the country even if it is not used for the fixation of nitrogen.

I seriously doubt whether hydro electric power will be necessary or desirable three years from now for the most efficient process of fixing nitrogen, and accordingly I deem it unwise to install such hydro electric power at great cost with the sole purpose of producing nitrogen. If, however, such water power can be utilized by the Government in the production of certain ferro alloys absolutely essential for ordnance and other munitions; can be sold to commercial companies who will take upon themselves the financial risk involved in the erection of plants for nitrogen fixation, under guarantee of cheap ammonia to the Government; or can be sold during peace times to companies requiring power for purposes which would allow instant requisition of the power by the Government in time of war without handicapping the supplies of other needed war material, the development of such hydro electric power would be highly desirable.

In the course of a supplemtnary report Dr. Parsons states that a small plant for the oxidation of ammonia erected at Syracuse, N.Y., is progressing successfully; another experimental oxidation plant at Laurel Hill, L.I., has developed other new features. At Syracuse, two new forms of apparatus for the oxidation of ammonia are now being tried out—one of which, if successful, will do away with entirely the use of platinum in the production of nitric acid. Whether or not this will be accomplished is doubtful, but desirable. The main point is that the preliminary arrangement for the plant for the oxidation of ammonia is progressing rapidly and satisfactorily.

At the time his report was written, he felt confident that the Haber process and Cyanide process would be shortly available for the use of this country and would largely, if not entirely, displace the Arc and Cyanamid processes, which require large ex-electrical development and a correspondingly large expenditure.

Development has been rapid during the last two months: A Synthetic Ammonia process and a Cyanide process have now reached a state of development where he is prepared to recommend definite action by the Government.

General Chemical Company Process

During the past four years, the General Chemical Company, working on the basis that it should be possible to develop conditions under which the synthetic production of ammonia by the direct combination of nitrogen and hydrogen should take place at lower pressures than those deemed necessary by the Haber patents, has achieved sucess. This process has been in successful operation on a large experimental scale with several small units for ammonia production and one unit larger than those supposed to be used in Germany.

The General Chemical Company has also developed and brought to a commercial basis the production of a mixture of nitrogen and hydrogen from coke, air and water, which will yield hydrogen at a cost lower than heretofore obtained in this country and probably lower than that obtained in Germany.

Complete engineering plans have been prepared and bids obtained on the main items of construction so that the erection of a plant for the synthetic production of ammonia can be proceeded with without delay. The Company itself would have already had a plant in operation save for the present high construction costs and other difficulties incident to operation at the present time.

The General Chemical Company feels that, so far as its own relations to the nitrogen industry are concerned, sound business policy would call for delay in the construction of a plant untilthe war is over. Many of the difficulties facing the General Chemical Company, however, do not apply to the Government, such as inability to secure the raw material and quick mechanical construction.

For some months the General Chemical Company was working on this Synthetic Ammonia process but only recently has it been possible to obtain detailed information. The outbreak of the war convinced the officials of the General Chemical Company, headed by Dr. William H. Nichols, Chairman of the Board of Directors, that they should place at the disposal of the Government the results of their investigations. Accordingly, when the Bureau of Mines requested information regarding the present status of their operations, a preliminary conference was arranged in Washington on April 4. As a result of the information then obtained, arrangements were made for a meeting with representatives of the General Chemical Company on April 14.

After this conference, Dr. Nichols offered the free use of process devised by the General Chemical Company to the Government and the full help of the General Chemical Company in installing and operating the process. Arrangements were made for a visit to the experimental plant of the General Chemical Company and for a further conference in New York.

Dr. Parsons adds: "On April 20, Col. C. B. Wheeler, Col. C. C. Keller, Dr. A. A. Noyes, and myself visited the plant and saw it in operation. On the same day a meeting was held at the office of the General Chemical Company at which the plans for the proposed plant were exhibited and a proposed agreement between the General Chemical Company and the Government handed to me for delivery to Brigadier-General William Crozier. The original of this offer is now in his hands and a copy is attached hereto. Estimates on construction and on operation were also sub- mitted.

These estimates are presented in detail under the promise, however, that they would be carefully guarded. Detailed estimates are attached both for a plant of 60,000 pounds of ammonia per day and for a smaller plant of 15,000 pounds per day.

It is estimated—I believe conservatively—that even under present conditions a 30 ton per day plant can be built for an expenditure of $3,000,000 and can be operated at a cost of not to exceed 4 cents per pound of ammonia produced, allowing $5.00 per ton of product for repairs and 12½ per cent of the cost of the plant for interest and depreciation. It is believed that the charges for repairs, interest, and depreciation are excessive, as together, they comprise more than 50 per cent of the total cost of the ammonia production. In the estimates $3.00 per ton of product is allowed for general expenses and over head charges.

It is estimated that a smaller plant of at least 7½ tons per day capacity can be built at the present time for approximately $1,100,000, including land and buildings. Such a plant would yield 2,700 tons of ammonia per year—equivalent to 8,700 tons of 90 per cent nitric acid, assuming 85 per cent recovery. Such a plant would require about 500 horse power.

After examining the process in some detail and giving great weight to the standing of the General Chemical Company and to the statements of its officers and engineers—than whom there are none better fitted to judge of the situation—I recommend the following:

That an initial plant to produce 60,000 pounds of ammonia per day be immediately constructed.

To this end I recommend:

1—That the War Department set aside the sum of $3,500,000.

2—That an agreement with the General Chemical Company be consumated whereby the process be accepted by the Government for its own use, together with the services of the requisite engineers already trained by the General Chemical Company for use in construction and

3—That an agreement be reached where by a definite or at least a maximum royalty per ton of fixed nitrogen produced be paid to the General Chemical Company if sold for non-government use.

4—That this initial plant be constructed at some point to be selected by the War Department in Southwest Virginia, or adjoining territory in West Virginia, reasonably near to the sulfur, sulfuric acid, and coal supplies of that region and so situated near to plenty of good water that an ammonia oxidation plant and a powder plant may be erected later near-by.

Cyanide Process

The Cyanide process, too, has greatly developed in the last few months as anticipated in my preliminary report.

Since that report appeared, the scientific details of the process have been published by Prof. J. E. Bucher in the Journal of

Industrial and Engineering chemistry, 9 (1917), 233. The President of the Nitrogen Products Company, Mr. Edward E. Arnold who 6 months ago declined to go on record as to the future of the process, now unequivocally states that he considers the process a certain commercial success and a probable competitor with any other process for the production of fixed nitrogen, A copy of his letter to me in reply to my request for information as to the present state of the process is attached hereto.

The Nitrogen Products Company is operating two experimental plants by the Cyanide process—one at Saltville, Va., in a coal fired-furnace and one at Niagara Falls in an electric furnace. Col. Wheeler of the Ordnance Department and Dr. J. K. Clement (on my behalf for the Bureau of Mines) visited the Saltville plant on April 6. Col. C. B. Wheeler, Col. C. C. Keller, Dr. A. A. Noyes, and myself visited the plant at Niagara in company with Mr. Arnold on Saturday, April 21.

Estimates of the cost of fixed nitrogen by the Cyanide process presented for the use of the Committee by the Nitrogen Products Company are attached. At my request, Mr. Arnold, president of the company, also submitted a proposal for the use of the Cyanide process by the Government. The offer made by the Nitrogen Products Company is essentially the same as that made by the General Chemical Company.

The process is offered free to the Government for its own use to any extent, both in time of peace and in time of war.

After careful examination of this process, I am not convinced that it has yet reached a point where plant installation should begin, as I believe a few months experimentation will add greatly to the efficiency of the furnace proposed.

It is my belief, however, that the process will become an important factor in the world's nitrogen market; that it may become a strong competitor even of other processes on account of the simplicity of its operations and the low cost of plant construction; and that a furnace which I believe I see in embryo can be developed which will be much more efficient than either of those now used.

The process is so promising that I recommend:

1—That active experimentation on a large scale be conducted.

2—That a sum not to exceed $200,000 be set aside for this purpose.

With this amount available I feel confident that this process can be put upon a commercial basis; that it will become a real competitor in the production of ammonia for nitric acid and of nitrogenous materail for fertilizer.

I believe this investigation should begin without delay and that as soon as practicable a small experimental plant be erected at Saltville, Va., where a large supply of nitrogen, soda, and coal is available. The present plant of the Nitrogen Products Company can probably be utilized in connection therewith.

Summary of Recommendations

I—That $3,500,000 be made available to build an initial plant which will produce 60,000 pounds of ammonia per day by the synthetic ammonia process, as offered by the General Chemical Company.

II—That the offer of the General Chemical Company be accepted with some subsidiary arrangement whereby a maximum royalty per ton of nitrogen, when the product is to be used for commercial purposes, shall be inserted.

III—That the construction of the initial plant be started at once at some point to be selected by the War Department in southwest Virginia or adjoining territory in West Virginia, reasonably near to the sulfur, sulfuric acid, and coal supplies of that region. The plant should be so situated that it is near to plenty of good water and that the land is available for the later erection of an ammonia oxidation and nitric acid concentration plant. It should be so located that a powder plant may be later erected near-by.

IV—That a sum not to exceed $200,000 be set aside for active experimentation on a large scale on the Cyanide process.

V—That experimentation on the Cyanide process be conducted at Saltville, Va., where nitrogen, soda, and coal are available and where the present plant of the Nitrogen Products Company may be studied and utilized.

Estimates on Construction and Operating Costs

In order that the recommendations made above may be considered in comparison with the older processes now operating on a large scale, I beg to submit herewith a table summarizing confidential data obtained from books of many companies bearing upon the cost of nitrogen production.

Data per Ton of Nitrogen—By the Arc, Cyanamid, Haber and General Chemical Company Processes

	ARC.	Cyanamid	Haber	Gen. Chem
Product..........	35% HNO_3	NH_3	NH_3	NH_3
Power required....	10.5	2.2	0.2	0.2
Investment.......	$1410(a)	$440(a)	$540	$300
Operating costs[2] ..	170	150(b)	119	97
Product..........	96% HNO_3	96% NHO_3	96% HNO_3	96% HNO_3
Power	10.8	2.3	0.3	0.3
Investment[3].......	$1550	$670	$570	$530
Operating costs[1]..	220	270	239	217

[1]Estimates on General Chemical Company process are based on present war time construction costs. All others on normal prices.

[2]Amortization for cyanamaid as charged by operating companies. Amortization for Haber 20% of plant cost for repairs, interest, depreciation, Amortization for Arc and Modified Haber 12½% interest and depreciation. $5.00 per ton of product for repairs.

[3]Except for Arc process, includes ammonia plant as given A, power additional $10, oxidation and absorption $140; concentration $40; steam plant, $40.

[4]Except for Arc process, includes ammonia costs as given; oxidation, $50; concentration, $70. No allowance made for unoxidized ammonia.

(a) Power plant investment reckoned at $100 per horse power.

(b) Cyanamid production, $122; ammonia from cyanamid, $28; total, $150.

The Research Corporation

We are indebted to Science for the following account of this corporation:

It was incorporated in the State of New York in 1912 on the initiative of Dr. F. G. Cottrell, who gave to it his patents concerning the process known as the "electrical precipitation of suspended particles." The corporation began with a cash capital of $10,000. As at February 16, 1917, the auditors reported that its assets of cash and securities were $217,862.72. It has a laboratory in which experts work to develop improvements in the precipitation process and to meet new problems.

For the purpose of encouraging scientific research directed to the development of the industrial arts, the Research Corporation offers a fellowship of the annual value of $2,500 to be awarded by competition. Details and forms of application may be obtained from the Secretary of the Research Corporation, 100 William Street, New York City.

Munition Makers

The Russell Sage Foundation of New York, has published a book on Munition Makers, describing conditions in England and in France and giving the results of a study of women in the cartridge shops of Bridgeport, Connecticut. The section of the book referring to Great Britain, deals with the facts discovered by the British Ministry of Munitions. "Careful study in the plants of Great Britain in war time," writes Miss Henriette R. Walter, one of the authors, "has shown that shortening hours actually increases output, that night work is uneconomical,that the workers need one day of rest in seven not only for their own benefit, but to make them able to serve their country better, and that for the same reason sufficient rest-periods and holidays should be observed. Moreover long hours increase accidents and loss of time through sickness. Bridgeport and other cities of this country in which plants receiving war orders are located, may profit also by the British discoveries that production in time of war is seriously affected by conditions in the community, by inadequate transit facilities, and by congested housing."

Industrial Alcohol

In the Journal of Industrial and Engineering Chemistry, A. M. Breckler, in the course of an article on industrial alcohol, states that the total quantity of alcohol produced in 1914 in the United States from all raw materials was 182,000,000 proof gallons, equivalent to about 5 per cent. of the present consumption of petrol in America. Of this quantity about 142,000,000 gallons were obtained from grain. In view of the increasing cost of grain and also of molasses, the author does not think it probable that industrial alcohol will prove a very serious competitor with petrol as a source of fuel under present conditions of manufacture. In regard to alcohol from wood waste he writes as follows:

"Enough money has been spent on sawdust plants to evolve several processes for tracking oils. The fact is that after seventy years of experimenting there are two plants running in this country, and were it not for the high price of alcohol at the present time it is doubtful whether they would run. The bulk of the material handled, the use of strong acids, the complex machinery for leaching and the rapid stripping of the timber tracts under cutting, all operate against the process, even were other conditions satisfactory. The sulphite liquors from pulp mills offer a cheap source of carbohydrates. None of the existing processes is exactly satisfactory. Just how much of this liquor is available is a little uncertain. One thing is certain, that the amount of fermentable carbohydrates in this liquor is very variable."

A very important factor in the manufacture of alcohol, the author continues, is the question of yeast nutriment, and from an engineering point of view the most important factors are fuel and water supply.

Industrial Research in the United States

The British Advisory Council for Scientific and Industrial Research has issued a paper, H.M. Stationery Office, London, England, price one shilling, by Mr. A. P. M. Fleming, of the British Westinghouse Company, on industrial research in the United States. The paper is full of information and practical suggestion.

The writer observes that modern tendency of American manufacturers to research may be seen most strikingly in what is being done by manufacturing and similar corporations themselves. Examples are to be found alike in the mechanical, electrical and chemical industries, and are on every variety of scale, up to the $150,000 per year tıwhich the Eastern Kodak Company devotes something under one per cent. of its profits, and the $400,000 to $500,000 a year spent by the General Electric Company, of Schenectady. Mr. Fleming gives particulars of what is being done by twenty corporations, but the list could be made longer. Most of these laboratories have sprung up in quite recent years, and their number is constantly increasing. The increase is not merely in number. It is as remarkable in its growing breadth. The laboratories of these firms undertake not merely the routine of testing of materials and products and the more or less empirical adventures after new products that was formerly the business of a works laboratory. At the one end of the scale they carry out experiments on the discovery of new products and the elaboration of new designs into the full manufacturing scale, and the laboratory supplies the needs of the market as if it were itself, a works, until they outgrow the capacity of its plant and call for a new works of their own. At the other end of the scale they undertake inquiries into the questions of pure science, of the solution of which no one can see an industrial application. They keep men investigating such problems constantly and perseveringly, and give them admirably equipped laboratories for the purpose. This sort of thing is being done in works after works, and every year adds to their number and the elaboration of their equipment. All the time, in spite of the enormous sums that are being spent on what at first sight is not only unproductive work, but work which tends to subordinate the wholesome rule of practise to the fantastic and costly demands of laboratories, the thing pays. The fact that the habit has grown so far is evidence that it must pay, for American business houses do not fling good money after bad. But there is no need to depend on inference or prima facie evidence. The individual experience of those who have tried it shows that in fact it has paid, and the air in America is thick with plans to extend the practise of applying science to help industry; for great as is the extent of what has been done already it is only a tiny fraction of what in American industry there is still room and the intention to do.

Side by side with these corporations and firms three groups of institutions are working to the same ends. Mr. Fleming quotes a dozen or more separate industries with their trade associations, each of which is undertaking research for the common benefit of their members; sometimes in their own common research laboratories, sometimes in those of their members, sometimes through university or the Buruea of Standards staff. An excellent instance of an important trade of which all members, great as well as smalı, have gained greatly by research work communicated to all alike, is that of the canners. The Canners' Association spend some $30,000 or $35,000 a year on its central laboratory, besides a good deal more on work done in the factory of individual members; and it is considered that the largest members have as much interest as the small in the results being made common to all, because the risk of the whole trade being discredited by imperfect production is thus minimized. Over a dozen universities and colleges are now running laboratories devoted not only to invest gations in pure science which may ultimately find a practical application, but to industrial researches for which the application is waiting. In many instances such work is done not on the strength of foundations, but at the request and expense and for the benefit of commercial firms and other industrial bodies, such as railway companies.

Porcelain Chemical Ware

Before the war porcelain chemical ware was a German monopoly. The increased acitivity in chemical laboratories, consequent on the outbreak of hostilities, soon exhausted the dealers' stocks of German ware and it fell to the British potter to supply the demand, not only for refractory laboratory ware, but also for larger vessels used in chemical manufactures.

The difficulties were very great and were not confined to the material side. Working drawings, models, moulds and material had all to be prepared under the stress of hampered facilities and limited time. In addition there was the "moral" factor. For years the Germans had industriously fostered the legend that British kaolin was fundamentally unsuited to the production of refractory ware, and this, in spite of the fact that large quantities of British kaolin were annually imported into Germany for the purpose of making this very ware.

It is gratifying to know that the difficulties have been so far overcome that the British chemical ware is now equal to the best ever produced by the Germans.

U. S. Steel Canadian Plant

The United States Steel Corporation has completed its plans for the erection of the $20,000,000 plant at Ojibway, Ont., referred to in a previous number. Development work will now be carried on according to Ward B. Perley, vice-president and general manager of the Canadian Steel Corporation, the Canadian subsidiary of the United States concern.

This company was incorporated three years ago. A tract of land on the St. Clair River, near Windsor, was purchased, a separate municipality was established under the name of Ojibway, and streets were laid out for an ideal town, such as the United States Steel Corporation has at its American plants. Then the war put a temporary stop to construction.

Laboratory Column

Notes and Queries

For publication under this heading we invite from our readers laboratory hints and "wrinkles," descriptions of new or modified apparatus and selected, tested methods of analysis. These may be modifications or adaptations of standard methods. To the sender of the most meritorious contribution received during any month we offer A PRIZE of one year's free subscription to The Journal.

The following rules will apply to contributions:

1. MSS. should be typed on one side the paper only. They must bear the name and laboratory address and must not exceed 300 words.
2. Contributions received after the 15th of any month will be held over until the month following.
3. The Editor's decision regarding the merit of any contribution will be final.

We also invite from our readers brief questions of interest regarding difficulties which they may encounter in their analyses, tests or laboratory technique.

The questions will be printed over a pseudonym if desired, but they must always be accompanied by the name and address of the sender.

Brief answers to the questions are invited from our readers.

Questions will not be answered by mail and the editor will not undertake to answer any questions.

Below we give specimen contributions from the "Chemist Analyst," such as are referred to above:

Detection of Free Carbonic Acid in Water

Determine whether the sample of water under observation is a hard or soft water. If the water is soft, the procedure is as follows: Add 3 c.c. of 10% Cu S O_4 to 100 c.c. of the sample, agitate and let stand for 12 minutes. If the sample remains clear in color throughout this period, no cloudiness resulting, the presence of uncombined CO_2 is indicated.

The operation, if the water is hard sample consists in adding 12 c.c. of a 1% solution of alizarine in alcohol to 100 c.c. of the sample. Agitate and let stand for 10 minutes. The presence of free CO_2 is indicated by a pure yellow color while a bluish red color indicates an entire absence of the compound in an uncombined state.

Oak Park, Ill. A. W. Jones, Jr.

Note on Filtering $BaSO_4$

E. Kaus has described a method of filtering $BaSO_4$ by adding a pulp or "Cereal" of ashless filter paper, stirring, filtering and settle for a few minutes. If a solution of $BaCl_2$ is allowed to pass down a piece of capillary thermometer tubing into a boiling solution of sulphuric acid, having the end of the tubing just below the surface of the boiling acid, the $BaSO_4$ will precipitate in grains large enough to be able to decant with ease.

Denver, Colo. Howard P. Tweed.

British Chemical Porcelain and Sands

Mr. Henry Watkin, Stoke-on-Trent, in a paper on "Chemical Porcelain," read at the recent conference of the Society of Chemical Industry at Birmingham, dealt with the future prospects of the trade and pointed out that the English potters for two years now had supplied Great Britain with nearly all that had been needed for scientific work, as also for chemical processes in connection with the war.

Professor P. G. H. Boswell said that, before the war, unnecessarily large supplies of foreign sands were imported, particularly for lining the hearths of furnaces, or steel castings, and for the making of the best qualities of glass, but, except in the case of one or two foreign supplies of sand, it had always been clear that the country could be self-supporting in these materials.

Anthracite Coal Mined in the United States

In 1916 the anthracite mined amounted to 78,195,083 gross tons valued at $202,009,561, a decrease in quantity of 1.6 per cent. and an increase in value of 9.4 per cent. compared with 1915. The shipments of prepared coal, of sizes above pea were 40,747,215 tons; of pea, 7,520,804 tons, and of sizes below pea 19,233,344 tons, representing decreases of 1.1, 8.4 and 0.05 per cent., respectively, compared with 1915. On the other hand, the anthracite obtained from the washeries increased 19.6 per cent. and that dredged from rivers increased 16 per cent. over the similar production for 1915.

These statistics have been compiled by C. E. Lesher, of the United States Geological Survey.

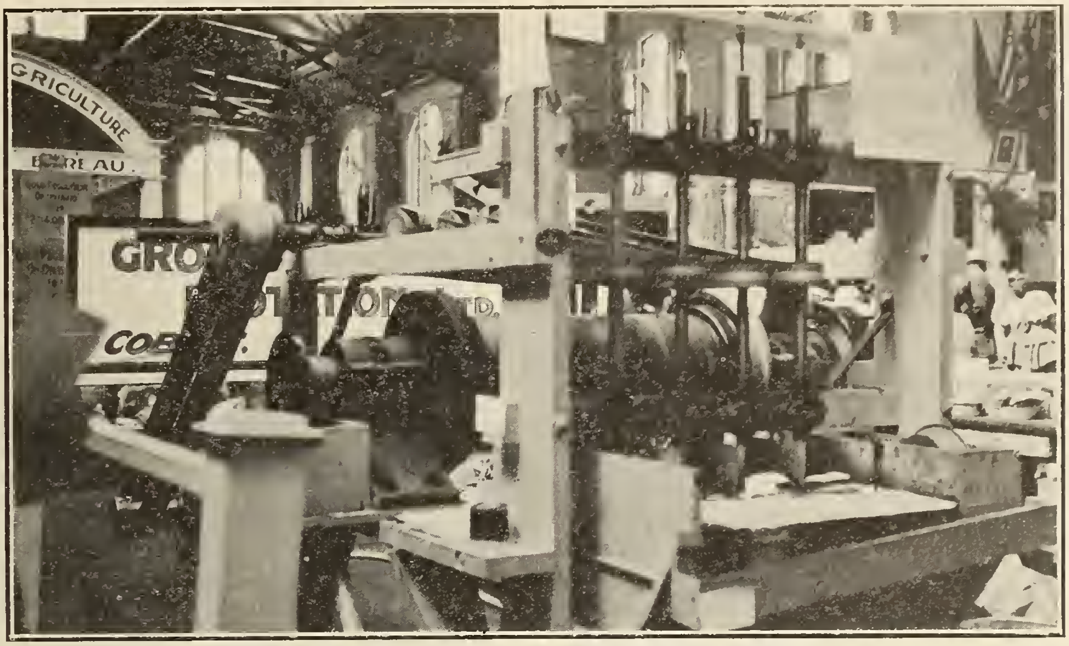
The output of coal in Canada in 1916 was estimated 14,461,678 tons, valued at $38,857,557, compared with 13,267,020 tons, valued at $32,111,182 in 1915. This output was all bituminous coal.

Preparation of Mannite from Silage

A. W. Dox and G. P. Plaisance, of the Iowa Agricultural Experiment Station, report in Science the results of an examination of many samples of silage for mannite.

Sunflower silage, from Montana, contained 5.61 per cent. of the air-dried material. Corn of various origins gave from 1.47 to 2.51 per cent. The mannite is obtained by pressing the silage filtering the juice and evaporating to one-sixth of its volume, and adding two to three volumes of alcohol. The mannite crystallizes out, the alcohol can be recovered and the pressed residue and mother liquor mixed and used for feed. Prepared in this manner mannite should be cheaper than glycerine. When nitrated it gives a compound which is more strongly explosive than nitroglycerine.

American manufacturers are interested in feldspar deposits in the Ottawa Valley and it is quite probable that in the near future works will be established for the mining of this product used in the manufacture of crockeryware. John C. Wilkes, representing a firm in Trenton, N.J., who has visited Ottawa, is mining engineer for three wealthy American brothers mainly concerned with the commercial possibilities of feldspar and they are going to look into located feldspar deposits in the district. Mr. Wilkes stated a great deal of the mineral is now obtained from Canada by the American manufacturers, and it would not be very long before the chief requirements of feldspar would be obtained in this country, as the feldspar mines of Pennsylvania and Connecticut are petering out. Feldspar is worth about $4.50 a ton now, Mr. Wilkes stated.—Ottawa Citizen.



New Type of Oil Flotation Machine

At the Canadian National Exhibition in Toronto last month there was exhibited for the first time a working model of a new type of oil flotation machine, the invention of a Canadian, who has introduced a new method of atomizing the oil. By using this method the inventor is able to extract three or four kinds of metal from the same ore in one run through the machine by using different oils adapted to each metal. Moreover, he claims that, from tests made on the operation of a machine at Cobalt, less power is required from a given amount of extraction than from other machines in use in oil flotation.

The inventor is Frank Groch, a young Canadian with experience in the Cobalt region, who has formed a company under the name of the Groch Centrifugal Flotation, Limited, of Cobalt.

The equipment consists of a tube mill for grinding the ore and an oil flotation machine for recovering the metals. The ore is fed into the tube-mill, along with a small quantity of water, by means of a revolving scoop and the grinding is performed by steel balls or hard flint pebbles in the cylindrical body.

As will be seen by the illustration, there is a series of hollow shafts (four to six, according to the kind of ore) and into the top of each shaft a light oil is dropped from a cup, the oil dropping upon a rapidly revolving wheel, or as it is here called, an impeller, whose blades disperse and atomize the oil, the action of the blades having the effect of drawing down a strong current of air to help the dispersion. As the pulp and oiled air are thrown out by the impeller the most easily floated minerals are smeared with the oil and float to the surface of a trough into which the combination escapes. The residue from this first operation is sucked into the second compartment of the machine and the system of treatment is repeated in the second impeller using the same or a different class of oil depending on the ease or difficulty with which the remaining minerals may be recovered. In this way it is possible to recover, by selection, various minerals, each in turn, from a complex ore by using different oils or oil mixtures during treatment.

This machine is to be shown in operation at the Exposition of Chemical Industries in New York.

Production of Iron Ore and Pig Iron in the United States and Canada

The iron ore mined in the United States during 1916 totalled 75,167,672 gross tons, an increase of more than 19,600,000 tons over 1915. The output is the largest hitherto made. The shipments from the mines were 77,870,553 gross tons valued at $181,902,277. The increase over 1915 was 40 per cent. in quantity and 80 per cent. in value. The average value per ton was $2.34 as compared with $1.83 in 1915. These figures were compiled under the direction of E. F. Burchard, of the United States Geological Survey. Only ore containing less than 5 per cent. of manganese is included.

The Lake Superior district mined nearly 85 per cent. of the total and the Birmingham district 8 per cent. There were twelve mines producing more than 1,000,000 tons of ore. The Hull-Rust mine at Hibbing, Minn., was the largest producer, with 7,658,210 tons, which was more than 10 per cent. of the total for the whole country and an increase of 232 per cent. over 1915. Such an increased production could only be possible with open-pit mines.

The American Iron and Steel Institute's figures for the production of pig iron, including ferro alloys was 39,434,797 gross tons in 1916, compared with 29,916,213 tons in 1915, an increase of 32 per cent. According to reports of producers to the United States Geological Survey the pig iron, exclusive of ferro-alloys, sold or used during 1916 was 39,126,324 gross tons valued at $663,478,118 compared with 30,384,486 gross tons, valued at $401,409,604 during 1915, an increase of 29 per cent. in quantity and 65 per cent. in value. The average price per ton at the furnaces was $16.96 compared with $13.21 in 1915, an increase of 28 per cent.

The production in Canada of pig iron from Canadian ore in 1915 was 158,595 tons valued at $1,715,874 and of iron ore sold for export, 89,730 tons valued at $181,381. In 1916 the production was 115,691 tons of pig from Canadian ore, valued at $1,328,595 and of iron ore sold for export 140,608 tons valued at $393,689.

The Metric System

A resolution favoring the introduction of the metric system has been repeatedly passed by the Association of Chambers of Commerce of Great Britain, but at this year's meeting the weight of argument was on the other side. The engineering trades particularly object to any change of standard being made under present conditions.

Book Reviews

The Distillation of Resins and the Preparation of Resin Products, Resinates, Lamp-black, Printing Inks, Typewriting Inks, etc. By Victor Schweizer. Translated and revised by H. B. Stocks, F.I.C., F.C.S. Second English Edition, pp. VIII. and 212, London. Scott, Greenwood and Son. Price, ten shillings and sixpence, $2.60 net.

A verbal and pictorial description is given of the methods and plant used in the distillation of resins, more particularly of common rosin, (colophony) and its resulting products, rosin spirit, rosin oil, etc., and also of fossil resins such as are used in the manufacture of varnish.

An outline is also presented of the preparation of resins from the turpentines and of the purification of fossil resins.

The methods used in the manufacture of printing inks, typewriter inks, manifolding papers and of various carbon pigments such as lamp-black, vegetable black, gas-black, etc., are also described, as likewise are those for the production of rosin derivatives such as rosin soaps, rosin lakes, rosin lake pigments and resinates.

An account is also given of the use of rosin for sizing purposes.

J. B. T.

The Ontario High School Chemistry. By George A. Cornish, B.A., and Arthur Smith, B.A. Authorized by the Minister of Education for Ontario. Pp. VIII, 298. Toronto: The Macmillan Company of Canada, Limited. Price, 50 cents.

The proof of a pudding is in the eating and the proof of an elementary text-book of chemistry is in the using. The authors of this book have endeavored to emphasize the human side of the science, to give the student some knowledge of the personalities of the chemists who discovered the fundamental facts of the science.

So far as a mere teacher can judge the authors have succeeded in their attempt. They are to be congratulated also on the fact that they have presented the facts, theories and descriptions contained in the book in a clear, interesting and attractive manner. J. B. T.

Canadian Mining Manual, 1916-17. Edited by Reginald E. Hore, Editor Canadian Mining Journal. Mines Publishing Company, Toronto. Price, $3.00.

The Canadian Mining Manual has become a standard work of reference for this country and the edition of 1916-17 is the most comprehensive yet issued. It makes a volume of 447 pages, and treats of each of the sixty-three mineral and metal products in Canada, ranging from aluminum to zinc. Besides these reviews and a tabulated summary of the values and quantities produced last year, there are several special articles such as "Canadian Metal Trades and Preparedness," the "Iron and Steel Industry in Nova Scotia," "Gold Dredging in the Yukon," "Canada's Water Powers," "Mineral Belt North of the Pas," "Debates on the War Tax," etc. Nearly 250 pages are devoted to sketches of the work of the various mining companies now operating in Canada. The work is a monument to the industry and ability of the compiler.

Petroleum in Canada. By Victor Ross. The Southam Press, Toronto; 109 pages. Price, $1.00.

Mr. Ross, well known as commercial and financial editor of the Globe, has presented to the public a timely work on a subject of practical interest. It is the first treatise of its kind published in Canada, and the author, while giving information for reference purposes on the subject of Canadian petroleum as an industry, has succeeded in putting into non-technical language a readable summary of the theories of the origin of petroleum. In these respects it is a highly instructive text book. After a chapter on the theories of the origin of petroleum, a history of the Ontario oil fields is given with an account of the present position of the Ontario petroleum industry. Other chapters treat of the methods of drilling and "shooting" of oil wells and of the methods of storing and refining oil. Mr. Ross also sketches the petroleum industry of Western Canada and Eastern Canada, and after a list of the manufactures, some of the products and uses of petroleum are given. Mr. Ross is an optimist regarding the future of the oil industry of Canada. The work is illustrated by many excellent photo engravings.

Water Supply. By Wm. P. Mason, Professor of Chemistry, Rensselaer Polytechnic Institute, Troy, N.Y. Published by John Wiley & Sons, New York. Size, 6×9 inches. Pages, 540. Illustrated. Fourth Edition.

The necessity for pure water is no greater to-day than formerly, but the difficulty of securing pure water for domestic and manufacturing purposes is an ever increasing one. The increased congestion in population, the volume of trade waste and sewage diverted into our streams and lakes and the continuous pollution of the soil all tend to make the securing of pure water in great volume difficult.

Professor Mason, in his book, "Water Supply," has in a most admirable manner presented the salient features of Drinking Water and Disease; Artificial Purification; Natural Purification; Rain, Ice and Snow; River and Stream Water; Stored Water; Ground Water; Deep Seated Water; Quantity and the Action of Water upon Metals.

This publication is not a handbook; although it contains much "handbook" information, but is rather a treatise on Water Supply considered principally from a sanitary standpoint, and while considerable information is given as original, where the author has drawn upon data supplied by others he has given fully the authority so the reader may know what value to put upon the statements.

The descriptive matter, the information contained and the numerous examples are well selected and concisely reviewed, and altogether the Fourth Edition is a valuable addition to the literature on Water Supply.

In addition to the table of contents, there is an index which is cross indexed, and this adds materially to the value of the publication both as a book of reference and as a handbook.

German Trade Methods

In the course of an address on "The Relation of Chemical Laboratories to the National Welfare," Dr. W. A. Noyes related the following story as reported in Science:

A good many years ago, Mr. Dow, of Midland, Mich., discovered that bromine can be produced economically from the salt brines of Michigan. In the course of a few years he developed the manufacture to such a point that he shipped some bromine to Germany.

Not long after a German appeared at his works in Midland and said to him: "I have conclusive evidence that you have been selling your bromine in Germany. Didn't you know that you can't do that?" Mr. Dow replied that he knew of no law against it. The German said: "Well you can not. If you do, we will sell two pounds of bromine in America for every pound you sell in Germany." No attention was paid to this threat, but some months later, when he was away in Texas, Mr. Dow received a telegram, "Bromine is selling at 15 cents." A normal price is 75 cents. Mr. Dow immediately stopped selling bromine in America and sent his whole product to Germany. It was not long before the German manufacturers were ready to come to terms.

Personals

M. Ernest Solway, the distinguished Belgian industrial chemist, who has made large gifts for the endowment of chemical and physical research and for the international work of chemical societies, has been elected a corresponding member of the Paris Academy of Sciences, in the place of the late Sir Henry E. Roscoe. According to the public press, the Germans, soon after their invasion of Belgium, imprisoned M. Solway, and levied heavy fines upon him.

Alexander Wilson Crouch, vice-president and general manager of the Dearborn Chemical Company of Canada, and vice-president of the Allied Chemicals, Limited, Toronto, has sailed from Vancouver on a year's trade expansion trip to Japan, Australia, Korea and India.

Messrs. Groch and Simpson, of the Groch Centrifugal Flotation, Limited, are preparing to exhibit at the National Exposition of Chemical Industries in New York, a working model of their oil flotation machine described elsewhere.

Messrs. J. B. Challies, of the Water Power Branch of the Department of the Interior, Ottawa, and Mr. Lynch or Mr. McClymont, of the National Resources Branch of the same department, will be at the Chemical Exposition in New York, where the Department of the Interior will have a bureau of information.

Industrial Notes

A company called the Canadian Nu-Fuel Company has been formed at Regina, Sask., to manufacture fuel from garbage, under the process of E. L. Culver, of Chicago.

The Canada Cereal Company will build a flour mill at Markham, Ont.

The municpality of Outremont, Que., is installing a filtration plant.

The Labrador Pulp and Paper Company propose to build a pulp and paper mill, operated from the great falls on the Hamilton inlet. R. H. Reid, of St. John's, Nfld., is interested.

The National Potash Corporation report the erection of a plant at Gravenhurst, Ont., for the manufacture of potash from feldspar.

The town of Oshawa, Ont., is erecting a filtration plant with a capacity of 1,200 gallons per minute.

Recent Incorporations

Eastern Chemical Company, Limited, Montreal, $100,000.

Canadian Hession Tillers and Tractors, Limited, Toronto, $5,000,000.

The Three Rivers Shipyards, Limited, Three Rivers, $49,000.

The Parker Pulpwood and Timber Company, Limited, Montreal, $49,000.

St. Denis Corporation, Limited, Montreal, $499,000.

British Dyes, Limited, Toronto, $40,000.

The B.C. Hardware and Paint Company, Limited, Duncan, B.C., $10,000.

Law the Druggist, Limited, Vancouver, $45,000.

Snug Cove Copper Company, Limited, (Non-Personal Liability), Vancouver, $500,000.

Wyatt Bay Fish, Oil and Fertilizer Company, Limited, Vancouver, $100,000.

Edmonton, Alta.—The Canadian Stewart Gold Mines, Limited, (non-personal liability), $500,000; the Davis and Chapman, Limited, $20,000.

Winnipeg, Man.—Wood Grain Company, Limited, $40,000. A. H. Wood, D. N. Stevens, C. N. Dalgleish; Macleods, Limited, $50,000. R. Macleod, J. A. Richardson, A. McBean.

Haileybury, Ont.—Kirkland-Porphyry Gold Mines, Limited, $3,000,000. W. A. Gordon, F. A. Day, E. M. Reilly.

Moncton, N.B.—Humphrey's Glass, Limited, $200,000. S. L. Holder, H. S. McWilliams, P. J. Ward.

Toronto, Ont.—Synthetic Drug Company, Limited, $40,000. J. F. Edgar, S. R. McEwen, N. R. Tyndall.

Montreal, Que.—The Quebec Charcoal Company, Limited, $50,000. A. Wainwright, C. G. Ogden and G. V. Cousins. Head office, Montreal.

Windsor, Ont.—Flesherton Oil Fields, Limited, (no personal liability), $500,000. G. Grant, M. MacDonald, E. Smily.

Haileybury, Ont.—Wisconsin-Skead Mines, Limited, (no personal liability), $2,000,000. F. A. Day, W. A. Gordon, R. H. Lyman.

McGee, Sask.—McGee Oil Company, Limited, $20,000.

Explosion in Munitions Plant

We are glad to be able to correct a number of inaccuracies in the report of the explosion at the works of Messrs. Curtiss' & Harvey, Limited, at Dragon, Que., which was reproduced from the daily press in the last issue of this Journal.

The report stated that five thousand hands were employed, whereas the pay-roll did not exceed eight hundred. No rescue train was called from Montreal as stated.

We very much regret the paragraph which attributed the cause of the accident to "some omission or carelessness in the operation of the plant." Such an inference was quite unwarranted where, as in this case, chemical actions and reactions are liable to take place and have caused accidents in spite of the utmost precautions and the closest attention in the best regulated explosives works in the world.

We are informed that, other arrangements having been made for the execution of their contracts, the plant will not be rebuilt at Dragon.

Potash from Kelp

The International Chemical Company, Limited, a concern financed by the National Chemica' Company, Limited, is now completing the installation of equipment for a potash plant on the Queen Charlotte Islands, B.C.

The company, which is controlled by Cleveland and Chicago capital, proposes to commence operations next month and has facilities for handling 1,000 tons of wet kelp per day. It enjoys exclusive licenses from the government on what are said to be the most extensive kelp beds on the Pacific Coast. They are situated in Cumshewa Inlet, Moresby Island, and cover about ten square miles.

Dyes in the United States

At the beginning of the war dyes to the value of about $15,000,000 per annum were used in the United States. Of this amount about $3,000,000 were made in the country and the remainder imported, chiefly from Germany.

The dye manufacturers have made special efforts to meet the shortage and, in another year they will be able to furnish the quantity of dyes required, but they will not be able to produce as great a variety as was formerly available.

In this connection the tariff situation is both important and interesting. At present there is an ad valorem tax on dyes of 30 per cent. and a specific tax of 5 cents per pound. This specific tax is to continue for five years. At the end of that time it is to be decreased one per cent. per year until it disappears.

It is also provided that, if the American factories do not produce 60 per cent. of the value of the home consumption at the end of five years, then the specific duty is to be repealed completely. Another curious provision sets forth that indigo, alizarin and their derivatives are excluded from the specific duties. No logical reason whatever can be given for this exclusion, nor has any been attempted. The indigo and alizarin dyes constitute 29 per cent. of the whole and at least 10 per cent. of the remainder are covered by foreign patents. It is evident, therefore, that there is small hope of the American factories being able to produce 60 per cent. of the dyes under normal conditions of foreign competition.—Science.

Chemical and Metal Markets

The quotations below represent average prices for the quantities indicated at the time of going to press. Larger amounts, of course, may be obtained at lower figures.

Toronto, September 20, 1917

The chemical and metal markets have been very firm during the past month; only a few items in the list below have altered in price. A steady demand and a fairly constant supply seems to account for this stability. The United States embargo on sulphur has not yet affected the price of this element. There appears to be a great excitement in the Republic to the south of us and everybody seems to be buying up all the available supply of various chemicals. A curious unique state of affairs exists in connection with ammonia. The price of aqua ammonia has always been about 2 cents per pound more in Canada than in the United States. To-day, however, the reverse is the case. Ammonia is selling in Canada for 8 cents per pound, while in the United States it commands 10 cents per pound.

It is considered by those competent to judge that the chemical market will remain firm for some time. There is, of course, the possibility that some unforseen disturbing factor may arise.

It will also be noted with great satisfaction to those who are interested in the new Canadian chemical industries that the production of benzoic acid in Toronto has been the means of lowering the price of this acid from $9.00 to $6.00 per pound. Sodium benzoate has also dropped 40 cents per pound. This is a good omen for the future of these new industries. Last month an increase in the price of calcium chloride was predicted. An increase of 0.5 cents per pound is recorded to date.

The price of silver fluctuates from day to day. At the time of going to press it is being quoted at $1.00 per oz.

Inorganic Chemicals

Alum, lump ammonia	100 Lbs.	$6.50
Aluminium Sulphate, high grade, bags	100 Lbs.	4.00
Ammonium Carbonate	10 Lbs.	2.50
Ammonium Chloride, white gran	Lb.	.21
Aqua Ammonia .880	Lb.	.8
Bleaching Powder, 35% drums	100 Lbs.	4.50
Borax, crystals	Lb.	.12
Boric Acid, powdered	Lb.	.18
Calcium Chloride, crystals fused	100 Lbs.	3.00
Caustic Soda, ground, Bbl	Lb.	.12
Chalk, light precipitated	Lb.	.10
Cobalt Oxide, black	Lb.	2.10
Copper Sulphate (Blue Vitriol)	100 Lbs.	11.00
Fuller's Earth, powdered	100 Lbs.	6.00
Hydrochloric Acid, carboys, 18°	Lb.	.3
Lead Acetate, white crystals	Lb.	.20
Lead Nitrate	Lb.	.30
Lithium Carbonate	Lb.	2.10
Magnesium Carbonate, B.P.	Lb.	.40
Nitric Acid, 36° carboys	100 Lbs.	8.75
Phosphoric Acid, S.G. 1750	Lb.	1.00
Potassium Bichromate	Lb.	.60
Potassium Bromide	Lb.	2.40
Potassium Carbonate	Lb.	1.50
Potassium Chlorate, crystals	Lb.	.85
Potassium Hydroxide, sticks	Lb.	3.00
Potassium Iodide, bulk	Lb.	4.25
Potassium Nitrate	Lb.	.55
Potassium Permanganate, bulk	Lb.	$6.00
Silver Nitrate	Oz.	1.00
Soda Ash bags	200 Lbs.	10.00
Sodium Acetate	Lb.	.40
Sodium Bicarbonate	100 Lbs.	4.00
Sodium Bromide	Lb.	.80
Sodium Cyanide, bulk, 98-99 per cent	Lb.	.50
Sodium Hyposulphite, bbls	100 Lbs.	3.00
Sodium Nitrate, crude	100 Lbs.	9.00
Sodium Silicate	100 Lbs.	4.00
Sodium Sulphate (Glauber's Salts)	100 Lbs.	2.00
Strontium Nitrate, com	Lb.	.55
Sulphur, ground	100 Lbs.	4.50
Sulphur, roll	100 Lbs.	5.00
Sulphuric Acid, 66°Be, carboys	100 Lbs.	3.00
Tin Chloride, crystals	Lb.	.65
Zinc Oxide	Lb.	.32
Zinc Sulphate, com	Lb.	.18

Organic Chemicals

Acetanilid, C.P.	Lb.	.95
Acetic Acid, 28 per cent. in bbls	Lb.	.8
Acetic Acid, glacial, 99½% in carboys	Lb.	.80
Acetone	Lb.	.75
Alcohol, methylated	Gal.	1.75
Alcohol, grain	Gal.	7.50
Alcohol, wood, 95 per cent., refined	Gal.	2.30
Benzoic Acid	Lb.	6.00
Carbolic Acid, white crystals	Lb.	1.00
Carbon Bisulphide	Lb.	.30
Chloroform, com	Lb.	1.25
Citric Acid, domestic, crystals	Lb.	1.40
Ether, 725	Lb.	.75
Glycerine	Lb.	.95
Oxalic Acid	Lb.	.65
Salicylic Acid	Lb.	1.80
Sodium Benzoate	Lb.	4.10
Tannic Acid, commercial	Lb.	2.00
Tartaric Acid, crystals	Lb.	1.25

Metals

Aluminium	Lb.	.57
Antimony	Lb.	.18
Brass, yellow ingots	Lb.	.22
Cobalt	Lb.	2.25
Copper, casting	Lb.	.32
Copper, electrolytic	Lb.	.33
Lead	Lb.	.14
Magnesium	Lb.	2.50
Mercury	Lb.	2.40
Nickel	Lb.	.48
Platinum, pure	Oz.	105.00
Silver	Oz.	1.00
Spelter	Lb.	.11
Tin	Lb.	.64
Mild Steel	100 lbs.	5.50
Common Bar	100 lbs.	5.25

Several chemical works in Ontario have been visited by the Provincial Chemist, Mr. Bostock, to ascertain what injurious effects to employees have resulted from gases or liquids, and to advise as to means of reducing the risks from explosions. There appears to be a willingness on the part of the owners of chemical plants to make improvements and safeguard the health of employees, and the Chemist and Health Inspector have made a number of recommendations which will be carried out.

Index of Advertisements

Priestley Memorial of the American Chemical Society

Joseph Priestly was born at Fieldhead, in England, in 1733. He was educated for the Episcopalian ministry, but became a Unitarian and acquired note as a teacher, lecturer and investigator of natural science. His researches culminated in the discovery of oxygen in 1774.

Twenty years later, in 1794, he emigrated to the United States, and settled in Northumberland, Pa., where he died in 1804.

On July 31, 1874, many of the leading chemists of America met near Priestley's grave, in honor of his memory and in celebration of centenary of the discovery of oxygen. Later, and as a result of this meeting the American Chemical Society was established.

Because of this association of the Society with Priestley, a committee has been appointed by the president to devise and carry out a plan for a suitable memorial to Joseph Priestley. The committee has decided: (1) to secure a copy of the best available portrait of Priestley to be deposited as a loan in the national museum in Washington, D.C. (2) That a gold medal be awarded at intervals of probably more than one year for superior achievement in chemical research.

For these purposes at least $2,000 will be required.

Subscriptions of $1.00 and upwards will be received by F. C. Phillips, Chairman of the Committee, University of Pittsburg, Pittsburg, Pa.

An important agreement has been arrived at between two of the principal British chemical firms which will enable them to meet more successfully than otherwise would be the case the strenuous world competition anticipated after the war. The interests of Brunner, Mond, and Company, Limited, of Northwich, and Chance and Hunt, Limited, of Oldbury, Wednesbury, and Stafford, are consolidated. Messrs. Brunner, Mond acquire a majority of the ordinary shares of Chance and Hunt, but no alteration in the name of the company will be made, nor is any material change of administration at present contemplated. The amalgamation follows upon a long period of friendly working arrangements.

Acid-Proof Tower Packing or Filling

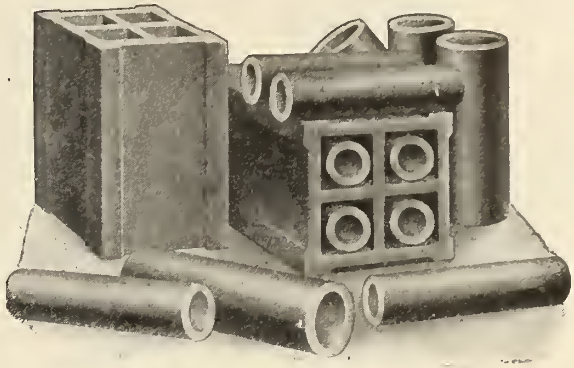
We are now in a position to give

—Prompt Deliveries—

As we have quadrupled our capacity

Acid Proof Hollow Balls

The most efficient packing for small towers. Made 3½ in. in diameter. All our packing is salt glazed.



Tower Packing "A," "B," "C"

A strong and efficient packing for large Sulphuric Towers.
"A"—Partition block, 8 in. x 8 in. x 12 in.
"B"—4 in. x 12 in. Pipe—to break joints.
"C"—3 in. x 12 in. Pipe—to fill blocks, adding greatly to scrubbing surface.

Acid Proof Vitrified Brick

Made in most any size or shape. Standard size 8 in. x 4 in. x 2 in. carried in stock. Used in packing or lining towers.

Acid Proof Partition Rings

The most popular tower packing for any kind or size tower. Note the curved partition. These rings afford a good draft and a maximum scrubbing surface. Made in three standard sizes—4 in. x 3 in., 4 in. x 6 in., 6 in. x 6 in.—carried in stock.

Large Acid Proof Tower Basetile

Used for bridge work at bottom of towers for supporting packing. Made in any sizes up to 60 in. x 36 in. x 6 in.

We do not depend upon a glaze, enamel or veneer.

Let us send you prices and Circulars.

It is the

BODY ITSELF

We make every description of Acid-Proof Chemical Stoneware, from special pieces to complete plants.

MAURICE A. KNIGHT Office Kelley Ave., **East Akron, Ohio**

Classified Index of Advertisements

CANADIAN CHEMICAL JOURNAL

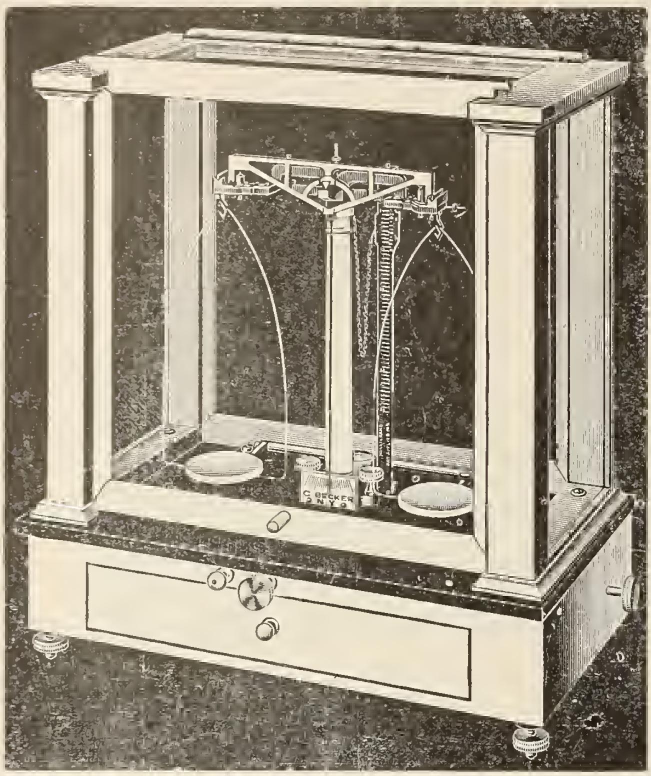
A Canadian Journal devoted to Metallurgy
Electro-Chemistry and Industrial Chemistry.

Vol. 1, No. 7 TORONTO, NOVEMBER, 1917 20c. a copy; $2 a year

PROFESSIONAL DIRECTORY

Analytical Chain Balance

INVALUABLE FOR RAPID WORK



The **chain balance** is of the usual construction of analytical balances, with the exception that there is no rider and consequently no graduations on the beam. All weighing below 50 m.g. to 1/10 m.g. is accomplished by lifting or lowering a small gold chain, suspended at one end from the beam, and at the other from a sliding hook attached to the graduated scale, from which direct readings are taken. To operate it is only necessary to rotate the thumb screw, conveniently placed outside the balance case, on the right hand side. (See illustration). This operation can take place while the beam is swinging, this in conjunction with the **elimination of all riders, and small weights below 50 m.g., resulting in a great saving of time.**

ANALYTICAL CHAIN BALANCE No. 15
With Vernier

Capacity	100 grams
Sensitiveness	1/20 milligram
Diameter of Pans	3 inches
Length of Beam	6 inches
Bearings	Agate
Knife edges	Agate
Capacity of bar and vernier	50 Mg. to 1/10 Mgm.

Polished mahogany case, front sliding frame, counterpoised. Mounted on black plate glass.

Price Duty Free)	**$120.00**
" (Duty Paid)	**168.00**

Above prices subject to advance without notice.

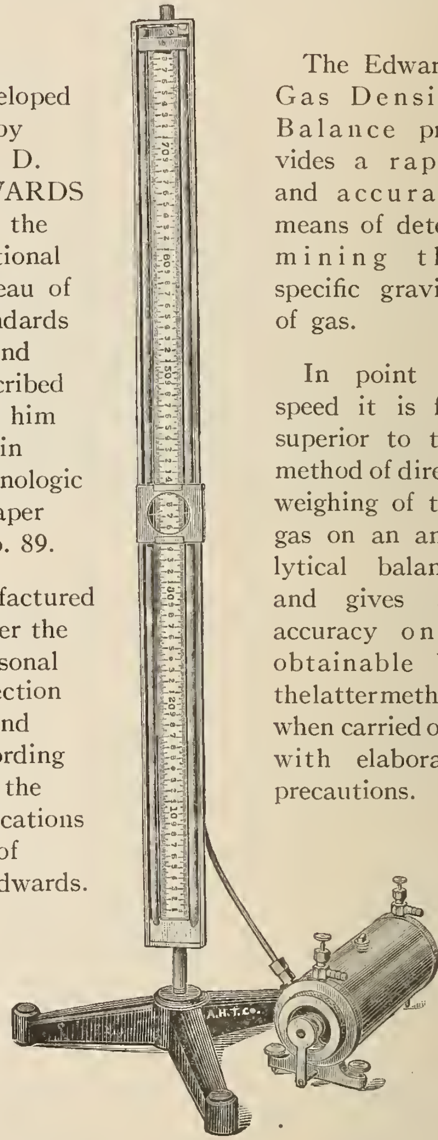
SALES AGENTS

LYMANS, LIMITED
344 St. Paul St. West MONTREAL

EDWARDS GAS DENSITY BALANCE

Developed by J. D. EDWARDS at the National Bureau of Standards and described by him in Technologic Paper No. 89.

Manufactured under the personal direction and according to the specifications of Mr. Edwards.



The Edwards Gas Density Balance provides a rapid and accurate means of determining the specific gravity of gas.

In point of speed it is far superior to the method of direct weighing of the gas on an analytical balance and gives an accuracy only obtainable by the latter method when carried out with elaborate precautions.

Price, complete with manometer and sufficient mercury for charging same, in carrying case **$100.00**

Complete Descriptive Pamphlet sent upon request.

ARTHUR H. THOMAS CO.
IMPORTERS—DEALERS—EXPORTERS
LABORATORY APPARATUS AND REAGENTS
West Washington Square Philadelphia, U.S.A.

CANADIAN CHEMICAL JOURNAL

A Canadian Journal devoted to Metallurgy Electro-Chemistry and Industrial Chemistry.

Vol. 1 TORONTO, NOVEMBER, 1917 No. 7

CANADIAN CHEMICAL JOURNAL

DEVOTED TO THE CHEMICAL AND METALLURGICAL INTERESTS OF CANADA.

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NOTICE

The Editorial Department of The Canadian Chemical Journal exercises every practicable care to ensure the correctness of the contents of the Journal. In the case of signed articles it is to be distinctly understood that the authors of such articles are alone responsible for the statements which they may contain of fact, opinion or conclusion.

Principal Contents

In order to complete sets of the first volume the publishers will be thankful for copies of THE CANADIAN CHEMICAL JOURNAL of any month from May to August, inclusive.

Particulars of the Canadian Victory Loan will be found on page 39B of this issue. The men of the Canadian Army will be nerved for the fighting when Canadians at home pledge their money as readily as our soldiers pledge their lives.

As we go to press Ottawa despatches report that an Order-in-Council has been passed lifting the ban from oleomargarine, which may now be imported or manufactured in Canada under restrictions after Nov. 14th.

The Chemical Elements

THE chemical elements are, needless to say, the basis of all chemistry and are, therefore, of fundamental importance to every chemist, no matter in what field he works. Until a few years ago chemists, with hardly an exception, accepted the idea that each of the seventy odd elements represented an unique form of matter, which was simple, in the sense that it was undecomposible.

It is true that Dr. Crookes had suggested the existence of "protyle" as a hypothetical element, of which he supposed the "ordinary" elements to be composed. Thus, for example, he explained the difference between oxygen and hydrogen as consisting essentially in their being compounded of different numbers of particles of protyle, whereas the ordinary view was that they each constituted a separate and distinct elementary form of matter.

Crookes' suggestions led to much discussion, but failed to gain many converts, chiefly, probably, because he was, of necessity, unable to demonstrate the existence of "protyle."

The discovery of radium and its analogues, the discovery, that is to say, of "elements" actively decomposing into other elementary forms of matter, naturally caused chemists to reconsider their traditional views of the nature of ordinary, nonradioactive elements.

In the meantime, and, of course, independently physicists had been working on the nature of electricity. They reached the conclusion that unit charges of electricity possessed mass. This was a hard saying to many chemists, because they had been trained to regard mass as the one unchangeable, fundamental property of matter, whereas electricity was supposed to be a form of energy, i.e., not matter.

The field of greatest promise for the investigation of the nature of the elements is evidently to be found in connection with the radio-active substances. By far the most work and by far the most important work on this question has been done by Rutherford and Soddy, in association and separately. It is, therefore, very gratifying to be able to present to our readers the report of a lecture by Professor

Soddy, on the nature of the chemical elements. This lecture gives, in a non-technical form, the latest and best considered results obtained in the investigation of this fascinating subject.

Industrial Research Scholarships

Perhaps one of the most important effects of the war is the dramatic manner in which it has forced the public to recognize the part which the chemist plays in the production of almost all articles of commerce and in the profitable utilization of raw materials.

Chemists themselves are well aware that their work falls naturally into two great divisions, which may be termed "testing" and research, respectively. There is, of course, some overlapping and not infrequently the same individual may perform both kinds of work, but the essential distinction between the two is quite definite and clear. The "tester" follows along well beaten paths, which have been discovered and made for him by previous research workers. This does not imply in any way a reproach, the minute to minute activity of many industries depends on the faithful and skillful work performed in their analytical and testing laboratories.

The army of chemists is like the army of soldiers. It necessarily consists of officers and of privates, each alike essential to the success of the army and to that of the individuals comprising it. We speak of some individuals as being "born leaders," or as "born investigators," the expressions are, perhaps, occasionally true, but are generally misleading.

Experience has shown that the majority of the best army officers can be recruited from the ranks and that what chiefly distinguishes a good officer from a good private is education. It is exactly the same in chemistry; the majority of good routine workers may become good, though not necessarily distinguished, investigators, provided they obtain the needful training.

At present Canada is, chemically speaking, independent of Germany. The question is, will she remain so after the war is over? The answer to this is that it will depend, fundamentally, on the number and skill of her research chemists. Should these be adequate and should manufacturers and capitalists co-operate with them liberally and freely, Canada will win in the post-war struggle, otherwise she will drop back into her previous condition of chemical servitude. The Government of the day may help a little, or hinder a little, by wise—or unwise—patent and trade-mark legislation, but it cannot alter the final result.

In order to increase the supply of investigators the Dominion Parliament has recently voted money to establish twenty research studentships and five research fellowships, which are to be divided amongst some seven branches of science. The small number of these studentships may, perhaps, be accounted for by the fact that the whole plan is in the experimental stage. Unfortunately the scheme is open to grave objection on other grounds. The holders of studentships must possess a Bachelor Degree, or its equivalent and must devote their whole time to research.

This latter condition is absolutely opposed to all the best educational experience in the development of research men.

In Germany and the United States, for example, the practice is for the holder of a bachelor degree (or its equivalent) to take a three years' course leading to a Ph.D. degree. About half the time is spent in research, and the remainder on intensive, advanced courses of work, collateral to, but outside of the special research topic. In this manner the student gains an intensive and extensive training. The plan of research studentships is bound to narrow the minds of the holders and to make them mentally lop-sided.

It is, of course, to be recognized that no university in Canada is equipped to give courses of graduate work of the kind indicated above, and which are given by any one of a dozen or more universities in the United States. Until such courses are provided it is hopeless to expect any special increase in the number of trained investigators in Canada. The way to accomplish this, which we all wish for, is first to improve the quality of instruction given in our universities. and then, if necessary, offer scholarships or fellowships so that students of the best type and of sufficient capacity, may be able and willing to utilize the enhanced opportunities which the universities will offer.

The Complexity of the Chemical Elements*

By Prof. Frederick Soddy, M.A., F.R.S.

The elements of the chemist are now known to be complex in three different senses. In the first sense the complexity is one that concerns the general nature of matter, and therefore of all the elements in common to greater or less degree. It follows from the relations between matter and electricity which have developed gradually during the past century as the result of experiments made and theories born within the four walls of this institution. Associated initially with the name of Davy and Faraday, they have only in these days come to full fruition as the result of the very brilliant elucidation of the real nature of electricity by your distinguished Professor of Physics, Sir Joseph Thomson. Such an advance, developing slowly and fitfully, with long intervals of apparent stagnation, needs to be reviewed from generation to generation, disentangled from the undergrowth that obscures it, and its clear conclusions driven home. This complexity of the chemical elements is a consequence of the condition that neither free electricity nor free matter can be studied alone, except in very special phenomena. Our experimental knowledge of matter in quantity is necessarily confined to the complex of matter and electricity which constitutes the material world. This applies even to the "free" elements of the chemist, which in reality are no more free then than they are in their compounds. The difference is merely that, whereas in the latter the elements are combined with other elements, in the

*A lecture delivered at the Royal Institution, May 18, 1917.

so-called free state they are combined with electricity. I shall touch but briefly on this first aspect, as in principle it is now fairly well understood. But its consistent and detailed application to the study of chemical character is still lacking.

The second sense in which the elements, or some of them at least, are known now to be complex has, in sharp contrast to the first, developed suddenly and startlingly from the recognition in radio-active changes, of different radio-elements, non-separable by chemical means, now called istopes. The natural corollary of this is that the chemical element represents rather a type of element, the members of this type being only chemically alike. Alike they are in most of those properties, which were studied prior to the last decade of last century and which are due, as we now think, to the outer shells of the atom, so alike that all the criteria, hitherto relied upon by the chemist as being the most infallible and searching, would declare them to be identical. The apparent identity goes even deeper into the region reached by X-ray spectrum analysis which fails to distinguish between them. The difference is found only in that innermost region of all, the nucleus of the atom, of which radio-active phenomena first made us aware.

But though these phenomena pointed the way, and easily showed to be different what the chemist and spectroscopist would have decided to be identical, it did more. It showed that although the finer and newer criteria, relied upon by the chemist in his analysis of matter, must of necessity fail in these cases, being ultimately electrical in character, yet the difference should be obvious in that most studied and distinctive characteristic of all—the criterion by which Dalton first distinguished the different kinds of atoms—the atomic weight. Those who have devoted themselves to the exact determination of these weights have now confirmed the difference in two separate cases, which, in absence of what perhaps they might regard as "preconceived notions," they were unable to discover for themselves. This is the experimental development to which I wish more especially to direct your attention. It indicates that the chemical analysis of matter is, even within its own province, superficial rather than ultimate, and that there are indefinitely more distinct elements than the ninety-two possible types of element accommodated by the present periodic system.

The third sense in which the elements are known to be complex is that which, in the form of philosophical speculations, has come down to us from the ancients, which inspired the labors of the alchemists of the Middle Ages, and which in the form of Prout's hypothesis has reappeared in scientific chemistry. It is the sense that denies to Nature the right to be complex, and from the earliest times, faith out-stripping knowledge, has underlain the belief that all the elements must be built up of the same primordial stuff. The facts of radioactive phenomena have shown that all the radio-elements are indeed made up out of lead and helium, and this has definitely removed the question from the region of pure speculation. We know that helium is certainly a material constituent of the elements in the Proutian sense, and it would be harmless, if probably fruitless, to anticipate the day of fuller knowledge by atom building and unbuilding on paper. Apart altogether from this, however, the existence of isotopes, the generalisation concerning the Periodic Law that has arisen from the study of radio-active change on the one hand and the spectra of X-rays on the other, and experiments on the scattering of α-particles by matter, do give us for the first time a definite conception as to what constitutes the difference between one element and another. We can say how gold would result from lead or mercury, even though the control of the processes necessary to effect the change still eludes us. The nuclear atom proposed by Sir Ernest Rutherford, even though, admittedly, it is only a general and incomplete beginning to a complete theory of atomic structure, enormously simplifies the correlation of a large number of diverse facts. This and what survives of the old electronic theory of matter, in so far as it attempted to explain the Periodic Law, will therefore be briefly referred to in conclusion.

The Free Element a Compound of Matter and Electricity

Although Davy and Faraday were the contemporaries of Dalton it must be remembered that it took chemists fifty years to put the atomic theory on a definite and unassailable basis, so that neither of these investigators had the benefit of the very clear view we hold to-day. Davy was the originator of the first electrochemical theory of chemical combination, and Faraday's dictum, "the forces of chemical affinity and electricity are one and the same," it is safe to say, inspires all the modern attempts to reduce chemical character to a science in the sense of something that can be measured quantitatively, as well as expressed qualitatively. Faraday's work on the laws of electrolysis and the discovery that followed from it, when the atomic theory came to be fully developed, that all monovalent atoms or radicles carry the same charge, that divalent atoms carry twice this charge and so on, can be regarded to-day as a simple extension of the law of multiple proportions from compounds between matter and matter to compounds between matter and electricity. Long before the electric charge had been isolated, or the properties of electricity divorced from matter discovered, the same law of multiple proportions which led, without any possibility of escape, to an atomic theory of matter, led, as Helmholtz pointed out in his well-known Faraday lecture to the Chemical Society in this theatre in 1881, to an atomic theory of electricity.

The work of Hittorf on the migration of ions, the bold and upsetting conclusion of Arrhenius that in solution many of the compounds hitherto regarded as most stable exist dissociated into ions, the realization that most of the reactions that take place instantaneously, and are utilized for the identification of elements in chemical analysis, are reactions of ions rather than of the element in question, made very familiar to chemists the enormous difference between the properties of the elements in the charged and in the electrically neutral state.

More slowly appreciated, and not yet perhaps sufficiently emphasized, was the unparalleled intensity of these charges in comparison with anything that electrical science can show, which can be expressed tritely by the statement that the charge on a milligrm. of hydrogen ions would raise the potential of the world 100,000 volts. Or, if we consider another aspect, and calculate how many free hydrogen ions you could force into a bottle without bursting it, provided, of course, that you could do so without discharging the ions, you would find that, were the bottle of the strongest steel, the breech of gun, for example, it would burst, by reason of the mutual repulsion of the charges, before as much was put in as would, in the form of hydrogen gas, show the spectrum of the element in a vacuum tube.

Then came the fundamental advances in our knowledge of the nature of electricity, its isolation as the electron, or atom of negative electricity, the great extension of the conception of ions to explain the conduction of electricity through gases, the theoretical reasoning, due in part to Heaviside, that the electron must possess inertia inversely proportional to the diameter of the sphere on which it is concentrated by reason of the electromagnetic principles discovered by Faraday, leading to the all-embracing monism that all mass may be of electro-magnetic origin.

This put the coping-stone to the conclusion that the elements as we apprehend them in ordinary matter are always compounds. in the "free" state they are compounds of the element in multiple atomic proportions with the electron. The ions, which are the real chemically uncombined atoms of matter, can no more exist free in quantity that can the electrons.

The compound may be individual as between the atom and the electron, or it may be statistical, affecting the total number merely of the opposite charges, and the element presumably will be an insulator or conductor of electricity accordingly. Analogously, with compounds, the former conditions applies to unionised compounds such as are met with in the domain of organic chemistry or, ionised, as in the important classes of inorganic compounds, the acids, bases, and salts. Just as the chemist has long regarded the union of hydrogen and chlorine as preceded by the decomposition of the hydrogen and chlorine molecule, so he should not further regard the union itself as a decomposit ion of the hydrogen atom into the positive ion and the negative electron, and a combination of the latter with the chlorine atom.

One of the barriers to the proper understanding and quantitative development of chemical character from this basis is, perhaps, the conventional idea derived from electrostatics, that opposite electric charges neutralize one another. In atomic electricity or chemistry, though the equality of the opposite charges is a necessary condition for existence, there is no such thing as neutralization, or the electrically neutral state. Every atom being the seat of distinct opposite charges, intensely localized, the state of electric neutrality can apply only to a remote point outside it, remote in comparison with its own diameter. We are getting back to the conception of Berzelius, with some possibility of understanding it, that the atom of hydrogen, for example, may be strongly electro-positive, and that of chlorine strongly electro-negative, with regard to one another, and yet each may be electrically neutral in the molar sense. Some day it may be possible to map the electric field surrounding each of the ninety-two possible types of atom, over distances comparable with the atomic diameter. Then the study of chemical character would become a science in Kelvin's sense, of something that could be reduced to a number. But the mathematical conceptions and methods of attack used in electro-statics for macroscopic distances are ill-suited for the purposes of chemistry, which will have to develop methods of its own.

We have to face an apparent paradox that the greater the affinity that binds together the materials and electrical constituents of the atom, the less is its combining power in the chemical sense. In other words, the chemical affinity is in inverse ratio to the affinity of matter for electrons. The helium atoms offer a very simple and instructive case. Helium is non-valent and in the zero family, possessing absolutely no power of chemical combination that can be detected. Yet we know the atom possesses two electrons, for in radio-active change it is expelled, without them as the α-particle. The discharge of electricity through it and positive-rays show that the electrons, or certainly one of them, are detachable by electric agencies, although not by chemical agencies. One would expect helium to act as a diad, forming helides analogous to oxides.

Professor Armstrong for long advocated the view that these inert gases really are endowed with such strong chemical affinities that they are compounds that have never been decomposed. They certainly have such strong affinities for electrons that the atom, the complex of the + ion and electrons, cannot be decomposed chemically. Yet, in this case, where the affinity of the matter for the electron is at a maximum, the chemical conbining power is absent.

These gases seem to furnish the nearest standard we have to electric neutrality in the atomic sense. The negative charge of the electrons exactly satisfies the positive charge of the matter, and the atomic complex is chemically, because electrically, neutral. In the case of the electro-positive elements, hydrogen and the alkali-metals, one electron more than satisfies the positive charge on the ion, and so long as the equality of opposite charges is not altered, the electron tries to get away. In the case of the electro-negative elements, such as the halogens, the negative charge, though equal presumably to the positive, is not sufficient to neutralize the atom. Hence these groups show strong mutual affinity, one having more and the other less negative electricity than would make the system atomically neutral like helium. The electron explains well the merely numerical aspect of valency. But chemical combining power itself seems to require the idea that equal and opposite charges in the atomic sense are only exactly equivalent in the case of the inert gases. None of these ideas are now new, but their consistent application to the study of chemical compounds seems curiously to hang fire, as though something were still lacking.

It is so difficult for the chemist consistently to realize that chemical affinity is due to a dissociating as well as to a combining tendency and is a differential effect. There is only one affinity, probably, and it is the same as that between oppositely charged spheres. But, atomic charges being enormous and the distances over which they operate in chemical phenomena being minute, this affinity is colossal, even in comparison with chemical standards. What the chemist recognizes as affinity is due to relatively slight differences between the magnitude of the universal tendency of the electron to combine with matter in the case of the different atoms. Over all, is the necessary condition that the opposite charges should be equivalent, but this being satisfied, the individual atoms display the tendencies inherent in their structure, some to lose, others to gain electrons, in order, as we believe from Sir Joseph Thomson's teaching, to accommodate the number of electrons in the outermost ring to some definite number. Chemical affinity needs that some shall lose as well as others gain. Chemical union is always preceded by a dissociation. The tendency to combine, only, is specific to any particular atom, but the energy and driving power of combination is the universal attraction of the + for the — change of matter for the electron.

The Electrical Theory of Matter

Another barrier that undoubtedly exists to the better appreciation of the modern point of view, even among those most willing to learn, is the confusion that exists between the earlier and the present attempt to explain the relation between matter and electricity. We know negative electricity apart from matter as the electron. We know positive electricity apart from the electron, the hydrogen ion and the radiant helium atom or α-particle of radio-active change for example, and it is matter in the free or electrically uncombined condition. Indeed, if you want to find matter free and uncombined, the simple elementary particle of matter in the sense of complexity being discussed, you will go, paradoxically, to what the chemist terms a compound rather than to that which he terms the free element. If this compound is ionised completely it constitutes the nearest approach to matter in the free state. Thus all acids owe their common acidic quality to really free hydrogen, the hydrogen ion, a particle more different from the hydrogen atom than the atom is from the hydrogen molecule.

Positive electricity is thus emphatically not the mere absence of electricity, and any electrical theory of matter purporting to explain matters in terms of electricity does so by the palpable sophistry of calling two fundamentally different things by the same name. The dualism remains whether you speak of matter and electricity, or of positive and negative electricity, and the chemist would do well to stick to his conception of matter until the physicist has got a new name for positive electricity which will not confuse it with the only kind of electricity that can exist apart from matter.

On the other hand, the theory of the electro-magnetic origin of mass or inertia is a true monism. It tries to explain consistently two things—the inertia of the electron and the inertia of matter—by the same cause. The inertia of the former being accounted for by the well-known electro-magnetic principles of Faraday, by the assumption that the charge on the electron is concentrated into a sphere of appropriate radius; the 2,000-fold greater inertia of the hydrogen ion, for example, can be accounted for by shrinking the sphere to one-two-thousandth of the electronie radius.

But the electrical dualism remains completely unexplained. Call the electron E and the hydrogen ion H. The facts are that two E's repel one another with the same force and according to the same law as two H's repel each other, or as an H attracts an E. These very remarkable properties of H and E are not explained by the explanation of the inertia. Are E and H made up of the same stuff or of two different stuffs? We do not know, and certainly have no good reason to assume, that matter minus its electrons is made of the same thing as the electron. We have still to reckon with two different things.

(To be continued)

Canadian Wood Oils for Ore Flotation*

By R. E. Gilmore and C. S. Parsons*

In August, 1916, the Canadian Government, at the request of the Cobalt mining interests, began active work on an Investigation of Canadian Wood Oils for Ore Flotation.

The success of the flotation process for the concentration of the low grade silver ores was already demonstrated. On account of the difficulty which the flotation plants, the number of which was rapidly growing, reported in obtaining an adequate supply of imported pine oil, it was decided to investigate the possibilities of either finding a substitute for pine oil which was found necessary as a selective frothing oil, or of producing a satisfactory grade of pine oil in sufficient quantities from Canadian resinous wood waste.

The collecting of the wood oils was carefully planned and speedily carried out by the Forest Products Laboratories, Montreal, where physical and chemical examinations were made. The flotation tests were made by the Division of Ore Dressing and Metallurgy, Mines Branch, Ottawa.

Part 1.—The Collection and Examination of the Wood Oils

Experience has shown that the flotation value of an oil or oil mixture for a given ore, and especially silver ores of Cobalt, cannot as yet be forecasted. Hence it was necessary to collect all available wood oils both resinous and hardwood, of which the price seemed reasonable and in the collecting of these oils special care was taken to understand their origin and to make sure, as far as possible, that these oils could be duplicated commercially.

With the permission of the Standard Chemical Iron and Lumber Company of Canada, Limited, the accompanying flowsheet (No. 1) outlines the origin of the hardwood oil samples collected from their Longford, Ont., plant.

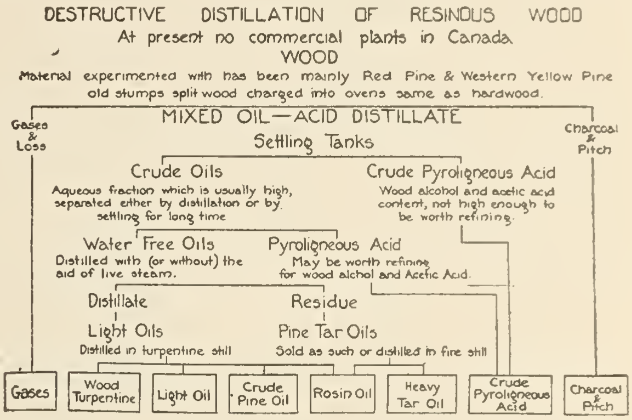
As yet there is no commercial source of resinous wood oils in Canada. The purest grade of pine oil comes from the longleaf southern pine of the Southern States by the steam and solvent process and a less pure grade by destructive distillation. As it is very doubtful whether any process other than destructive distillation will prove successful for Canadian resinous wood waste, a flow sheet (No. 2) of the destructive distillation process only is given here. Resinous wood oil samples collected and tried out for flotation value include crude oil distillate and its fractions from experimental runs made on red pine stumps at the Buffalo Mines, Cobalt, Ont., and crude oil distillate, including crude turps, crude light oil and pine tar oil from experimental distillation runs made on British Columbia western yellow pine stumps at Wilmington, North Carolina, by the Pritchard heat control process.

In addition to a knowledge of the origin of an individual oil, a fractional distillation and determination of the physical properties of the fractions in detail were considered ample in order to describe the oil and to be able to obtain a duplicate sample when desired. In the following standard method adopted for the examination of the oils by fractional distillation the description of an oil by curves was employed. A few of the more successful oils are illustrated in Figures 1, 2, 3 and 4.

Details of this standard fractional distillation method are as follows:

Distillation Flask Used.—Ordinary half litre Engler distillation flask made of Pyrex glass.

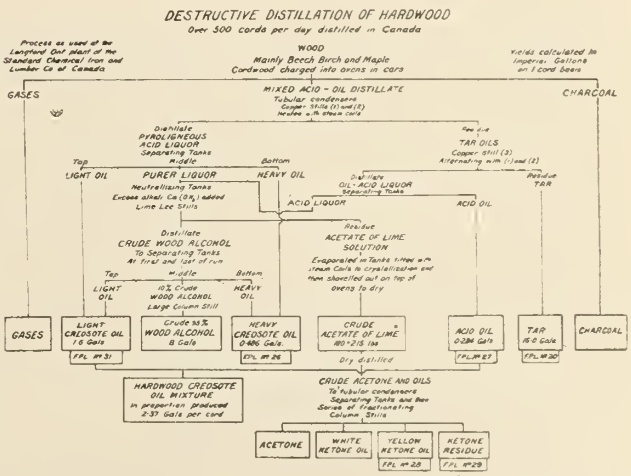
Fractionating Column.—Two inches of standard glass ring beads supported in platinum or aluminum wire basket resting on hollow glass tubing; upper end of the glass tubing is bent in loop and fits the lower end of the stem of the flask, while the lower end rests on the bottom of the distillation flask itself.



This glass tubing support with the upper loop end drawn out and sealed and the lower end left open also helps to prevent bumping by causing a steady stream of fine bubbles of the expanding air within the tube to escape from the contact point at the lower end as the temperature rises.

Condenser.—A short Liebig water condenser held in position at an angle of about 45 degrees and fitted so that for a high boiling oil the water could be run out from the jacket and a stream of air passed through either by pressure or suction.

Source of Heat.—An electric oven was constructed for the purpose, in which the distilling flask was set, leaving only the neck of flask with its fractionating column of beads exposed. By this arrangement with an electric current differing for dif-



ferent oils the time factor in the heat equation (Heat = Constant $\times$ R C^2T, where R = resistance in ohms, C = current in amperes and T = time in seconds) takes care of the rate of distillation which it is all important to keep uniform.

Thermometer.—A 360-degree mercury thermometer was inserted so that the top of the mercury bulb was level with the top of the delivery tube opening. The standard correction for emergent stem was added; viz., N $(t-t^1)$ 0.000143, where N = number of degrees on the part of the mercury column outside the bath, t = temperature read and t^1 = the average temperature of the air surrounding the emergent part of the stem.

* R. E. Gilmore, Forest Products Laboratories of Canada, Forestry Branch, Montreal. C. S. Parsons, Ore Dressing Division, Mines' Bra

Rate of Distillation.—The average rate of distillation was 2.0 to 2.2 grams per minute, running between 90 and 120 drops in the same time, depending on the density of the distillate.

Amount of Sample Used and Fractional Cuts.—350 grams was the usual sample taken and 10 per cent. fractions (about

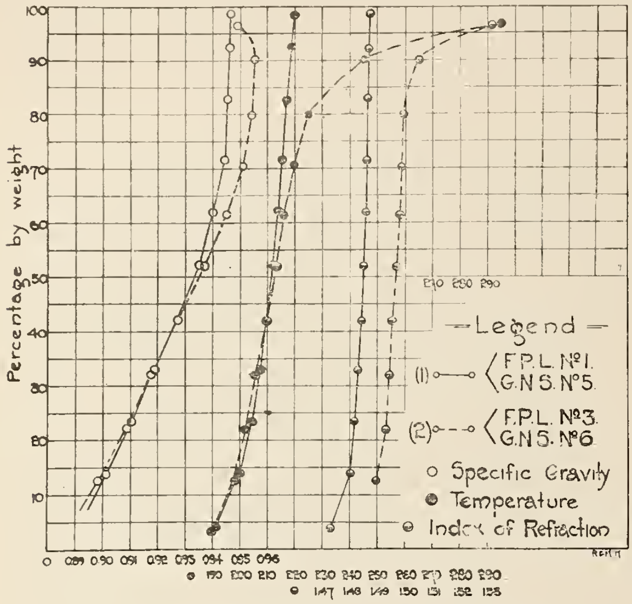


Fig 1. Curves showing records of fractional distillation of two different samples of pine oil. (1) Pine Oil by steam & solvent process. F.P.L. Nº1 (G.N.S. Nº5). & (2). Pine Oil by destructive distillation. F.P.L. Nº3 (G.N.S. Nº6)

35 grams) were separated, noting the temperature and time at each cut. Each fraction was collected in a small cylinder stand ¾ inches in diameter and 5 inches high, suitable for taking specific gravity readings.

Specific Gravity and Refractive Index Readings.—Specific gravity readings were taken with a Westphal balance

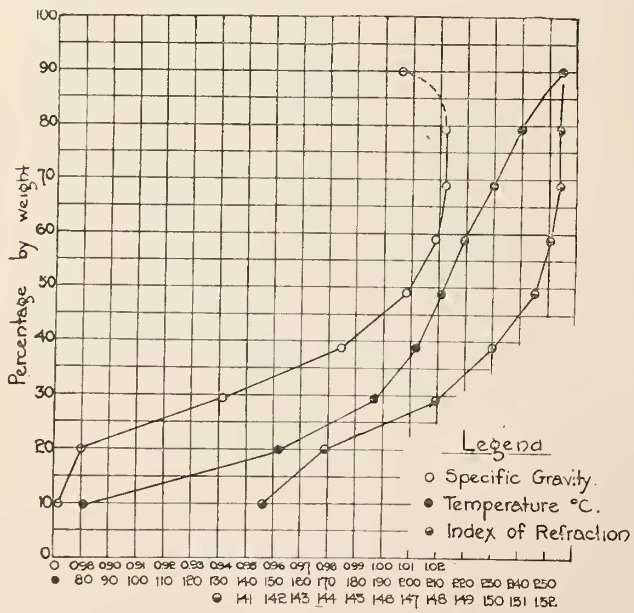


Fig. 2. Curves showing distillation record of F.P.L. Nº 31 (Crude hardwood creosote mixture) of which all its fraction except 1 & 2 (i.e. below 20% by wt.) gave satisfactory results as a frothing oil in place of Pine Oil on Cobalt Ore.

and at room temperature, while the refractive index readings were observed by an Abbe refractometer also at room temperature. All readings were corrected to 15°C.; in the case of specific gravity 0.0008 was added to the observed reading for every degree above 15°C, and in the case of refractive index 0.000365 was added to the observed reading for every degree above 15°C.

It is evident that in order to check one distillation with another

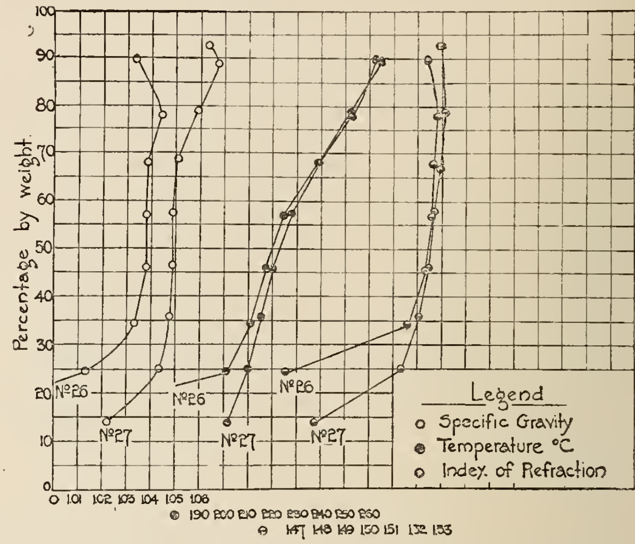


Fig 3. Curves showing distillation of crude oils F.P.L. Nºs 26 & 27; heavy hardwood creosote, and hardwood "Acid Oil" respectively.

on the same sample a uniform rate of distillation is all important, and a uniform rate of distillation is directly dependent on a uniform rate of heating. Although the best checks were obtained when using an electric oven, remarkably close checks were obtainable with the distilling flask set in sand bath over a gas flame which flame could be regulated by a screw pinch cock. This is true and adaptable for oils with boiling point range, say below 250°C. For higher boiling oils, especially tar oils, a free flame is necessary but a fractionating column of beads is inadvisable. When using a gas flame an asbestos box or better an asbestos cloth cover fitted over and around the distillation

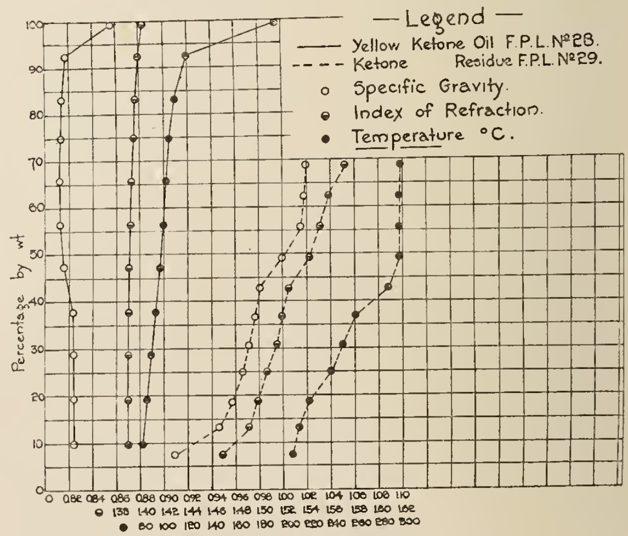


Fig. 4. Curves showing distillation records of Yellow Ketone Oil F.P.L. Nº28 and crude Ketone Residue F.P.L. Nº29 both produced in the hardwood distillation refinery.

flask served to give better heat control and resembled more closely the conditions where the electric oven was used.

Although not necessary providing a uniform rate of heating was supplied, it was found even for the crude hardwood creosote oils that a fractionating column of beads aided in giving a more uniform rate of distillation; the curves of distillations where beads were used showed more pronounced deflection points and gave much better checks than when no beads were used.

Determination of Water Content of an Oil Sample.— Where the moisture content of an oil is less than 10 per cent. and where only a small fraction of the oil distils below say 150°C, the aqueous fraction will be practically all in the first fractional cut and if collected in a small graduated cylinder can be read off directly. When an oil sample has a high aqueous content it is best first to run a preliminary distillation up to say 200°C and then after noting and separating the water layer return the oil content to the cooled distilling flask and begin again. A few pieces of broken porous porcelain or pumice stone and a small amount of paraffin wax put into the flask with the oil generally aid greatly in preventing superheating, bumping and excessive frothing when distilling an oil sample containing more or less water.

Oils for Flotation Tests

1st. Among the first series of oils tried out were the original crude oils as collected. These are represented by serial numbersl

2nd. A sample of the total distillate, being the combined fractions from a distillation run, was in each case saved and tried out to see if the removal of free carbon and heavy pitch or coke residue from the oil improved its flotation value. These distillates are represented by an alphabetic letter after the number of oil from which it was derived.

3rd. Individual fractions and groups of fractions were saved for the purpose of finding out just what part of a crude oil was of most flotation value.

4th. Preliminary chemical separations of the hardwood creosote oils into neutral and acidic (phenolic and creosotic) constituents were carried out and the respective flotation values of these two group separates tried out.

Following in Table No. 1 is a description of all the oils submitted for flotation tests. A more detailed description of each of these oils is available at the Forest Products Laboratories where also a duplicate sample is in reserve.

TABLE NO. 1—DETAILS OF THE WOOD OILS COLLECTED AND EXAMINED

F.P.L.[1] No.	DESCRIPTION OF OIL	Appearance	Sp. Gr. and Ref. Index at 15°C	Flotation Action on Cobalt Ores
1	**Pine Oil,** G.N.S.[2] No. 5 (same as G.N.S. No. 55 from longleaf southern pine by the steam and solvent process. 95% by wt. distilled between 190°C. and 220°C. where sp. gr. was 0.890 to 0.946 and ref. index 1.473 to 1.488.	Clear, Light Amber	0.9330 1.4837	Excellent selective frother; poor collector
2	**Pine Oil,** redistilled from G.N.S., No's 55 and 4. 100% distilled between 190°C and 220°C.	Clear, Light Amber	0.9310 1.4848	Same as above
3	**Pine Oil,** G.N.S. No. 6 (same as G.N.S. No. 4) from longleaf southern pine by destructive distillation process. 67% distilled between 190°C and 220°C where sp.gr. range was 0.890 to 0.951. Only 90% distilled below 246°C.	Clear, Amber	0.934 1.4995	Good selective frother; poor collector
4	**Crude Oil Distillate,** P.T.T.[3]. No 350 from southern pine by destructive distillation. 50% by wt. only, distilled below 345°C. On primary distillation only 13% distilled between 190°C and 245°C where sp.gr. range was 0.897 to 0.965.	Black, Opaque	1.0190	Good Frother but Non-selective; poor collector
14	**Crude Oil Distillate** from red pine stumps. Yield of this oil is 13.9% by wt. of original wood or 36 Imp. gals. per 2,600 lb. cord. On secondary distillation only 5% of original oil distilled between gravities of 0.890 and 0.965; 28% of this oil is distillable with steam.	Black, Opaque	1.009	Good but Non-selective; poor collector.
17	**Crude Turps,** from western yellow pine stumps. Yield equals 10.8 Imp. gals. per 2,600 lb. cord. Primary distillation gave over 60% distilling below 174°C with sp. gr. below 0.870.	Black, Opaque	0.9070	fair frother
18	**Crude Light Oil** from western yellow pine stumps. Yield equals 2.4 Imp. gals. per 2,600 lb. cord. Primary distillation gave over 50% distilling below 190°C. with sp.gr. below 0.88.	Black, Opaque	0.9300	Good frother and fairly selective
19	**Crude Pine Tar Oil** from western yellow pine stumps. Yield equals 38 Imp. gals. per 2,600 lb. cord. Less than 12% distilled below 246°C having gravity below 1.01. This oil yields 6.5% of crude pine oil suitable for flotation of Cobalt ore.	Black, Opaque		Good frother but non-selective, poor collector
23	**Coal Tar** from the Dominion Tar and Chemical Company, Sault Ste. Marie, Ont.	Black, Opaque		Excellent collector
24	**Coal Tar Creosote** from the same company as above. 80% by wt. distilled between 170°C and 325°C.	Black, Opaque		Excellent collector

1Forest Products Laboratories of Canada.
2General Naval Stores Company, New York.
3Pensacola Tar and Turpentine Co., Gull Point, Florida.

F.P.L.[1] No.	DESCRIPTION OF OIL	APPEARANCE	SP. GR. AND REF. INDEX AT 15°C	FLOTATION ACTION ON COBALT ORES
25	**Light Hardwood Creosote Oil** from top of separating tanks after crude pyroligneous acid copper stills and also after lime-lee stills. 35% by wt. distilled below 150°C having gravity below 0.885. Over 90% distilled below 255°C of which gravity was below 1.025.	Black, Opaque	0.9550	Good frother and selective, fair collector
25A	**Light Hardwood Creosote,** being 35% of No. 25. Distillation range, 60°C—150°C. Sp. Gr. range, 0.880—0.882. Ref. Index range, 1.407—1.458.	Clear, Light Amber	0.8880 1.4288	Poor frother
25B	**Light Hardwood Creosote,** being 57% of No. 25. Distillation range, 150°C—255°C. Sp. Gr. range, 0.882—0.990. Ref. Index range, 1.458—1.520.	Clear, Reddish Amber	0.9750 1.5077	Good selective frother; good collector
26	**Heavy Hardwood Creosote Oil** from bottom of same separating tanks as above. Less than 24%, including 8.5% aqueous distilled below 200°C. 62% distilled between 200°C and 260°C where sp.gr. range was 1.013 to 1.044.	Black, Opaque	1.0375	Very good selective frother; collector. good
26A	**Heavy Hardwood Creosote Distillate** being 82% of No. 26. Distillation range, 60°C—260°C. Sp. Gr. range, 0.924—1.036. Ref. Index range, 1.434—1.524. 75% acidic, 23% neutral.	Reddish Amber	1.0300 1,5115	Good selective frother and good collector
27	**Heavy Hardwood Creosote Oil** known as "acid oil" coming from separating tanks after heavy oil and tar still. Less than 14% including 5.25% aqueous distilled below 200°C. 75.5% distilled between 200°C and 265°C where sp. gr. range was 1.0435 to 1.0675.	Black, Opaque	1.0545	Very good selective frother good collector
27A	**Heavy "Acid Oil" Distillate** being 87.5% of No. 27. Distillation range, 90°C—265°C. Sp. Gr. range, 1.023—1.063. Ref. Index range, 1.479—1.530. 90% acidic, 9% neutral.	Reddish Amber	1.0490 1.5210	Same as No. 27
28	**Heavy Yellow Ketone Oil** from the refining of acetone. Of the several ketone oils this sample is the heaviest of the series leaving ketone residue. Over 90% distilled below 120°C where sp.gr. range was 0.81 to 0.82 and ref. index 1.389 to 1.400.	Clear, Amber	0.8275	Fair frother selective action greatly increased by alkali (NaOH
29	**Ketone Residue,** of thick syrupy nature being residue after the refining of acetone and various ketone oils. 70% is distillable below 300°C above which it is hard to proceed under ordinary conditions. Over 60% distilled between 210°C and 300°C where sp.gr. range was 0.91 to 1.014.	Black, Opaque	1.0345	Good selective frother and fair collector
29A	**Ketone Residue Distillate** being 70% of No. 29. Distillation range, 95°C—310°C. Sp.Gr. range, 0.910—1.020. Ref. Index range, 1.470—1.590.	Reddish Brown, Slightly Opaque.	0.943	Good frother and fairly selective
30	**Hardwood Tar,** being residue left in tar stills after all available acid-alcohol liquor and creosote oils have been removed. Without the aid of a small amount of superheated steam it is difficult to distill more than 30% of this tar. 39%, including 9% aqueous distilled below 300°C of which sp.gr. was below 1.132.	Black, Opaque and quite viscous		Good frother, but non-selective
30A	**Hardwood Tar Distillate** being 30% of No. 30. Distillation range, 90°C—235°C. Sp. gr. range, 1.025—1.14. Ref. Index range, 1.490—1.50. Roughly—50% acidic.	Reddish Brown, almost Opaque	1.058 1.495	Good frother, poorly selective; and fair collector
31	**Hardwood Creosote Mixture,** being mixture in proportion produced of: No. 25—Light creosote oil. No. 26—Heavy creosote oil and No. 27—Acid oil. See F.P.L. No. 31A.	Black, Opaque	0.9985	Good selective frother and good collector
31A	**Hardwood Creosote Mixture Distillate** being 87% of No. 31. Distillation range, 55°C—255°C. Sp.Gr. range, 0.882—1.022. Ref. Index range, 1.416—1.524. Roughly—50% acidic, 50% neutral.	Clear, Dark Amber	0.989	Good frother and selective; fair collector

F.P.L.[1] No.	DESCRIPTION OF OIL	APPEARANCE	SP. GR. AND REF. INDEX AT 15°C	FLOTATION ACTION ON COBALT ORES
32	**Crude Light Oil** from red pine stumps being oils distilling below 235°C from F.P.L. No. 14 having sp. gr. below 0.995.	Dark Amber	0.9293 1.4830	Poor frother in quantities used; poor collector
33	**Rosin and Tar Oil** from red pine stumps being oils distilling between 235°C and 345°C in primary distillation of F.P.L. No. 14 having a sp.gr. range, 0.995 to 1.017.	Reddish Amber	1.0150	Poor frother in quantities used
34	**Turps. and Light Oil** from secondary distillation of oil distillate from red pine stumps, being fraction of No. 32 distilling up to 175°C having gravity below 0.886 and refractive index 1.451 to 1.477.	Light Amber	0.8900 1.4708	Poor frother in quantities used
35	**Crude Pine Oil** from red pine stumps being fraction from distillation of No. 32, distilling between 175°C and 216°C (using beads as fractionating column) and having gravity range of 0.886 to 0.995 and Ref. Index range of 1.477 to 1.503. Yield equals 4.3 Imp. gals. per 2,600 lb. cord.	Clear, Light Amber	0.9443 1.4942	Excellent frother and selective; fair collector
36	**Light Rosin Oil** from red pine stumps being fraction of No. 32 distilling between 216°C and 250°C having sp.gr. range 0.995 to 1.03 and ref. index, 1.503 to 1.517.	Reddish Amber		Good frother; poor selector
37	**Light Hardwood Creosote Oil** (G.N.S. No. 17). 50% of this oil distilled below 150°C with gravity range between 0.875 to 9.885. 90% distilled below 240°C with gravity below 1.002 leaving 10% hard pitch residue.	Black, Opaque	0.9370	Good frother in quantities used; fair collector
37A	**Light Hardwood Creosote Oil** from primary distillation of No. 37. Distillation range, 60°C to 240°C. Sp. gr. range, 6.87 to 1.002. Ref. Index range, 1.411 to 1.523.	Clear, Dark Amber	0.9195 1.4665	Fair frother
38	**Heavy Hardwood Creosote Oil** (G.N.S. No. 18) 63% of this oil distilled below 240°C having gravity range, 0.871 to 1.079, leaving 37% hard pitch residue.	Black, Opaque	1.0620	Good frother; good selector; good collector
39	**Hardwood Oil Fraction 20% of No. 31** (Hardwood creosote mixture). Distillation range, 55°C to 152°C. Sp.gr. range, 0.880 to 0.890. Ref. Index range, 1.410 to 1.440. 28% acidic, 70% neutral.	Clear, Light Amber	0.8910 1.4297 1.4297	Poor frother
40	**Hardwood Oil Fraction 18.5% of No. 31** (Hardwood creosote mixture). Distillation range, 152°C to 202°C. Sp. gr. range, 0.890 to 0.985. Ref. Index range, 1.440 to 1.505. 33.5% acidic; 66.5% neutral.	Clear, Light Amber	0.9623 1.4883	Good frother; good selector; fair collector
41	**Hardwood Oil Fraction 19.5% of No. 31** (Hardwood creosote mixture). Distillation range, 202°C to 220°C. Sp. gr. range, 0.985 to 1.020. Ref. Index range, 1.505 to 1.520. 66% acidic; 34% neutral.	Clear, Amber	1.0142 1.5182	Good frother; good selector; fair collector
42	**Hardwood Oil Fraction 20% of No. 31** (Hardwood creosote mixture). Distillation range, 220°C to 240°C. Sp.gr. range, 1.020 to 1.025. Ref. Index range, 1.520 to 1.525. 69% acidic; 31% neutral.	Clear, Dark Amber	1.0230 1,5245	Good frother; good selector; fair collector
43	**Hardwood Oil Fraction 10% of No. 31** (Hardwood creosote mixture). Distillation range, 240°C to 255°C. 50% acidic; 50% neutral.	Reddish Amber	1.0143	Good frother; fair selector
44	**Pine Oil** from western yellow pine (from crude turps No. 17). Distillation range, 190°C to 246°C. Sp. gr. range, 0.880 to 0.9540. Ref. Index range, 1.4820 to 1.508. Yields equals 0.75 Imp gals. per 2,600 lb. cord.	Clear, Light Amber	0.9320 1.4945	Good frother; comparing with No. 3
45	**Crude Pine Oil** from western yellow pine stumps obtained from crude light oil No. 18 and pine tar oil No. 19. Distillation range, 190°C to 245°C. Sp. gr. range, 0.895 to 0.989. Yield equals 0.35 and 2.6 Imp gals. per 2,600 lb. cord from No. 18 and No. 19, respectively.	Dark Amber	0.9480 1.4960	Same as above

F.P.L. No.	Description of Oil	Appearance	Sp. Gr. and Ref. Index at 15°C	Flotation Action on Cobalt Ores
46	**Light Oils**—turps and light oil from western yellow pine stumps obtained from crude turps No. 17 and crude light oil No. 18.	White to Amber	0.8735 1.4780	Very poor frother
47	**Neutral Oil—50% of No. 31A** (Hardwood creosote mixture) after extraction with dilute H_2SO_4 and NaOH. % of No. 47 / Dist. Range / Sp. Gr. / Ref. Index 47A....... 23.4 / 55°C to 150°C / 0.8805 / 1.4442 47B....... 25.4 / 150°C to 200°C / 0.9113 / 1.4805 47C....... 42.8 / 200°C to 290°C / 0.9585 / 1.5120	Amber	0.9260 1.4900	Good frother; fairly selective
48	**Acidic Oil—50% of No. 31A** (Hardwood creosote mixture)—being portion extracted by dilute NaOH and then recovered by acidifying and distilling. Only about 1% distilled below 200°C. 36% dist. 200 to 215°C—sp. gr. 1.025. 40% " 215 to 230°C—sp. gr. 1.050. 23% " 230 to 255°C—sp. gr. 1.050.	Dark Amber	1.0425	Good selective frother
48A	**Acidic Oil from No. 26A and No. 27A** (Hardwood creosote oils). Distillation gave the following: Corrected Temperature / % by Volume 26A / 27A Up to 200°C / 10.0 / 7.5 200°C to 215°C / 31.0 / 19.5 215°C to 230°C / 31.0 / 37.5 230°C to 255°C / 28.0 / 35.5	Dark Amber		Same as above
49	**Neutral Hardwood Oil from No. 26A** (Heavy hardwood creosote oil) and from 27A (heavy acid oil). 18% of this oil distilled below 200°C.	Dark Amber	0.9634 1.5090	Same as No. 48
50	**Crude Wood Oil**—a by-product from top of digesters of the alkaline sulphate process for manufacturing paper pulp from jack pine, spruce, etc. The crude oil is of grease-like consistency while its distillate is a light oil. Both have a very disagreeable odor. Only 11.8% distilled below 250°C. 69.1% by wt. distilled between 250°C. and 310°C. where sp.gr. range was 0.920 to 0.935 and ref. index 1.480 to 1.522. Over 19% remained above 310 C. as a hard pitch residue.	Dark Yellow, Thick Emulsion	0.9820	Unsatisfactory

Pine Oil as a Standard Frothing Oil

The purest grade of pine oil available (namely G.N.S. No. 5) was chosen as the standard forthing oil in this investigation. In the standard oil mixture adopted the pine oil was 10 per cent., the balance being 80 per cent. coal tar creosote and 10 per cent. coal tar.

Practically all the pine oil of commerce is obtained from the ongleaf southern pine. In this connection a definition of 'pine oil" is interesting. According to specifications as adopted by the United States Navy Department, "pine oil" must be a properly prepared light straw colored oil, produced by redistillation of heavy high boiling point fractions resulting from the steam distillation of wood turpentines, and shall have a strong aromatic odor resembling turpentine. The specific gravity shall be not greater than 0.937 and not less than 0.933 at 60°F. One hundred cubic centimeters of the oil when subjected to distillation in a standard Engler distilling flask must yield at least 95 per cent. of distillate between the temperatures 375°F. and 475°F. (190.5°C—246°C).

It is also interesting to note the difference between pine oil produced by the steam and solvent process and pine oil produced by destructive distillation. A good grade of each of these oils is supplied by the General Naval Stores Company, New York, the oils being kown as G.N.S. No. 5 and G.N.S. No. 6, respectively. 95 per cent. by weight of the pine oil from the steam and solvent process distilled between 190°C and 220°C where the specific gravity range was 0.890 to 0.946 and the refractive index range 1.473 to 1.4888, while 67.0 per cent. by weight of pine oil from the destructive distillation process distilled between 190°C and 220°C and only 87.0 per cent. between 190°C and 246°C where the specific gravity range was 0.890 to 0.955 and the refractive index range, 1.485 to 1.530. (See Figure 1).

As will be noticed this sample of pine oil from the destructive distillation of southern pine does not conform with the United States Navy Department specifications, while pine oil from the steam and solvent process comes well within the above specifications. Judging from actual flotation results for Cobalt ore the use of steam distilled pine oil is to be recommended greatly in preference to the destructive distillation grades, and graded specifications approaching 95 per cent. distilling between 190°C and 220°C with the proper specific gravity range seem worthy of consideration in buying pine oil for flotation purposes. A pure pine oil is not always necessary for flotation purposes, but in using destructive distillation grades their value appears to be in direct proportion to the pine oil content as defined above.

Pine Oil from Canadian Resinous Woods

In Canada the most promising resinous wood materials are the red (Norway) pine stumps of Northern Ontario and the western yellow pine stumps of British Columbia. The old stumps from ten to twenty years after felling the tree in many cases have sound hearts rich in oleoresin. Although the rosin content is high, the yield of wood turpentine is only fair and the proportion of true pine oil is small compared with the standard species, longleaf southern pine. In the Southern States the yield of pure pine oil is 2 3.5 United States gallons per cord of about 4,000 pounds from the best grades of resinous wood waste. From the above Canadian woods the crude pine oil fraction, containing more or less "light oil" distilling between turpentine and pine oil proper, amounts to about 4 Imperial gallons per 2,600 pounds cord and only a small proportion of this can be considered as true pine oil. By using two or three times the usual quantity of the sample, fairly satisfactory flotation results were obtained. All attempts to utilize the whole crude oil distillate or its turpentine or rosin oil content met with failure in this investigation. As pine oil is essentially a by-product of turpentine and rosin recovery from resinous wood waste and as this recovery industry has not yet shown prospect of profitable establishment in Canada, there is little promise of obtaining a commercial supply of frothing oil suitable for Cobalt ores from Canadian resinous wood waste. In this connection the recent statement* of Professor H. K. Benson, of the University of Washington, who has investigated wood waste industries for the United States Government, is significant, viz.: "The commercial status of the softwood distillation industry is unsatisfactory in the Pacific States, in the Michigan and in the Wisconsin districts." However, considerable commercial progress has recently been made in the Southern States on richer material after a series of failures, and it is to be hoped that technical investigation will in time place the whole resinous wood industry on a sound commercial basis.

Hardwood Oils as Substitutes for Pine Oil

In the flow sheet (No. 1) for destructive distillation of hardwoods the creosote oils have been fully outlined as to their source. These hardwood creosote oils, for which there is at present little market value, can be drawn off separately as crude oils in the process of refining the wood alcohol and acetic acid.

The combined production of these three oils, namely F.P.L., Nos. 25, 26 and 27 (combined as oil No. 31), is approximately 2.4 Imperial gallons per 3,700 lb cord and indications are that all three can be used as frothing oils in place of pine oil.

While this yield per cord is about the same as for pine oil from longleaf southern pine, the supply is comparatively large, there being over 500 cords of hardwood distilled daily in Canada at present and over ten times this amount in the United States, mostly in the border states.

Of the individual hardwood creosote oils heavy hardwood creosote oil No. 26 appeared to give the best laboratory results; with "acid oil," No. 27, nearly as good. Light hardwood creosote oil, No. 25, with its lighter fraction boiling below 150°C, having gravity below 0.882 removed, gave results comparing favorably with Nos. 26 and 27. This lighter fraction has a disagreeable and penetrating odor and its removal would no doubt make both oils, Nos. 25 and 31 (the former oil comprising over 50 per cent. of the latter) more agreeable to work with. (See Figures 2 and 3).

Other hardwood oils worthy of mention are heavy yellow ketone oil and ketone residue, by-products of the manufacture of acetone from gray acetate of lime. While the yellow ketone oil is already of considerable value in the industries, its value as a flotation frothing oil is important especially in an alkaline pulp where it gives a high grade concentrate. Ketone residue, which is black and syrupy in nature, is produced in fairly large quantities and has noticeable collector values, as well as being a good frothing agent. This oil deserves more attention, not only for Cobalt ores, but for use alone with other ores, where it has very promising qualities. (See Figure 4).

* U.S. Dept. of Commerce, Bureau of Foreign and Domestic Commerce, Special Agents Series No. 110, "By Products of the Lumber Industry."

(To be continued)

Proof of Microbial Agency in the Chemical Transformations of Soil

In a communication to Science (XLVI, p. 252) H. J. Conn, of the New York Agricultural Station, Geneva, N.Y., calls attention to the fact that, in by far the majority of cases, too little attention has been given to the steps involved in proving the casual relation of definite microorganisms to definite biological activities in the soil. In consequence of this neglect, many loose statements have been made, in the past, in regard to the actual functions of these organisms.

Canadian Laboratories

UNDER the above caption we hope to publish, from time to time, illustrated descriptions of the principal laboratories, Dominion, Provincial, Municipal, Educational and Technological—of the country.

We begin with an account of Laboratories of the Mines Branch of the Department of Mines, Ottawa.

In the Geology and Mines Act (1907), one of the chief functions assigned to the Mines Branch of the Department of Mines was, "to make such chemical, mechanical, and metallurgical investigations as are found expedient to aid the mining and metallurgical industry of Canada."

It was foreseen that the usefulness of the Mines Branch would depend very largely on the essentially practical tests of metals and minerals made under its direct supervision.

The first of the new units for the proposed general laboratories and testing system, namely, the Fuel Testing Station, with its laboratory for the analysis of mine air, natural and other combustible gases, oils, etc., and well equipped machine shop, was opened in southwest Ottawa, in 1910; and this was followed, in 1911, by the erection of an Ore Dressing and Metallurgical laboratory, adjoining the Fuel Testing Station. Then, in 1912, came the combination, and installation under one roof at the headquarters of the Mines Branch, Sussex Street, Ottawa, of the old Geological Survey and newer Mines Branch Chemical Laboratories; and to these was added, in 1915, a fully equipped section for the testing of the waters of Canada. In the same year, a Cermaic laboratory, completely equipped for testing the clays of the Dominion, was erected in the Mines Branch building also; together with a fully equipped laboratory for the testing of structural materials: cement, concrete, building stones, and sands for concrete making, foundry purposes, and glass manufacture. The latest addition is a Metallographic laboratory, for the preparation and micrographic examination of specimens of steel and alloys required for the practical work of the Metallurgical Division.

It is purposed, in the near future, to still further extend the scope of the technical work carried on in the various laboratories above mentioned: such as the testing of lime, road materials, paint mixtures, etc.; and to provide suitable appliances and equipment for other lines of work which come under the statutory jurisdiction of the Mines Branch.

Having outlined the general character of the existing laboratories, it may be of interest to state some of the more important reasons which led to the establishment of the various units comprising the system; and this will be followed by a description of each laboratory.

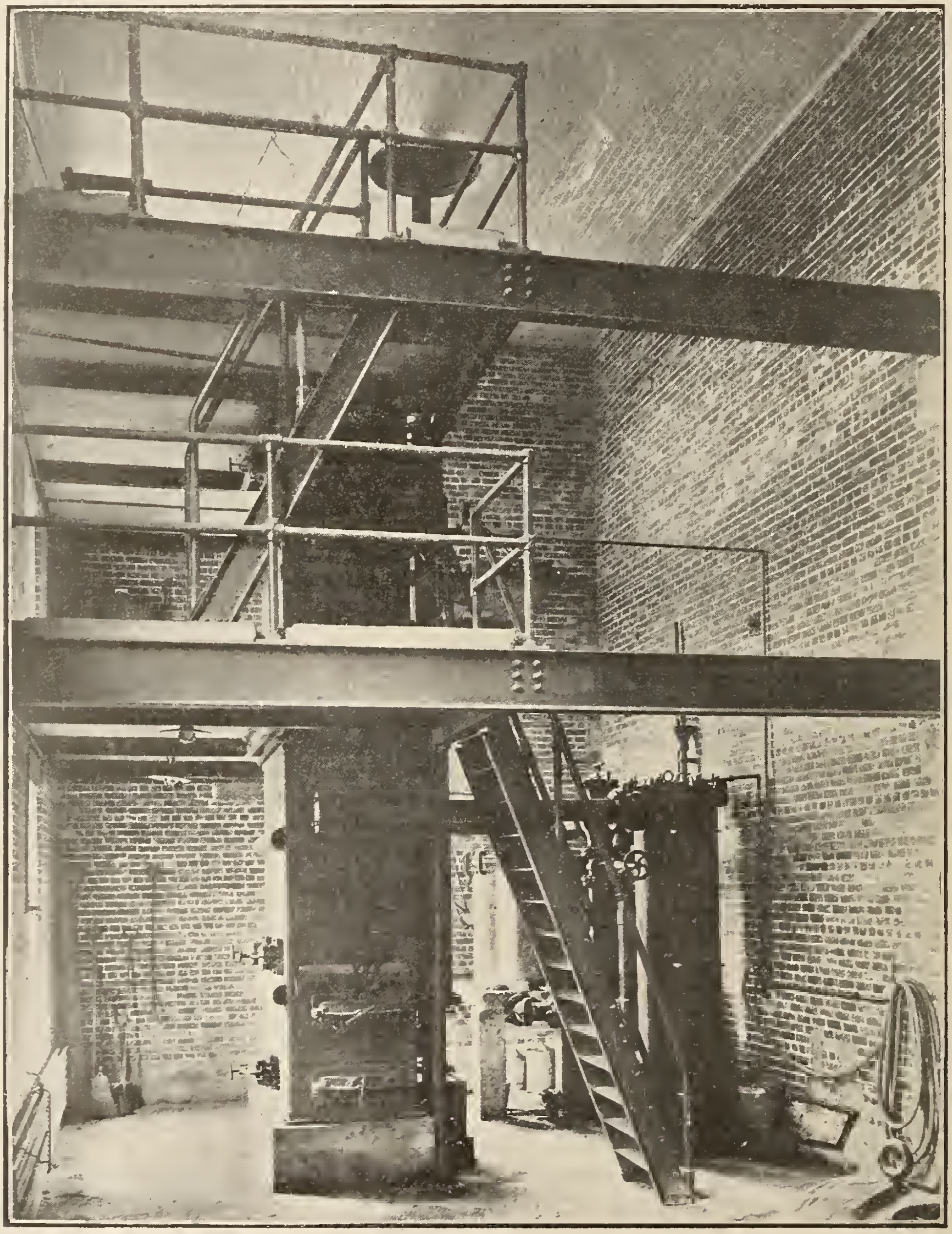
Chemical Laboratories

When the Geological Survey of Canada was founded in 1843, a chemical division was established as one of its necessary branches of work, but with the creation of the Department of Mines in 1907, all the chemical work pertaining to the entire department was placed under the direction of the Mines Branch. Since this change was made, applications from the mining and general public for the chemical analysis, examination, identification, and assays of rock and mineral specimens, ores, etc., have increased to such an extent, and the analyses and assays needed for supplementing the descriptive text in the many technical reports now being issued by the Department of Mines have become so numerous, that it has necessitated extensive alterations and additions to the old laboratory, in order to provide greater facilities, and to meet the constantly increasing demands from all quarters. The pressing importance of a pure water supply in all parts of the Dominion, led to the installation of a complete equipment for the analysis and testing of the waters of the country. At the present time, therefore, the chemical laboratories of the Mines Branch may be said to be well equipped for the analysis and assaying of all kinds of rocks, minerals, and ores; the preparedness and capability for doing useful work, in the interests of the country, being limited only by the number of staff experts employed.

Fuel Testing Station and Laboratories

One of the functions of the Mines Branch is the investigation of the fuel resources of Canada: solid, liquid, gaseous; and in order to gain a comprehensive knowledge concerning their Testing Station and its laboratories were erected as a permanent feature of Mines Branch operations.

The Fuel Testing Station is equipped with commercial-size gas producers, large steam boiler, and 60 h.p. gas engine, also fully equipped chemical and assay laboratories, and a well equipped machine shop. The latter is an indispensable adjunct to the laboratories devoted to research and large scale work; since new apparatus of special design and construction, and repairs to existing apparatus and machines, must be made in the shortest time possible.



Basement and Fuel Testing Station, Mines Branch

value for the varied uses in the arts and industries, investigations of a practical character must of necessity be conducted on a sufficiently large commercial scale—where testing is concerned—to enable accurate conclusions to be drawn from the results obtained.

For the purpose of carrying out the provisions of the Act, and in order to study the best methods and processes whereby the various fuels found may be utilized to advantage, the Fuel

In addition to the large scale fuel testing investigations, for which special provision has been made, and which have been conducted since the inauguration of the Fuels and Fuel Testing Division, the laboratories have been fully equipped for the analyses of mine air, natural and other combustible gases, oils, etc.

The analyses of mine air, free of charge, which was begun by this Division a short time ago, has grown to large proportions, and has met with the hearty approval of the mine operators who have availed themselves of the services of the Department along this line. The results of the analyses of mine air are of special value to the coal operators, since defective ventilation, or parts of mines in which the air is dangerously charged with fire-damp, are definitely indicated. The operators or managers are consequently provided with information which will enable them to correct defects, and otherwise safeguard the mines.

The physical examination, and chemical analysis of fuel and refined mineral oils have developed into an important part of the duties of the chemical staff of this division; particularly as the oils used by both the Militia and Naval Departments are sent to the Mines Branch for analysis and physical investigation, before contracts are let.

The analyses, both proximate and ultimate, and determinations of the heating value of the coals of Canada, have been begun in a systematic manner. Accurate mine samples are taken from the various seams of producing mines, and transmitted in

In designing the plant, care was taken to place the machines so that ore dressing combinations could be made with as little handling of the ore as possible. Actual mill conditions are therefore, duplicated to some extent. What the proper combination should be, and the best mode of treatment, is pre-determined by preliminary tests made on laboratory type machines. After having arrived at the most suitable flow sheet the large machinery is adjusted for this combination. The plant is equipped with large sized apparatus as employed in actual practice as well as with laboratory type apparatus used for small scale and preliminary tests.

The machinery installed comprises crushers, rolls, ball mills, and screens for purposes of crushing and sizing; various magnetic separators; electrostatic separation machines; apparatus for conducting cyanide tests on gold ores; a full scale gold stamp battery; hydraulic and pneumatic ore jigs; concentrating tables; oil and water flotation separation apparatus; roasting and sintering furnaces.

Analytical Laboratory, Mines Branch

hermetically sealed containers to the Mines Branch. The published results of these investigations will put the public in possession of reliable information concerning the classification of the coals of Canada, as regards chemical analyses, etc., and their value and fitness for various purposes.

Ore Dressing and Metallurgical Laboratory

The Ore Dressing and Metallurgical Laboratory is installed jointly with the Fuel Testing Station in a commodious and well appointed building situated on Division Street, Ottawa, S.W. The Ore Testing equipment has grown from a modest installation, in 1910, to one of the most completely equipped experimental laboratories that may be found anywhere in North America.

It was designed primarily to assist the prospector and small mine owner to secure concentration and metallurgical tests on his ore, at a nominal cost.

Ceramic Laboratory

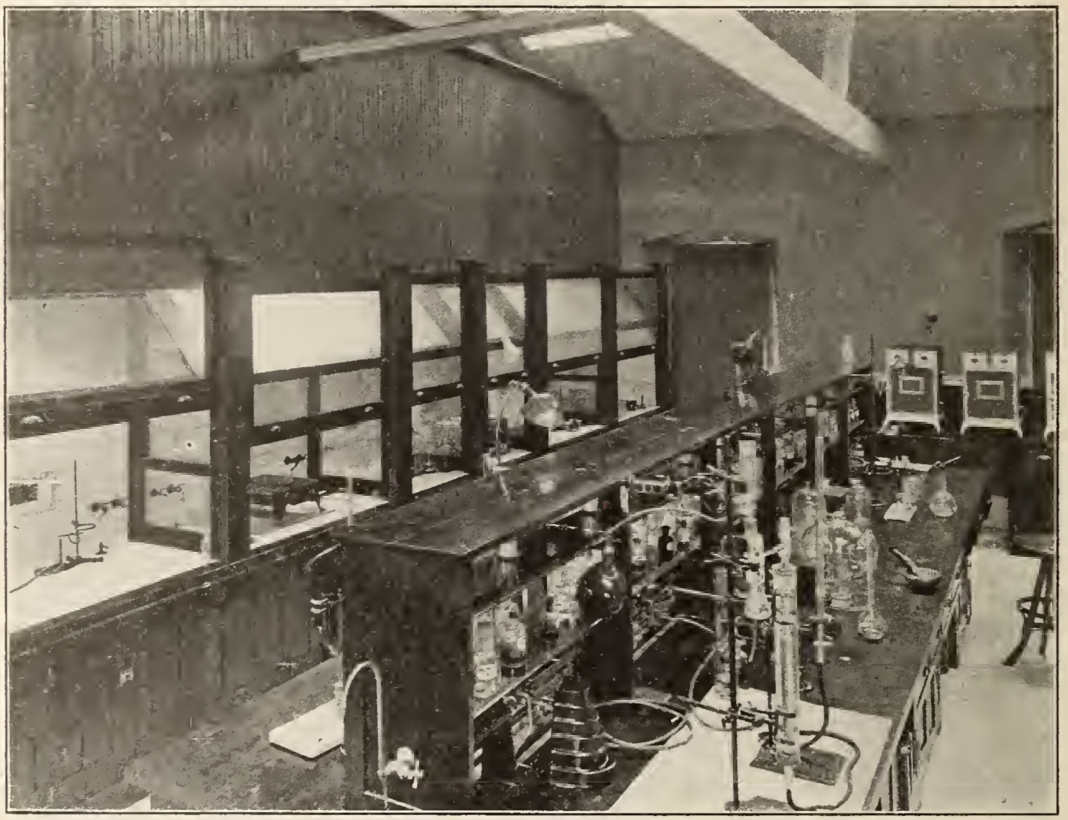
In the great expansion and development of commercial activities, so apparent in the Dominion of Canada prior to the war, and which must, after its cessation, be even more vigorously prosecuted, the subject of ceramics is necessarily of great importance.

During the year 1905 the importation of clay products amounted in value to $2,501,206, and it increased to $6,760,762 for the year 1913, but dropped in 1914 to $4,467,140, due to the war. In the year 1914, we utilized clay products valued at $11,291,024, yet the returns show that we imported over 39 per cent. of these products. This simple statement shows that in 1914 we sent out of Canada for these products alone, $4,419,067, which if it had been held in our own country, would have meant the investment of a large amount of capital, and would have given employment to a large number of men.

It must not be concluded from this statement, that this very large importation is due to lack of raw materials at home. Reports on the location and character of the clay deposits of Manitoba, Saskatchewan, Alberta, Quebec, and the Maritime Provinces, issued by the Geological Survey, show that Canada is rich in materials for an important ceramic industry. New deposits are constantly being discovered and specimens sent to our laboratories, with the request that we state what use can be made of the material. To merely send the owner of the deposit a chemical analysis of his clay, does not meet the case; since chemical analysis is only a preliminary step in ascertaining the fitness or unfitness of a clay for the manufacture of any special product. Before a sound opinion can be arrived at, as to whether a particular specimen of clay is suitable for the manufacture of tiles, brick, terra cotta, sewer pipe, or other clay products, the specimen must be submitted to a physical examination to ascertain the character of the product as it comes from the kiln. It is during this investigation that the problem, in many cases, admits of solution, namely, how a clay, otherwise unfit, may, by special treatment, be rendered suitable for the manufacture of a commercial product. To enable the government to furnish this complete information regarding clays submitted by prospective operators of clay deposits, provision was made for the establishment of a ceramic division in the Mines Branch, with a properly trained and experienced ceramic specialist in charge. The completion and equipment of the ceramic laboratory was accomplished during the latter part of 1915. Through the activities of this Division, intelligent assistance will be given to the manufacturers of clay products. It is expected that this course will lead on the one hand, to a decrease in the large imports of clay products, and on the other hand, tend to the further development, and increasing importance of the ceramic industry in the Dominion.

Structural Materials Testing Laboratory

During 1914 and 1915, field investigation of the numerous sand and sandstone deposits of the provinces of Quebec and Ontario, was made with a view to determining the suitability of these materials for use in concrete making, in the iron and steel foundry, and in the manufacture of glass. Field work in an investigation of this nature is of secondary importance; definite commercial results depend almost entirely on physical tests conducted in a suitably equipped laboratory. Such a laboratory was installed in the basement and rear of the Mines Branch building, Sussex Street, Ottawa, early in 1915, and testing operations were commenced during the later months of the same year. In equipping this laboratory, adequate provision was made for conducting complete tests on all kinds of building supplies, etc., such as sands, brick, stones, cement, concrete, and like materials. The laboratory equipment includes machines for making all the physical tests necessary for the determination of the transverse, tensile, and compression strength of all structural materials. The installation of the machines for testing iron and steel is complete.



Main Chemical Laboratory Works, &c.

The increasing use of bituminous materials in the surfacing of city streets and interurban highways, has emphasized the necessity for apparatus suitable for the testing of such materials; but in connection with the installation of apparatus for the examination of bituminous road materials—including bituminous sand—there has been a regrettable absence of generally accepted standard methods of testing. The apparatus available in the Mines Branch Structural Materials Testing Laboratory, however, is well suited for classifying, and for determining the value of bituminous road materials.

Metallographic Laboratory

In the basement of the Mines Branch Building, Sussex Street

Ottawa, complete appliances, machines, and accessories, have been installed for the grinding and polishing of metal specimens for the microscopic examination of steels and alloys; and on the second floor of the same building is a room completely equipped for the photomicrography of metals.

In addition to the foregoing the Dominion maintains an Assay Office at Vancouver, B.C.

Potash from Cement Dust

IN view of the numerous exaggerated and misleading statements which have appeared on the potash question the following article should be of value. It is compiled from information supplied to this JOURNAL by the Western Precipitation Company, of Los Angeles, Cal.

The Directory of Cement, Gypsum and Lime Manufacturers, 1917 edition, lists twenty cement factories in Canada—ten operating according to the "dry" process and ten by the "wet" process. These twenty plants have a combined rated daily capacity of 47,900 barrels.

A probable average of 625 pounds of raw mix is required at these factories to produce a barrel of 380 pounds of cement.

The theoretical amount of raw mix required for the production of a barrel of cement is about 580 pounds. The difference between 625 pounds and 580 = 45 pounds, represents the amount of dust which is mechanically carried out of the kilns with the gases and represents what is usually termed "cement plant dust." The kiln dust loss from dry process plants is, however, usually assumed to be about 4 per cent., or 25 pounds of dust per barrel of cement produced. The dust loss from wet process plants is usually assumed to be about 2 per cent., or 12½ pounds per barrel. The apparent discrepancy between the assumed dust loss and the actual dust loss is easily explained by the fact that few manufacturers have actually measured the dust loss from their cement kilns. Where the dust loss is abnormally high—and we should call 50 pounds per barrel much too high—it has been found that by proper attention to kiln operation, the dust loss can be greatly reduced and brought down from—say, 45 or 50 pounds per barrel, or even more, to nearer the theoretical dust loss, which is about 24 or 25 pounds, in the case of dry process plants and from 10 to 15 pounds in the case of wet process plants.

The average potash content of the raw mix used in all Canadian cement factories, whose materials have been investigated, is apparently about 0.8 per cent. K_2O. A theoretical calculation of the amount of potash lost from kilns would be:

$625 \times 0.008 = 5$ pounds K_2O entering kilns in the raw mix for each barrel of cement produced.

The amount of potash expelled from rotary cement kilns along with the gases and dust, varies, and may be from 20 to 95 per cent. of the potash entering the kilns. The variation depends upon various factors.

Where the percentage of potash expelled from a kiln is low (30 to 45 per cent.) it can be raised by mechanical or chemical means, to from between 60 to 70 per cent. Of course, in a great many cases, the percentage of potash lost from kilns with the gases is considerably higher than 70 per cent., and as stated above, may run as high as even 95 per cent.

Assuming, for the sake of calculations, that 60 per cent. of the potash entering the kilns can be liberated and expelled from the kilns with the gases, we should have:

5 pounds $K_2O \times 0.60 = 3$ pounds K_2O per barrel of clinker produced which would be liberated and expelled with the gases.

Although the average potash content of Canadian cement raw feed probably averages about 0.8 per cent., yet enrichment by the addition of feldspar or other potash-bearing rock, may be made to bring the potash content of the feed up to about 2.5 per cent. The addition of such potash does not affect the quality of the cement, as has been pointed out by various writers; it is only necessary to keep the proper ratio of silica, lime and alumina.

In a wet process mill, having a kiln dust loss of 12½ pounds per barrel, the theoretical potash content of escaping dust would be: $3/12.5 \times 100 = 24$ per cent. K_2O.

Likewise, in a dry process mill, the theoretical potash content of the dust would be: $3/25 \times 100 = 12$ per cent. K_2O.

This theoretical potash content of cement rotary kiln dust agrees very closely with actual results obtained at some of the American factories, where the dust is collected and sold for its potash content.

On a basis of 47,900 barrels daily capacity, and with potash expulsion from the rotary kilns of 3 pounds of potash per barrel, there would theoretically be lost each day, providing all kilns were operating:

$3 \times 47{,}900 = 143{,}700$ pounds, equal to 71.85 tons K_2O.

This would amount to 21,555 tons per 300 operating days per year.

The American cement manufacturers, who are collecting and who sell the collected cement mill potash, are obtaining, at the present time, $5 or more per unit, equivalent to 25 cents per pound, or $500 per ton.

$\$500 \times 21{,}555 =$ nearly $11,000,000 per year, the estimated value, at present prices of potash, which might be collected, provided all the kilns in Canada, as noted above, were operating at full rated capacity.

Many processes have been tried for the collection of cement mill dust, but none have proved so commercially successful as the Cottrell process of electrical precipitation, which is controlled by the Western Precipitation Company, of Los Angeles, Cal.

Four cement plants, having a combined rated capacity of 15,500 barrels per day, are equipped with Cottrell treaters and four cement plants, with a combined rated capacity of 7,000 barrels per day, are now being equipped.

Nitrate of Soda

Increase of Chilean Export Duties

For many years the export duty on nitrate of soda paid by the exporter to the Chilean Government has amounted to 2s. 4d. per Spanish quintal. This duty has been maintained at the same figure through periods of nitrate crisis and through periods of nitrate boom without any variation on the part of the Chilean Government. It has been payable partly in ninety days' sight drafts on London and partly in Chilean gold or Chilean currency at current rates of exchange, the proportion of duty to be paid in each way being fixed from time to time by Government decrees in accordance with the requirements of the Chilean Government. The understanding has always been that a part of the amount was payable in ninety days' sight drafts on London in order to meet the foreign debt service of Chile.

Though the duty has always amounted approximately to 2s. 4d. ($0.58) the customs tariff is based on a payment in Chilean gold, which is supposed to have a value of 18d. per peso, and the value of which has, in fact, been usually maintained very near that figure. The result has been that the duty has had a fixed sterling basis, which is the only basis fair and suitable to the nitrate producer, who receives the value for his product always in sterling. Recently the present Minister of Finance has issued a decree to the effect that nitrate duties are to be paid part in actual Chilean gold coin, and part in ninety days' sight drafts on London, not at the rate of 18d. per peso, but at the rate at which the actual gold can be purchased in the market.

As there is only a limited amount of actual gold coin in the market and as all actual gold coin in all parts of the world has appreciated, this new decree means at present to the nitrate producer an increase in duty of 15 per cent. and a corresponding extra income to the Chilean Government. This procedure is considered very unfair by the nitrate producer, who justly says that the Chilean Government makes no reduction in duty when times are bad, and therefore ought not to make any increase when times are good. On the other hand, the Chilean Government desires to increase its income.

Chile holds a unique position owing to her endowment by nature of the only nitrate of soda deposits at present known to the world.

In normal times, previous to the war, the greater part of nitrate exported was used for agricultural purposes in various quarters of the world, but now, though it is impossible to obtain actual figures, it can be estimated that more than 75 per cent. of the nitrate exported is used in the manufacture of explosives. As the official figures show a total export during 1916 of 2,900,000 tons the supreme importance of Chile to the Allied Powers can easily be realized.

Germany with her supplies of Chilean nitrate cut off by our blockade has been obliged to substitute for it nitrate chiefly produced from the air by the Haber process, but the evidence available shows that it is more costly to produce in this manner.

At the outbreak of the war the nitrate industry was in one of its periodical bad periods—a period of production in excess of consumption with its resultant inflation of unsold stocks—and the producers were considering some means of reducing the output or forming a trust for the centralization of sales. The declaration of war was almost universally considered as a disaster to the industry, demand decreased alarmingly, and a great number of the works were closed down. Whereas in July, 1914, there were 134 oficinas or factories producing the number fell in March, 1915, to 36.

Increased Activity

It was not until towards the end of 1915 that it was fully appreciated that the war instead of being a calamity to the nitrate industry was a blessing to it, and the oficinas began to reopen, with the result that there are now 118 oficinas in full swing, with a production in December last of 240,000 tons—almost a record in the history of the nitrate industry.

This figure had been reached notwithstanding the closing down of most of the German-owned nitrate oficinas, of which at the present moment only five (mostly small oficinas) are working out of a total of 14. The closure of these oficinas has been attained by means of the British control of shipping and the jute trade, which supplies the bags to carry the nitrate, and by the judicious use of black list regulations, which prevent the German producers from finding buyers.

German capital has been for many years an important factor in the nitrate-producing industry of Chile, and the approximate proportions belonging to companies of different nationalities were in 1913 out of an export of 2,700,000 tons:

Chilean companies	49 per cent.
English companies	36 "
German companies	15 "

And in 1916 out of an export of 2,900,000 tons:

Chilean companies	53 per cent.
English companies	37½ "
German companies	9½ "

As described above, the position of the nitrate market previous to the outbreak of the war was one of depression owing to the excess of production over demand and the consequent inflation of stocks, and in June, 1914, the price on board nitrate port was 7s. 5d. per Spanish quintal. In December, 1914, the price fell to 5s. 10d. per quintal, but with the subsequent demand for the manufacture of explosives the price has risen until it has reached 10s. 2d. for immediate delivery, while sales for future delivery over 1917 have been made at 9s. 6d. and 1918 at 8s. 6d. per quintal.

Only a small amount of spot nitrate has been sold at the high figure mentioned above, which is an abnormally inflated price. —London Times.

The Universities and Technical Chemical Research

By Herbert Levinstein, Ph.D., M.Sc.

(Continued from Page 129)

Research and the University

It seems entirely undesirable for the universities to try to teach men to carry out industrial research (in the narrow sense), a subject of which most of the professors know nothing, rather than to devote their resources to the training of men of high scientific attainments, a matter they thoroughly understand and which is so much more useful. As has been shown above, manufacturers are in urgent need of men so trained. Moreover, there are grave objections to providing a grant of money to a university for purely industrial purposes. Indeed, a policy of endowing universities for industrial as opposed to scientific research would in my opinion be a retrograde step and opposed to the true interests of the universities themselves.

Technical research means, speaking generally, the discovery or improved preparation of substances that can be made and sold at a profit. It is easy for any skilled chemist to discover new dyestuffs or to make new organic compounds; by new one means compounds which have not been described in chemical literature. In the laboratory books of all the works which have carried on research for a number of years there is a large amount of scientific information about products and processes which has not been made public. A university man working in these subjects would be bound to waste his time on rediscovering what is well known and has probably been discarded by those who have an established research department. The governing difficulty in carrying out technical research is not the preparation of new compounds, but the selection of the small residuum of technically valuable matter from the great mass of material accumulated by the research staff. This is a matter which cannot be carried on effectively in a university. It must be carried out by one who has a constant intimate touch with the requirements of the industry. To discover a new dye is one thing; to discover one which the public wants to buy and for which it will pay a remunerative price is another matter. There are hundreds of dyes already on the market, and no new dye is wanted unless it is in some respects better or cheaper than those already in use. I speak, of course, without regard to war conditions.

Chemists and Their Training

In what directions, then, can the universities render national service by assisting in the development of the chemical industry of the country? In the first place, as I have endeavored to show, by training young chemists possessed of knowledge, originality, and resource, and giving them experience in the methods of chemical research. To establish the organic chemical industry of this country on a footing equal to that of Germany will require a far larger number of chemists than are employed to-day. These will be engaged in the first instance in the research laboratories of the works. In these laboratories a constant stream of young chemists will be required every year to make good the wastage owing to men leaving the research department to take charge of manufacturing operations. The manufacturers look to the universities to provide them with this stream of highly trained chemists. Success in technical as in scientific research is the reward of but few men. It is a matter of the personality at the head and not of the institution. The great discoveries of Berzelius were made in a cellar. To achieve, however, the greatest possible measure of success in industrial research a large body of willing and highly skilled workers is necessary in order to carry out the ideas of the head. Such a staff is a costly undertaking and requires financial support from the Government for its full realization.

The second direction in which the universities can assist the chemical industries is by bringing academic research into closer touch with existing industrial conditions, not by making such research less scientific, but rather by directing it to clearing up the still unknown principles and factors underlying many technical processes, the elucidation of the mechanism of chemical changes, investigation of new reactions, and similar fundamental problems, which can seldom be attempted within an industrial laboratory. By such work the universities and their professors will be brought into closer association with chemical industry, whilst their students will be given greater opportunities of acquiring knowledge of practical manufacturing conditions and a taste for industrial work.

The Practical Way

The interest of scientific workers in the universities may well be secured or strengthened by means of retaining fees paid by the industry. Such fees would establish an interest in technical matters in the minds of academical workers, and direct them into channels which might be productive of valuable technical results. This system would not in any way destroy the academic spirit and independence, for its object would be merely to encourage the professors and their assistants to work in closer association with those engaged in practical manufacture and to submit for consideration or trial any ideas or discoveries which might seem likely to repay development. If commercially valuable results were finally obtained, the professor would become entitled to a substantial share of the profits. Such a system has been employed in Germany with most remarkable results. The names of Adolf von Baeyer and of Emil Fischer are even now in times of war respected by all organic chemists. They are the shining spirits in the modern development of our science, yet their work and that of other university professors has been productive of extraordinary technical results, and has contributed greatly to the development of the German chemical industry.

At the same time we must avoid the danger that our university research, in becoming less academic, should pass to the other extreme and become entirely utilitarian in outlook. In addition to investigations having a more or less direct bearing on the practical affairs of life, there will always be a need for the prosecution of research into the realms of pure knowledge, in which no practical outcome is desired or can be foreseen; but even here it is useful to remember that some of the most important technical advances, involving entirely new industries, have arisen from investigations undertaken in the first instance without any utilitarian object.

To sum up my contention. Financial assistance to the universities should be directed to encouraging the prosecution of research in pure chemistry and in fundamental principles or problems underlying industrial processes, whilst the immediate development of the chemical industries of the country can best be assured by grants made towards the maintenance of industrial research laboratories within or in close connection with the works and staffed with chemists trained in the universities. The universities can best assist by carrying out researches of the first two types and by providing highly trained students to feed the industries.

Cyanuric Acid in Soils

In a communication to the Journal of Agricultural Research (10, p. 85), Messrs. L. E. Wise and E. H. Walters announce the isolation, for the first time, of cyanuric acid, $C_3H_3O_3N_3$, from soil of widely varying type and location. The quantity found corresponds approximately to 26 pounds per acre-foot. The "tetracarbonimide" reported by Scholtz and also by Schittenheim and Wiener as existing in soil, may be really cyanuric acid. The description of their compound, given by the Teutonic authors, is insufficient for its identification. The cyanuric acid may be produced from urea in the soil, or it may be formed from cyamelid, an isomer, during the process of extraction.

Cobalt and Its Uses

Almost the whole of the world's supplies of cobalt ores now come from the mines of Ontario. The metal cobalt, which has been called the twin sister of nickel, has not only grown in importance during the last few years, but its utilization, says a writer in the London Times, is confidently expected to become a much bigger thing in the near future, partly on account of the remarkable results obtained with it in electro-plating and also on account of the possibilities of an extended use of the alloy "stellite."

The consumption of cobalt is at present comparatively small, and it is thought that a reduction in price would lead to many new uses of the metal. The output from Canadian refineries could be readily increased if the demand warranted it. An expanding demand would be an important matter for Ontario, where the Provincial Government is quite alive to the fact and has already greatly assisted the development of the industry by granting a bounty on cobalt produced. The rate of this bounty is six cents per lb. of metallic cobalt, on all cobalt and cobalt-oxide refined in the province. The Dominion Government has also assisted the investigation of the metallurgy of cobalt and new applications for the metal by a vote for research work in the metallurgical laboratories of Queen's University, Kingston, Ont.

Up to a few years ago, the chief, if not the only, uses of cobalt were for the production of a blue color in glass and on porcelain, in the enamelling trade, and in the manufacture of paints such as cobalt blue. For these purposes a few hundred tons a year were sufficient to meet the world's requirements. Supplies were derived from the ores of New Caledonia which were shipped to Germany for extraction of the metal and the preparation of the salts and compounds. New Caledonia, however, cannot compete with Ontario, and her shipments of cobalt ores have practically ceased.

Cobalt is now being recovered at the smelters of the Coniagas Reduction Company at St. Catharines and Thorold, Ont., at Deloro and at Welland, Ont., from the rich silver-cobalt-nickel ores of the Cobalt district. The cobalt-chromium alloy stellite is also being produced there.

Ferro-cobalt containing about 70 per cent. of cobalt is the form in which cobalt is added to steel to increase its hardness. Steel containing 4 per cent. of cobalt, in addition to chromium and tungsten, is one of the best high-speed tool-steels, from which machine tools are made that retain their edge even when raised to a red heat by the friction of working.

Stellite is a new, non-ferrous cutting metal, originally an alloy of cobalt and chromium only, but tungsten and sometimes molybdenum are now added to increase it hardness. It contains no iron. The use of stellite in cutlery is of special interest. Knives of this alloy do not tarnish and are unaffected by fruit acids.

Small quantities of molybdenum are said to be added to the chromium and cobalt which are the main constituents of stellite with good results. To an alloy consisting of 85 per cent. cobalt and 15 per cent. chromium 25 per cent.of molybdenum was added and resulted in a fine-grained metal of excellent color and lustre which ought to find a wide use for cutlery.

In electro-plating cobalt has several advantages over nickel. For instance, a smaller quantity gives a more durable plating, and the plating operation can be conducted more rapidly. Another new use for cobalt salts is in the manufacture of cobalt driers for mixing with paints.

In electro-plating with cobalt the best two solutions have been found to be: (1) cobalt-ammonium-sulphate, 200 grammes per litre of water, and (2) cobalt sulphate 312 grammes, with sodium chloride 19.6 grammes per litre, and nearly sufficient boric acid to saturate the solution. From these solutions cobalt is deposited readily on all articles that are commonly nickel-plated. The solutions may be operated at a lower voltage than would be used for the standard nickel solutions to attain a given speed of plating, or with higher voltages a very rapid rate of plating can be obtained. Cobalt-plating is harder than nickel-plating, and a small quantity of cobalt will therefore afford the same protective covering as a greater quantity of nickel. The difference in the weight of the metal used more than counterbalances the higher cost of cobalt as compared with nickel, whilst the rapidity of the process also reduces the working costs.

Metallic cobalt is prepared from the oxide with anthracite as reducing agent at a temperature of about 1,000° C., the final product containing no more than 0.2 per cent. of carbon. Small quantities of very pure cobalt can be obtained by heating the oxide in a current of hydrogen or carbon monoxide. By the thermit process, with aluminum powder, metallic cobalt containing not more than 0.1 per cent. of aluminum and free from carbon is obtained. Cobalt is magnetic, and its hardness is greater than that of cast-iron or cast-nickel.

Important advances have been made in the metallurgy of cobalt, and the extraction and refining of the metal do not present so many difficulties as formerly. It will be seen, therefore, that conditions are favorable to an expansion of both the production and utilization of cobalt, an expansion which should prove profitable to the industry in Ontario.

A publication of the United States Bureau of Mines states that the demand for molybdenum for steel-hardening has been retarded by the fact that steel makers who might use or might investigate the possibilities of using the metal are restrained by the uncertainty of being able to obtain regular supplies. On the other hand, production is restricted by the small visible demand.

The Bureau purposes to prove to possible consumers that the ores of molybdenum are not so rare as is commonly supposed, and that there are in the United States many deposits of low-grade ore from which large supplies may be derived; and also to assure present and prospective producers of molybdenum that there is a latent market for the product in the steel trade which needs only the assurance of steady supplies for development.

Important shipments of molybdenite are being made from the Quyon Mine in Quebec, which was opened a little over a year ago and is a large producer. The total Canadian output last year was about 71 tons of molybdenum sulphide, for which approximately a dollar a pound, or £537 a ton, was paid. Seventeen different localities in Quebec, Ontario, and British Columbia contributed to this production. Molybdic acid and ferromolybdenum are both being made in Canada.—London Times Trade Supplement.

The Canadian Chemical Journal is informed by a competent authority that there are deposits of molybdenum ore within a radius of one hundred miles of Ottawa, sufficient to supply eighty per cent. of the world's present markets for this metal and its alloys and compounds.

Artificial Silk Industry

All the early artificial silk was made by the Chardonnet process (Brit. Pats. 6,045 of 1885, 221 of 1886, 5,270 of 1888, etc.), or modifications of it, which had for a basis guncotton dissolved in ether and alcohol. Its lustre was considerably greater than that of natural silk. Lehner improved the details of this process. (Brit. Pts. 1,183 of 1891, 22,736 of 1892, 24,003 of 1893, etc.) Instead of a solution containing 20 per cent. of cellulose nitrate, he used 10 per cent., and further reduced the viscosity by the addition of sulphuric acid or other mineral acids. Patents have been taken out by Du Vivier (Brit. Pats 2,570 and 2,571 of 1889), who nitrates his cotton with a mixture of sulphuric acid and dry potassium nitrate and carries out the operation at the unusually high temperature of 60 to 80°C. He also added to his nitrocellulose albumen or gelatine. The next process to be developed was dissolved cellulose in ammonical copper oxide for spinning. Pauly took out his first patent (Brit. Pat. 28,631 of 1897, D.R.P. 98,641) in Germany seven years later. Bronnert, Fremery and Urban were prominent in later work, (Brit. Pats. 20,801 of 1900, 1,283 of 1905, etc.), and the processes of these workers have been the basis of manufacture by the Vereinigte Glanzstoff Fabriken A. G. of Elberfield and its subsidiaries, with factories in Germany, Austria, France and Wales. The cotton, generally in the form of linters, is boiled with about ten times its weight of the solution containing 0.25 per cent. of caustic soda, and 0.5 per cent. of sodium carbonate for 1½ hours, at a pressure of 2½ atmospheres. The cotton is washed, hollandered and centrifuged until it contains about its own weight of water; and then again boiled with a fresh amount of liquid of half strength for the same length of time. The cotton is washed and bleached in a weak solution of sodium hypochlorite, containing 0.1 per cent. available chlorine. All traces of chlorine are removed by washing with thiosulphate. The purified cotton is again taken and centrifuged until it contains less than 50 per cent. water. The cuprammonium solution is prepared by filling a large iron vessel with copper turnings, and covering them with ammonium hydrate solution, containing 14 per cent. ammonia. Air is blown through the solution, which is kept at a temperature below 4°C., and in about one day the copper is dissolved. Caustic soda is added, and if necessary copper sulphate to raise the copper oxide content, and 2,500 lb. of it is run into the mixer, into which has been put 500 lb. of the wet purified cotton. Solution takes about six hours, and during the whole of the operations and the subsequent filtering a temperature of lower than 5°C. must be maintained, otherwise copper is thrown out of the solution and spinning becomes impossible. The cellulose solution is forced through glass jets into a liquid, in which coagulation takes place. This liquid or spinning bath was made of sulphuric acid at a concentration of about 50 per cent. For a number of years past it has been made of an alkaline solution, 40 per cent. caustic soda; later various additions have been made, the most interesting being glucose, (Brit. Pat. 27, 707 of 1907)l Viscose silk is the latest important form of artificial filaments. Norwegian spruce forms the usual starting material. The formation of alkali cellulose is produced by steeping the sheets of pulp in a strong solution of caustic soda of a sufficient strength to produce mercerizing, the excess of soda is then removed by pressing, and the alkali celluolose is ground into crumbs. The alkali cellulose, after maturing, is treated with carbon bisulphide, when a cellulose xanthate is formed as a brown sticky mass. This xanthate has the composition $C_6N_9O_4$|

|-CS., but hydrolysis

NaS |

breaks it down with successively decreasing amounts of the xanthate group, until cellulose or cellulose hydrate is reached, and it is at an intermediate stage of "ripeness" between these two extremes that viscose is used for spinning purposes. The hydrolysis takes place spontaneously under ordinary conditions, and with varying rapidity, according to the temperature, and as the proportion of xanthate to cellulose decreases the solubility is reduced. For this reason the solid xanthate, though soluble in water when freshly made, is dissolved in dilute caustic soda, and after a series of filtrations, to remove all dissolved fibres, is ready for the spinning operation.—Pulp and Paper Magazine.

Potash in Texas

It is reported that the United States Government has struck a deposit of potash in the exploration well which it has been boring near Cliffside, Texas, during the past two years. The exploration work will be extended to the territory lying 75 to 100 miles south of the present well and bordering New Mexico, where brackish water is found in many wells, and there are salt lakes which show strong indications of the near presence of potash.

The Exposition of Chemical Industries*

The Third National Exposition of Chemical Industries was held in the Grand Central Palace, New York, from September 24th to 29th, inclusive.

Chemists representing every branch of chemistry met here. They had come from all parts of Canada, United States and even South America to listen to the addresses given by leaders in the sciences, to see the moving pictures depict the various stages in the manufacture of some important chemicals and allied products, and to note the wonderful advances made in home production as displayed by the six hundred exhibits.

The Addresses

Dr. C. F. Roth formally opened the Exposition on Monday at 2.00 p.m. in the conference room and introduced Dr. C. H. Herty, former president of the American Chemical Society. The speakers at this meeting were presidents of societies that have been in a great measure responsible for the growth of chemical and allied industries in America. They were Dr. G. C. Fink, of the American Electrochemical Society; Dr. G. Stieglitz, of the American Chemical Society, and Dr. G. W. Thompson, of the American Institute of Chemical Engineers. All of the speakers dwelt on the remarkable growth of chemical industries in the United States and Canada, and of the difficulties which have been met and overcome. A warning, however, was given that American chemists have yet much to accomplish and that if they rested now on the laurels already won they would be in imminent danger of losing all that had been gained as soon as peace returns. Various incidents were quoted concerning the obstacles in the path of large scale production and how these hindrances were surmounted, in order to show what an immense amount of work has been done to render possible the production of chemicals in large quantities.

Dr. C. H. Herty, in the course of his address, said the battle for national self-containedness in that portion of the line held by the chemist is progressing favorably. It is not yet won, but many heights have been conquered, many formidable streams crossed, and the open plains of full national service are almost in sight. This exposition, increasing in magnitude each year by 100 per cent. of its original size, constitutes the bulletin by which the nation is informed of the progress made. On the extreme right the forces of "empiricism" have steadily yielded ground to the advances of our research chemists. More and more called upon for utmost effort, they have never failed to respond. On the left flank a steadily increasing force of the ablest American chemists is being gathered to capture the hill of "obsoletism of army equipment," and is providing the great armies we are now raising with the most efficient forms of modern chemical means for both offensive and defensive warfare. On the right centre the terrain of "congressional apathy" has been partly won, as typified by favorable protective legislation for our dyestuff industry and by the guarding of the all important electro-chemical industries at Niagara Falls from power shortage due to lapsing legislation. On the left centre the quagmire plains of "public indifference" have been largely dried and made possible through the clearing skies of a sympathetic daily press which has constantly emphasized the value to the independence of the nation of a full-rounded chemical industry. The optimism engendered by such splendid progress will prove, however, a curse indeed if it leads us to overlook a feature of the present situation. In order to man the present lines of this battle of the chemical industries, we have already drawn heavily upon our reserves in the universities throughout the country. Many professors, advanced students, and even only partly trained students have been called into the industries. This has created a serious shortage of chemists, whose replacement through all favoring means should be a constant charge upon the liberality of the leaders of our chemical industry and the far-sightedness of those vested with the power of national administration.

Dr. Fink laid stress upon the great asset which Canada and the United States possess in their almost unlimited water powers. Cheap accessible electricity is one of the greatest factors in the development of many a chemical and metallurgical industry. After the addresses a Canadian Government film occupied the attention of all present. Four films showing the development of water powers at Montreal (including those at Lachine Rapids, Grand Mere, Richelieu River, etc.), Winnipeg, Calgary and Vancouver, were "screened." The natural beauty and the great potentialities of the water falls in these localities thrilled the audience. One enthusiastic chemist remarked, "What a great country of opportunities!"

On Tuesday evening Professor Marston T. Bogert, chairman of the National Research Council, gave a timely address on Research. The German research chemist has proved to be a very valuable asset to the Central Powers in this war. Without the fixation of atmospheric nitrogen Germany would have been defeated long ago. The business of the chemistry committee, continued the speaker, consisted of: the co-ordination of scientific activities under various sub-committees; a census of research chemists. The returns from this census have been classified and indexed, all of the sub-committees have been furnished with lists of chemists experienced in particular branches of chemistry; the detailing of drafted chemists to positions of greater national value. More than three hundred problems of widest range have been given careful and serious consideration and reports made to various departments concerning these problems. Its chief function, however, has been to serve as a central clearing house and co-ordinating agency for the chemical research throughout the country. It serves as an information bureau by which accumulated information is given wide usefulness. The speaker stated that the British authorities estimated from their longer experience that only one suggestion in 300,000 proved to be of usefulness, hence the need for good suggestions was great.

Professor Bogert laid great stress on the value of research work to the nation at large and urged that facilities for research should be greatly increased and that adequate appropriations should be made to continue the work in a more effective manner. The committee has warned the military authorities not to make the same mistake that England and France made early in the war by sending their chemists and highly skilled workmen to the trenches. "The proper place for a chemist is in the laboratory and not in the trenches," said the professor. "All of the Allied countries have withdrawn their chemists from the front and placed them where they ought to be—in the laboratory. France gives her chemists an insignia to indicate that they are performing valuable and important national service." Dr. Bogert in concluding stated that over one hundred and fifty chemists were now employed in the United States on poisonous gas production and gas mask protection for use at the front by American troops. He thought that Congress had overlooked the important role that chemistry was playing in winning the war.

Dr. Baekeland, of the United States Naval Board, spoke at the Wednesday evening meeting on the future of the American Chemical Industries. He deplored the fact that the United States was neglecting the development of water powers for the production of cheap electricity. Canada is developing her water powers at a wonderful rapidity, already she is producing thousands of horse power of electrical energy at a cheap rate, so cheap that many a chemical industry would find in Canada a very inviting home. The same is true of Norway. Dr. Baekeland stated that in his opinion the steady development of the industries of heavy chemicals in the mineral or inorganic line, would very probably proceed as in the past. The greatest development in the future will consist of further extension of industries in the field of organic chemistry. It is evident too that the work of the chemist is greatly needed in aviation. A number of aviators have already discussed with chemists the

*By Walter A. Lawrance who represented the "Canadian Chemical Journal" at the Exposition.

problems which confront them in the aviation field. Extreme vibration and extreme changes of temperature due to rapid ascent or descent. A substance is sorely needed to impregnate the fabric used in the planes. The ideal fabric should be waterproof, air proof and slow burning. The material used for impregnation should give a low visibility, prevent deterioration and be non-poisonous. Much study has yet to be done to discover light alloys of a non-rustable type which are capable of withstanding great strains.

The Exhibits in General

On the three floors of the palace was a wonderful collection of exhibits, dyestuffs, chemicals, porcelain, quartz ware, minerals, machinery, electrical apparatus and instruments of all descriptions. Dyestuffs and intermediates easily lead the rest for number and variety of exhibits. Colors ranging from red to violet met the eye at almost every turn; sulphur blacks and khaki of many shades were in abundance. A close examination of some dyestuffs revealed that many difficulties have yet to be overcome. One trouble seems to be the makeshift substitution of wrong materials for the right ones because the right ones are as yet unavailable, instead of endeavoring to produce the correct substances. As yet no color standard has been adopted in America and in consequence a certain amount of confusion exists. Indigo was conspicuous by its absence. Only one exhibitor displayed indigo dye and they had none for sale as all their output went to the United States navy as does all the imported indigo. No fast cotton vat dyes of the Indanthrene type were exhibited except those which were imported. One was surprised to find a splendid exhibit of dyes "Made in England." This was another proof that British chemists and capitalists are availing themselves of the opportunities opened up by the great world war.

A very instructive exhibit was in the form of a glass case containing in diagramatic form all the products (and their derivatives) obtained by the distillation of coal. Not a few were surprized at the large number of substances obtained and many asked themselves the question, "Why don't we burn only coke in our homes?"

An analytical balance with keys like those of a typewriter attracted the attention of a large number of chemists. It resembles an ordinary balance in that the operator places the weights above one gram on the scale pan as usual. When the weight is obtained to within one gram, the shutter is pulled down and by pressing various keys the smaller weights are placed upon the beam until an equilibrium is reached.

A large amount of porcelain and glassware was exhibited. Varied tests were carried by most makers showing the peculiar properties possessed by their goods. A favorite test was to heat a porcelain crucible to red heat and immerse it in water at room temperature. The height through which a beaker or flask would have to drop in order to break was an experiment watched with interest by many chemists, some doubtlessly wondered why such glassware was not in use when they pursued their freshman laboratory experiments. Quartz-ware of the transparent and translucent varieties were to be seen in all forms, and for many uses. Flasks, dishes, beakers and organic combustion tubes seemed to be the most popular, the price, however, was prohibitive except for special research work.

Professor Alexander Silverman, of Pittsburg, "the glass city," entertained a large number of visitors by giving an illustrated lecture on glass manufacture. He stated that the government laboratories had tested out five brands of glassware and found that they were of high quality. The lecture was very interesting and proved to be quite educative.

The noise of machinery in operation was to be heard on every floor. Vacuum dryers, filter presses, ore separators, mixers, etc., etc., were kept running during the greater part of the day. Demonstrators busied themselves in pointing out the salient features of the machine in their charge.

Many exhibits were of great interest to the paper chemist. Machinery, pulp and paper, dyes for coloring paper, and chemicals used in the manufacture of paper were examined by "paper men." Paper articles, such as automobile steering wheels, combs, barrels, drums, jackets for aeroplane motors, proves that paper is finding an ever widening range of usefulness.

The Chemists' Club and many other chemical societies had booths for the convenience of their members and friends.

New York City Health Department exhibited dried vegetables and fruits and demonstrated methods by which "Dehydration" can be accomplished. The wives of many chemists gave much attention to this booth and also to the lectures given there, while their husbands sought exhibits of greater interest.

Much interest was centred in those chemical and allied products which are used in modern warfare. At one booth short lectures were given by expert chemists on Trinitrotoluene, cordite and smokeless powder. The manufacture, chemical and physical properties of these explosives were ably and fully explained. Judging by the number who were present at these talks, there was more than a passing interest being taken in them.

The Canadian Chemical Journal had a booth at the Exposition for the convenience of Canadian chemists who were present. A comparatively large number of chemists and metallurgists from Canada made use of this convenience. Many enquiries were registered concerning Canadian chemical industries and many expressed a desire to cultivate an export chemical trade to the United States. Other enquiries showed that even the South American Republics were considering Canada as a possible exporter of chemicals and allied substances. Large chemical manufacturers asked for information as to the market in Canada for various products. Many visitors listened with great interest to talks on the development of Canadian chemical and metallurgical industries during the past three years.

Major Victor Grignard and Lieutenant Rene Engel, of the French Scientific Mission to the United States, paid a visit to this Journal's headquarters at the Exposition. They expressed surprise to find that Canada had its own Chemical Journal. Many questions relating to industrial chemistry and electrochemistry and metallurgy in Canada were asked by these two famous French chemists. Just as they were leaving the booth Lieutenant Engel said, "Your (Canada's) success in building up and maintaining large chemical industries will depend directly upon the amount of research carried on in your university and industrial laboratories.

The Third National Exposition of Chemical Industries came to a close at 11.00 p.m., Saturday, September 29th, after a successful week. The addresses, the moving pictures and the exhibits all combined, gave it an educative and instructive function

Munition Factory Fires

Investigations into the cause of recent fires that have destroyed several of the large ammunition factories in the Province have resulted in the adoption of important preventive measures.

Lack of proper supervision over the unskilled alien workmen who were employed in some of the most important, and certainly the most hazardous (as regards fire) operations of shell making; together with gross carelessness, appears, from the evidence adduced, to have been the cause of this enormous fire waste.

Foreigners, some of whom could not speak English, were employed in washing shells in gasoline.

As a result of competition in the labor market, smoking has been permitted by ammunition factories at night. In the case of the Cluff Ammunition Company's fire in Toronto, the evidence showed that a foreigner who was washing shells in gasoline dropped a match on the bench where the shells were drained, and the fire spread throughout the plant very quickly.

One Hundred and Twenty-five German Dye Patents

(From a Correspondent of the Chemical News)

Applications for 125 licences to use German coal-tar dye patents have now been made to the British Patents Court.

The last was heard immediately before the court rose for the vacation, when the Morton Sandour Fabrics, Limited, of Carlisle, asked to be allowed to manufacture under 29 patents belonging to the Badische Anilin und Soda Fabrik, Leopold Casella and Company, the Aktiengesellschaft fur Anilin Fabrikation, Meister, Lucius, and Bruning, and the Chemische Fabrik Greisheim-Elektron.

The Morton Sandour Fabrics, Limited, have already applied for licence to use eighteen patents of the same class—the anthracene series—and Mr. James Morton, its managing director, explained that they had now practically swept the German field of the dyes which had any attraction for their own particular interests. British Dyes, Limited, of Huddersfield, have applied for between fifty and sixty German dye patents, and Messrs. L. B. Holliday and Company, of Huddersfield, for nineteen. A considerable proportion of the patents for which the Carlisle firm applied were post-war patents, belonging to the years 1914 and 1915, so that they gave the most modern range of fast vat-dye colors. Morton Sandour Fabrics, Limited, have decided to separate their dye factory from the rest of their undertaking, and a separate company, the Solway Dye Company, of Murrell Hill Works, Carlisle, has been promoted by them in the last two or three weeks, to take over the manufacture of dyes on a large scale. They will produce the dyes covered by this new range of patents. The Morton Sandour Fabrics were the first in England to make the blues, yellows, and browns of the indanthrene series and alizarine sapphirole.

Mr. A. H. Davies, M.Sc., the applicant's chief chemist, gave evidence, and the Controller of Patents, Mr. Temple Franks, intimated that he thought the licenses ought to be granted.

Analyses of Glycerine and Butter

The Inland Revenue Laboratory has issued reports on the results of analyses of glycerin and butter. Of the former, 230 samples were received during November, 1916. Six samples were doubtful, 194 samples were genuine, 20 samples were adulterated with more than 10 per cent. of water and 10 samples were adulterated with sugar syrup.

The samples of butter numbered 228; they were collected during the first three months of 1917. No admixtures or substitutions of foreign fats were found. At least the minimum amount of fat (82.5 per cent.) was present in 187 samples. Nine samples were adulterated by the addition of excessive quantities of water and four samples had a water content slightly over the legal limit of 16 per cent.

Kentucky as an Oil State

In order to produce a large, commercial oil field, four geological factors must be present. These, as pointed out by J. H. Gardiner in Science, are: (1) Structure, such as anticlines, domes, etc. (2) sand or other porous beds to serve as a reservoir; (3) water (salt) to concentrate the oil in the sand; (4) petroliferous shale or other oil producing rocks. Kentucky has the first three of these factors and the presence of the fourth is being investigated. It is very probable that Kentucky possesses oil pools, but it is unlikely that the State will ever rank with the chief oil producing districts of the United States.

The Paris Academy of Sciences is to establish a national physical and mechanical laboratory, for scientific industrial research.

Phosphate Rock Production in 1916

A report on this subject, by R. W. Stone, of the United States Geological Survey, gives the following figures:

Phosphate Rock Sold in the United States, 1913-16

Year	Quantity (Long Tons)	Value
1913	3,111,221	11,796,231
1914	2,734,043	9,608,041
1915	1,835,667	5,413,449
1916	1,982,385	5,896,993

The figures for 1913 were the largest in quantity, but those for 1910 were highest in value ($11,900,693). The rock mined in 1916 was 2,169,149 tons, compared with 1,935,341 tons in 1915.

Stock on hand at the close of 1916 showed an increase for the entire country of 20 per cent., the total stocks being well over 1,000,000 tons.

The principal phosphate rock in Canada is apatite, which occurs in workable quantity in two main districts—one in the Province of Ontario, the other in the Province of Quebec. The district in Ontario is 100 miles long and 75 miles wide, extending from St. Lawrence River northward toward Ottawa River over Addington, Frontenac, Lanark, Leeds, and Renfrew counties; the district in Quebec occupies a belt 15 miles wide, extending northward from Ottawa for an unknown distance. These deposits, which have been worked mainly by quarrying, are now practically abandoned. Rock phosphate occurs in a thin bed near Banff, Alberta, but is not used.

More Nebraska Potash

The Nebraska Potash Works Company, at Antioch, are now installing a second battery of dryers, and have begun the construction of a second unit of evaporators. This new work will all be finished before the end of the year, and will double the output of the plant. Beginning next January this company will produce from 2,500 to 3,000 tons of potash salts per month, depending upon the concentration of the water they are working.

New Process to Make Glycerine

Washington.—Discovery in the internal revenue division laboratory of a process for the manufacturing of glycerine from sugar was announced by the treasury department. Under the secret process evolved the cost of this substance, a heavy factor in the manufacture of explosives, will be reduced to slightly more than one-fourth of its present cost.

Glycerine is at present manufactured almost entirely from fats at a cost of ninety cents a pound, which is six times its cost of production before the war. Extraction of the product from sugar will insure production, officials estimate, at 25 cents a pound or less.

The immense importance of the discovery in conserving the fat supply of the nation is pointed out by officials, who declare that Germany's fat shortage is largely due to the use of fats for production of explosives. Germany has long since been forced to discontinue the manufacture of soap in order to conserve the fats for munitions making.

The discovery is the first to be announced by chemists working in cooperation with the council of national defence.

Chop Feed

The laboratory of the Inland Revenue Department received for analysis, during the first quarter of the present year 161 samples of chop feed. Of these 123 were genuine; 29 were genuine as to feed value, but contained an excess of noxious weed seeds; 5 were nearly of minimum value and were passed; 4 samples were adulterated. The standard for chop feed requires as minima protein 10 and fat 2 per cent. and a maximum of 10 per cent. fibre.

Items of Interest from the Exposition

H. Reeve Angel & Company, Inc., New York. Filter papers of all descriptions, both for industrial and research work, were on exhibit, and tests were carried out with barium sulphate and other finely divided precipitates. Samples of "Labruco" rubber tubing of excellent quality were given to visitors.

Bausch & Lomb Optical Company, Rochester, N.Y. A splendid collection of optical apparatus used in chemical and metallurgical industries.

Buffalo Foundry & Machine Company, Buffalo, N.Y., had a large exhibit of machinery on the main floor. The principal feature was the large vacuum drum dryer, the main casing of which weighs 50,000 pounds. This dryer is used for the concentration of acids, chemicals, milk, dyewood extracts, food products, etc.; in fact it can be used wherever a vacuum dryer is required. Other Buflokast products were also exhibited; vacuum crystallizers, autoclave, fusion kettle, denitrators, etc., all bearing the quality mark characteristic of this company.

The Canadian Government showed its appreciation of the practical value of the Exposition by taking a booth for the Department of the Interior and the Department of Mines. The former department was represented by Mr. Johnston, on behalf of J. B. Challies, superintendent of the Water Power branch, and by Mr. McClymont, on behalf of F. C. C. Lynch, superintendent of the National Resources branch. A large map of the water power systems of Canada displayed on the walls greatly impressed the visitors, and much valuable information was given to enquirers. The Department of Mines was represented by Dr. A. W. G. Wilson, chief engineer of the metalliferous division, who has been doing important work in reporting on the chemical and metallurgical developments of Canada since the war; and by Edgar Stansfield, engineering chemist of the fuel testing divsion of the department. Other officers of the Mines branch visited the Exposition from day to day, and will no doubt contribute something of value concerning the Exposition. Maps, reports and other information were constantly given to visitors by Dr. Wilson and Mr. Stansfield.

The Bureau of Mines of the Ontario Government also sent copies of its recent reports for which there were numbers of enquiries.

Eimer & Amend, New York. Barnstead automatic water still, electric ovens, multiple replaceable unit electric furnaces were exhibited. A comprehensive assortment of laboratory apparatus was displayed in an excellent way.

Foote Mineral Company, Inc., Philadelphia. Rare and semi-rare ores occupied a large portion of this exhibit. "Cooperite," an alloy of nickel and Zerconium (patented) with a melting point of 1150° for use in cutting tools was an important feature; also Monzanite sand from which Thorium nitrate for gas mantels is obtained.

General Ceramics Company, Inc. Among the exhibits of this stoneware company was an acid-proof stoneware pipe said to be the longest ever made. A small size acid lifter was featured as was a ceramic pump cased with iron. Percy C. Kingsbury was in charge.

Kalbfleisch Corporation, New York. A large number of acids and chemicals were displayed, the chief feature of which were samples of sodium permanganate in solution, which for many uses is displacing potassium salt.

A. Klipstein & Co., New York and Montreal. Tanning materials, dyestuffs and chemicals. Samples of dyed wools and tanned leather gave an added interest to this booth.

Madero Bros., Inc., New York. Drugs and dyestuffs were featured. Wools dyed from these dyestuffs displayed an unusual color quality. A large range of chemicals were also on view.

Merck & Company. Of particular interest were the coal-tar derivatives such as acetanilid, methyl salicylate, salicylic acid, phenolphthalein, hydroquinone, resorcin, aniline oil, aniline dyes, etc., beautiful samples of which were in abundance at this exhibit. Fine chemicals were exemplified by numerous alkaloids and their salts. There was also a display of chemicals used in research and analytical work, known as Merck's Blue Label Reagents.

Metals Disintegrating Company, New York. Metallic lead, tin, zinc, aluminum, copper and mangnesium powders, and flakes of zinc, aluminum, tin and copper.

Monsanto Chemical Company, St. Louis. This exhibit comprised of samples of acetanilid, saliyclic acid, phenolphthalen, aspirin and many other similar products.

Pfaudler Company, Rochester, N.Y. Enamelled iron ware featured; a mixing tank; a one-piece closed tank; a storage tank; a kettle with a new type adjustable agitator; and pots of various sizes.

The exhibit of the **Process Engineers, Ltd.,** of Montreal showed a complete model of a diluting system for producing solutions from free rosin soaps, partially soluble oils, etc. This process will produce solutions from materials which cannot be dissolved in any other way and promises to be of as much service in the tanning and other industries as it has been to the paper trade.

Ernest Scott & Company, Fall River, Mass. Maps showing world-wide locations where "Scott service" has been used, were displayed.

Tolhurst Machine Works, Troy, N.Y. The centrifugal machines exhibited were of a type which have become popular amongst users of centrifugals.

Valley Iron Works, Williamsport, Pa. The autoclaves, etc, which were to be exhibited, unfortunately, were lost in transit. A reception booth, however, was maintained.

Maurice A. Knight, East Akron, Ohio, the well known manufacturer of chemical stoneware was a visitor at the Exposition. Mr. Knight reported that he was too busy filling factory orders to maintain a booth at the Exposition, but he has made arrangements to exhibit tourills, nitrating kettles, etc., next year.

Production of Pig Iron in the United States During 1917

According to E. F. Burchard, of the United States Geological Survey, the daily average production of pig iron was, in gross tons, during the current year, 102,000 in January; 95,000 in February; 105,000 in March, and over 110,000 in April and May, as compared with the maximum rate of 113,000 tons during October, 1916. The total output of coke and anthracite pig iron during the first five months of 1917, was about 15,800,000 gross tons as compared with about 16,175,000 tons during the corresponding period of 1916, a decrease of about 2 per cent.

The quantity of iron ore from mines in the Lake Superior region shipped from Upper Lake ports from January 1st to June 1st, 1917, was about 6,500,000 gross tons compared with slightly more than 10,100,000 tons for the corresponding months of 1916, a decrease of more than 35 per cent. This large difference is ascribed to the belated opening of lake traffic and to numerous accidents to ore boats. It was not due to inability to mine the ore.

Quebec's Mineral Production

The annual report of the Mines Branch of the Department of Colonization Mines and Fisheries of the Province of Quebec, covering the year ending December 31, 1916, has just been issued. The report shows that the mining industry of the Province is in a healthy condition. The mineral production for the year amounted to $13,287,024, being an increase of nearly $200,000 over the previous record year, 1913.

The increase is wholly attributable to the products of the mines proper, such as asbestos, copper, chromite, magnesite, molybdenite, zinc, and lead, whereas the building materials, as stone, brick, lime, cement show decreases.

Notes From New York

(From Our Own Correspondent)

The principal event of the last few weeks—excepting the very successful third National Exposition of Chemical Industries in New York, which is dealt with elsewhere in these pages—has been the Pittsburgh meeting of the American Electrochemical Society, held October 3rd to 6th, inclusive. A large number of most excellent papers were read and the immense and varied nature of Pittsburgh's industrial activities gave opportunitity for some most interesting trips of inspection. Neither was the social side of life neglected, golf, motoring and dancing as well as a most successful dinner being arranged for.

President C. G. Fink presided at the opening session and Dr. John A. Brashear, the Dean of Pittsburgh scientists, gave an address. In this speech Dr. Brashear described his recollection of Pittsburgh's rise to a position of first importance in metallurgical and chemical industry. His remarks were full of personal anecdotes regarding great men and great happenings and will be well worth reading in full when they appear in the Transactions of the Society.

Space will not permit of reviewing all the papers presented, but it will be of interest to Canadians to point out that three of the most interesting and important papers were given by Canadian electrochemists and dealt with matters of great interest in the Dominion at present. These were, "Electrochemical Industries at Shawinigan Falls," presented by Mr. H. E. Randall, of the staff of the Shawinigan Water & Power Company, Montreal. Mr. Randall described all the principal industries at Shawinigan, and gave a good idea of the immense possibilities of the location, as well as its present importance. "Electric Furnaces in the Iron and Steel Industry," by Robert Turnbull, Welland, Ont., dealt with the production of pig-iron by electricity in war time as it is now carried on in at least four places in Canada—Orillia, Ont.; Collingwood, Ont.; St. Catharines, Ont., and Shawinigan Falls, Que. Mr. Thos. French, of Nelson, B.C., contributed a paper on "The Future of Electrolytic Zinc." In Mr. French's absence this paper was merely referred to, but will later be dealt with fully.

Among the excursions were trips to the works of the Republic Chemical Company, Neville's Island, the Owens Bottle Works, where bottles are turned out automatically, the by-product coke plant of the Briar Hill Steel Company, and the laboratory of the Youngstown Sheet and Tube Company, at Youngstown, Ohio; the Atlantic Oil Refining Company, of Pittsburg, and the Radium Laboratory of the Standard Chemical Company, in the Vanadium Building in Pittsburgh. Besides this many of the visitors inspected some of the large steel mills, and also the Westinghouse plant in East Pittsburgh. A most successful banquet was held at the Hotel William Penn, followed by a vaudeville show and moving pictures of metallurgical operations in South America. All present felt that thanks were due Pittsburgh and its engineering public for a pleasant and an instructive time.

Dr. C. G. Richardson, formerly connected with Metals-Chemical, Limited, Welland, Ont., has entered into an agreement with the Reade Manufacturing Company, Newark, N.J., to operate a factory for refining cobalt, nickel and arsenical ore, making a variety of dryers, arsenates, etc. For this purpose they have purchased a modern chemical plant at present idle at Newmarket, N.J., and about eleven acres of land to provide for future expansion. As this plant is in fine shape and includes most of the necessary apparatus it is expected that the company will have its products on the market in about thirty days. The factory was originally built for the production of barium salts.

The American Bridge Company has been awarded a contract by the United States Navy Department for seven six-ton electric steel furnaces, costing $550,000. Three of these are to be installed at Charlestown, W.Va., three at Watertown Arsenal, and one at the Navy Yard, Washington, D.C. This is an additional order, four such furnaces having been previously purchased by the government.

Chemists interested in problems relating to the hydrogenation of oils have followed with interest the recent litigation between the Procter & Gamble Company and the Berlin Mills Company. In a recent suit brought by the former company against the latter, the Procter & Gamble Company alleged infringement of its patent for "a vegetable oil,preferably cottonseed oil, partially hydrogenized and hardened to a homogenous white or yellowish semi-solid, simulating lard." The product is widely advertised as "Crisco." and is used instead of lard in cooking. Judge Hand, of the United States district court, ruled that the patent was void for lack of invention. As numerous packing companies are making products of this kind, the suit was of great commercial interest.

It is stated in a recent number of the Oil, Paint and Drug Reporter, that the Federal Chemical Company of Louisville, operators of the Globe Fertilizer Company, and a number of other fertilizing plants, has outgrown its capacity of 75,000 tons of mixed fertilizer annually, and has announced that it will spend about $300,000 on a new sulphuric acid plant,to be erected at Columbus, Ohio, adjoining its new mixing plant, started last spring and recently completed at a cost of $200,000.

The new plant will be built as soon as the plans are complete. The sulphur-burning process will be used. The capacity will be about one hundred tons of acid daily, and about $100,000 of lead will be used in construction of the chambers. The output is primarily for the company's own use, but the needs of the company at present will not be more than about fifty per cent. of the capacity, half of the material being used at Columbus or the other mixing plants, while the balance will be sold for commercial purposes or for making munitions.

It is expected that $50,000,000 of the new Liberty Loan will be raised by the drug and chemical trades. A meeting of the Drug and Chemical Trades Committee of the Liberty Loan Committee was held in this city recently at the Banker's Club and plans were laid for a vigorously prosecuted campaign.

There is a rumor in circulation that the Standard Oil Company is going to turn over the free use of the Burton process for refining gasoline to all the independent companies as a partiotic move so as to increase the amount of gasoline available for military operations. This process enables 40 per cent. of gasoline to be produced from crude oil compared with 20 per cent. from other methods. Up to the present it has been the property of the Standard Oil Company of Indiana, and has been a jealously guarded trade secret. The Oil, Paint and Drug Reporter, in commenting on this rumor states that Dr. Burton, the inventor of the process was not unqualifiedly in favor of the move.

Dr. Alcan Hirsch, of New York, is leaving for Japan next week to take up again his consulting work for the Japanese Dyestuff Manufacturing Company, which is a semi-governmental enterprise. This is Dr. Hirsch's second trip in this connection.

Next Friday night the Chemists' Club of New York will confer honorary membership on Prof. Victor Grignard, of the chemical department of the University of Nancy, France, who is in this country as a member of the French Scientific Mission to the United States. Dr. Grignard is well-known as the discoverer of the famous Grignard reaction, so useful in organic syntheses.

A New York section of the "Societe de Chimie Industrielle" of France is being formed in New York. This section has not been formed because of any need for another chemical society in New York, but rather to stimulate intercourse between American chemists and French chemists and to keep American chemists in closer touch with French industrial developments. Mr. Rene Engel, secretary of the French society, who is at present in this country as a member of the French Scientific Mission to the United States, signified his warm approval of the plan and steps will be taken immediately to form the section.

Having recently acquired the building next door, formerly a bachelor apartment house, the Chemists' Club of New York, has had an entrance made into this building and will use it as an annex to the Club. This will be most welcome to many of the out-of-town members who, owing to the increased popularity of the Club, have recently rarely been able to secure accomodations in the building. The new annex ought to take care of the non-resident members comfortably for some time, and in view of the great crowding of New York hotels at present—which is expected to increase rather than diminish—the move is a timely one. It is also an indication of the new status of the chemical profession. Time was when doubt was expressed about keeping the original two floors of rooms filled. That is all passed. Today the Club is the home of all those interested in industrial or academic chemistry when in New York.

We are informed by one of the leading textile chemists of this city that there will soon be a plentiful supply of the much desired alizarine reds and blues. Owing to the great demand for these blues for naval uniforms and the unsatisfactory nature of other blues which have been employed as substitutes this is welcome news. These dyes are practically the only important group which the American dyestuff industry has not yet contributed. There are no insuperable technical difficulties in the way of manufacturing these particular dyes and a plentiful supply of anthracene, which is the starting point for them, is promised by the refiners. All attempts to use substitutes have been woefully unsuccessful. Paranitraniline red runs dreadfully and the blues that have been tried are none of them fast enough. It may be asked why these dyes have not been made before when almost every other variety of dye has. The answer for this is not chemical; it is political. Alizarine products were exempted from the specific duty placed on dyestuffs by the Hill Bill. Since a large and expensive plant is necessary to make alizarine colors it is easy to see how this would prevent their production.

In general, however, except where hindered by such meddling legislation as the above, American manufacturers are showing their ability to produce practically every chemical, dye, drug and specialty formerly imported from Germany. The Bureau of Printing and Engraving is now receiving lakes suitable for printing stamps from domestic manufacturers and in all likelihood we will not much longer have two cent stamps of the queer hues of salmon, pink and terra-cotta, which have greeted our eyes during the last few years.

F. M. TURNER; JR.

New York, October 20th, 1917.

Interesting News Items

The Liverpool Select Vestry (the Board of Poor-law Guardians for the old city area) has accepted a tender for a large quantity of "pearl-powder." When a member asked the nature of the substance he was informed that pearl-powder is a substitute for the now unobtainable washing-soda, and that it is "three times as strong as soda."

A correspondent, writing to the Evening News, complains that a great amount of water is wasted by amateur photographers allowing "the water-tap to run all night, washing their prints." They must be "amateurs," indeed if that is the way they wash their prints.

A hypodermic syringe with a quartz barrel is now on the market. Its advantage is that the syringe can be sterilized in boiling water without risk of breakage. It is called the "Luc" syringe.

The forest fire losses in Ontario, Quebec, New Brunswick and Nova Scotia this season so far have been light, owing to wet weather and more vigilant patrol. British Columbia and Western Alberta have been the chief losers. July weather was blazing hot with practically no rain in the mountain sections of the two provinces.

Quebec sold the United States last year more than sixteen million dollars worth of lumber, laths, shingles and pulp products.

More than $7,500,000 are paid annually into the provincial and federal treasuries of Canada as timber and pulp-wood dues by commercial companies. British Columbia receives the largest amount, over two million dollars a year.

British Columbia's production of manufactured articles covers a wide range. The industries include the making of aeroplanes, of automobile accessories and tops, asbestos articles of many kinds, artificial stone and flooring, book bindings, boot polish, brick tile and clay products. The factories of the province make boxes, butchers' supplies, cans, cartons, paper boxes, cement, canvas tents and awnings, overalls, gloves, carriages, chemicals, clothing and vats.

It is not fully recognized that Japan is gradually changing from an agricultural to an industrial country, and that in her new drive to win some of the foreign markets she has captured considerable of the business which was formerly held by this country, says the latest issue of "Industrial Conservation."

The manager of Eastern Lands of the Canadian Northern has recently returned from a trip through Northern Ontario and says that he believes that there are tributary to the present railways and waterways leading to them, 250,000,000 cords of spruce pulpwood in Ontario and 350,000,000 cords in Quebec. He says that it is useless to consider timber north of the Transcontinental Railway, as the rivers run north, and only a small portion could be brought up-stream by building dams which would enable the wood to be towed back.

The quantity of pulpwood manufactured into pulp in Canada has been steadily gaining on the amount of wood exported to other countries in the unmanufactured state. In 1908, 482,777 cords were manufactured into pulp in Canada, and 794,896 cords were exported in the raw state. Since 1913 the quantity manufactured in Canada has exceeded that exported. In 1915, 1,405,836 cords were manufactured in Canada, and 949,714 were exported in the raw state. In 1916 the figures were manufactured in Canada, 1,764,912 cords; exported in the raw state, 1,068,207 cords, showing that 696,705 cords more were manufactured into pulp in Canada than were exported in the raw state to be manufactured abroad.

Drilling for oil in the Rockwood neighborhood is reported by the Intercolonial Gas Journal of Canada. All leases are signed by the Trenton Oil and Gas Company, a concern which is backed by a number of Toronto capitalists. A large number of leases have been secured, and the company is confident that there is a good supply of gas and oil to be had, but until the actual drilling has started nothing of a definite nature can be stated. This is not the first time that an attempt has been made to strike gas and oil in this same section; a few years ago some drilling was done at Crewson's Corners, near Acton, and quite a lot of stock was sold to the residents, but it did not amount to anything.

Professor Julius Stieglitz delivered his presidential address before the American Chemical Society at the Boston meeting. The subject was "The Outlook in Chemistry in the United States." He pointed out the danger to chemistry which may arise if all the best men are attracted from the universities to industrial work, and he also mentioned instances of shabby treatment, by some corporations, of men who have made valuable discoveries for them.

The thirty-second general meeting of the American Electrochemical Society was held at Pittsburg, October 3rd to 6th. The leading feature was a series of papers and discussions on electrochemical war supplies.

In connection with experiments on the effect of drainage on soil acidity, S. D. Conner, of the Indiana Experiment Station, reaches the conclusion that it is probable that most acid soils are formed in poorly drained areas.

Hon. C. C. Ballantyne

At least one of the Cabinet Ministers of the new Coalition Government of Canada may be claimed by the chemical industries—Hon. C. C. Ballantyne, to whom has been allotted the important portfolio of Minister of Public Works. Mr. Ballantyne was born at Colquohoun, Ont., and began life in Montreal. After starting as a young man in the works of the Sherwin-Williams Paint Company, he became a director of the company and has been for some years vice-president and general manager. The business of the Canada Paint Company, during his administration, has been affiliated with that of the Sherwin-Williams Paint Company. Mr. Ballantyne is also a director of Canadian Explosives, Limited, and the Canada Cement Company. He is connected with several of Montreal's institutions, such as the hospitals, banks, etc., and is a member of the Council of the Montreal Board of Trade. In 1905 he was elected president of the Montreal branch of the Canadian Manufacturers Association. He is exceptionally qualified for his new work by his own experience and by his knowledge of the business and industrial conditions of Canada.

Molybdenite

The daily press reports that an eastern company has secured an option on 200 acres in Conmee township, three miles from Kakabeka Falls, and within one and one-half miles of a railway siding. The price paid for the option was $75,000, and a gang of men is at work stripping and trenching the vein, which has been proved to a depth of fifty feet. A cross-cut shows the vein to be at least sixteen feet wide, which measurement is a record for a molybdenite vein on the continent of North America. The ore will grade over one per cent., or about twenty pounds to the ton, and the price is $1.10 a pound, with a possible rise to $2.25 if the embargo is lifted and the refined metal allowed to go to the big steel works in the United States.

Trypaflavine as an Antiseptic

Trypaflavine, an acridine dye, patented by the Cassella Company in 1910, and now manufactured by Levinstein Limited, has met with great success as an antispetic. It is used generally in aqueous solution of 1 : 1,000. Its special advantages are apparently twofold; it stimulates the phaogocytes and it also possesses a high germicidal action. This latter is stated to be twenty times that of mercuric chloride. Solutions of trypaflavine of 1 : 2.5 concentration are said to equal 80 per cent. phenol in antiseptic power. Trypaflavine is being employed extensively by the British Army Medical Corps.

Tethelin

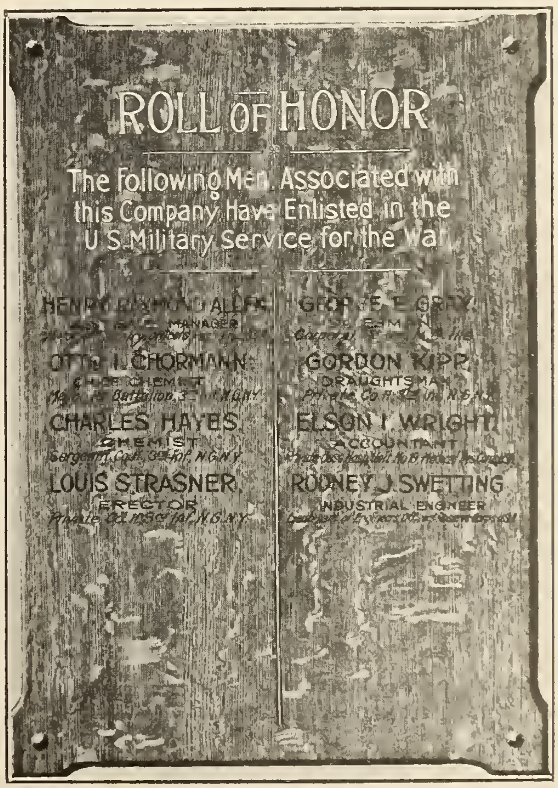
Dr. G. Brailsford Robertson, professor of bio-chemistry and pharmacology in the University of California, has donated to the University of California all his patent rights in the growth-controlling substance, "tethelin," which he has succeeded in isolating from the anterior lobe of the pituitary body, and which has been employed to accelerate repair in slowly healing wounds. All profits resulting from this discovery are to constitute an endowment, the income to be applied to medical research.

Tests of this new chemical substance made in army hospitals in Europe and in civil hospitals in America have shown that it is of value in curing wounds and in causing wounds to heal promptly, which for months or even years had refused to yield to treatment. Tethelin is of special use in cases where frost bite, burns, or varicose veins have injured the vitality of the tissues. There are thousands of such cases in Europe to-day and they occupy the hospitals for an exceptionally long time, consuming drugs, time, space and food and frequently such cases have to be discharged unhealed.—Science.

The Shawinigan Water & Power Company contemplates raising its capital from fifteen to twenty million dollars to extend its water power in view of metallurgical developments. The consumption of its power will be increased this year by 18,000 horse power. The Canada Carbide Company at Shawinigan Falls is increasing its output by fifty per cent. this year; and the Northern Aluminum, which began with 1,000 horse power is now using 40,000 horse power.

Serving Humanity

The industrial establishments of the United States have a new bond of sympathy with those of Canada. From office and factory every large concern is now contributing its quota of volunteers and drafted men and these men now in training are remembered by the boys at home. The accompanying sample of a "roll of honor" is the tablet by which the Pfaudler Company, of Rochester, N.Y., commemorates its contingent now serving their country.



Coming Events

The Toronto Branch, the Montreal Branch, the Ottawa Branch and the British Columbia Branch of the Society of Chemical Industry are now preparing for the winter series of meetings. At the meeting of the Toronto Branch, November 16th, Professor G. E. Day, of the Agricultural College, Guelph, will give a paper on "Drainage and Soil Moisture"; at the meeting on December 21st, Dr. Boswell, of the University of Toronto, will present a paper on "Chemistry in Relation to Agriculture." Alfred Burton, 114 Beford Road, Toronto, is general secretary.

Regular meetings of the Canadian Society of Civil Engineers will be held at the society's headquarters, 176 Mansfield Street, Montreal, on the following dates: November 18th, November 22nd, December 6th, December 20th. The date of the next annual meeting will be announced next month. Fraser S. Keith, secretary.

The Toronto section of the American Institute of Electrical Engineers will make an inspection of the Toronto Harbor Works on Friday, October 26th, starting in launches at 1.30 p.m. from the foot of York Street. E. V. Pannell, secretary, 60 Front Street West, Toronto.

The Canadian Mining Institute will hold its next annual meeting during the latter part of March next. The place and exact date will be announced later.

The First Chicago Cement Machinery and Building Show superseding the annual Chicago Cement Show, will be held at the Coliseum, under direction of the National Exhibition Company, February 6th to 13th, 1918.

Meetings of the American Chemical Society will be held in Rumford Hall, Chemists Club, New York., November 9th and 23rd. On the 7th December a joint meeting with the Society of Chemical Industry and the American Electro-chemical Society, will be held.

The Chicago section of the American Chemical Society and the branches of the same society in adjoining states have asked that a chemical exposition on the lines of that of New York be held in Chicago during the week commencing March 4th next. The Chicago Association of Commerce has promised its active aid.

The twenty-third annual meeting of the National Municipal League of the United States will be held at the Hotel Statler, Detroit, Mich., November 21st to 24th. Secretary, Clinton Rogers Woodruff, 703 North American Building, Philadelphia, Pa.

It is reported from Ottawa that the new Cabinet will lift the ban from oleomargarine at an early date.

The plant of the Metagami Pulp & Paper Company at Smooth Rock Falls on the Metagami River, is completed and will be in operation this month.

Mr. D. H. McMurtrie, chemical engineer with the Brown Corporation, La Tuque, Que., has gone to Washington to assist the American Government in solving some "war problems."

A site has been selected near Lake Temiskaming where the Riordon Pulp & Paper Company will erect a sulphite pulp mill and a paper mill, under the supervision of the commission of conservation. This is the first industrial enterprise on this plan undertaken in Canada, and the proposal is to create a model town. Thomas Adams will be the consulting engineer, and the town-planning and other features will be watched with interest. The site of the town is at present a primeval forest.

Officers of the Geological Survey have received with some skepticism the report of the discovery, by Capt. Russell Bellamy, of New York, of anthracite coal in the Salmon River district of New Brunswick. The report stated that the coal is similar to that of Pennsylvania and that half a million tons is in sight.

Personals

Mr. M. J. Bradley, M.A., superintendent of acetone production, under the Imperial Munitions Board, at Shawinigan Falls, has been appointed to a graduate fellowship at the University of Illinois, Urbana, Ill. Mr. John F. Demary, B.A., succeeds Mr. Bradley at Shawinigan Falls.

Miss Marion Louise Grimshaw, B.A. (McMaster), and Miss Bessie Irene Cooke, B.A. (McMaster), have received appointments in the chemical laboratory of British Cordite, Limited, Trenton, Ont. Until recently they were members of the chemical staff of the Canadian Explosives Company, Limited, Nobel, Ont.

Miss Winnifred Marguerite Grindell, B.A. (McMaster), has been appointed head of the laboratory of the Canadian Consolidated Rubber Company, Montreal. Miss Grindell was previously a member of the chemical staff of the Canadian Explosives Company, Limited, Nobel, Ont.

Dr. H. P. Talbot, professor of chemistry at the Massachusetts Institute of Technology; Dr. C. L. Parsons, chief chemist of the Bureau of Mines, and an army officer to be named by Major-General Hugh L. Scott, chief of staff, have been appointed by the United States Secretary of War to investigate the issue of defective ammunition sent to the American expeditionary force in France.

Science announces the following changes:

Dr. Colin G. Fink, for the past ten years in the Research Laboratories of the General Electric Company, has been appointed head of the new Chili Exploration Company Laboratories, New York City.

Dr. L. F. Nickell, assistant professor of chemistry at Washington University, has been appointed chemist in the research department of the Monsanto Chemical Works, St. Louis, Mo.

Society of Chemical Industry

The September meeting, held at Ottawa, was devoted to discussion of a standard method for water analysis and was participated in by Messrs. Wardleworth (chairman), McGill, Race, Shutt and others. The business for the meeting of October 19th in Toronto, is "Milk Powder; Its Manufacture and Uses," by S. B. Trainer; "Standardization of Deci-normal Sulphuric Acid," by A. Tingle and F. W. Babington; "Report of Ottawa Meeting re Standard Methods of Water Analysis."

Official denial from Ottawa is given to the reports that the right to dam the St. Lawrence at the Long Sault had been given to the Aluminum Company of America.

At a meeting of the Toronto branch of the Canadian Mining Institute, held on the 13th October, the following officers were elected for the ensuing year: E. P. Mathewson, of the British America Nickel Corporation, chairman; Reginald E. Hore, editor Canadian Mining Journal (265 Adelaide Street W.), secretary; W. A. Carlyle, H. E. T. Haultain, Col. R. W. Leonard, G. G. S. Lindsey, T. W. Gibson, Prof. W. G. Miller, C. E. Smith, J. B. Tyrrell and W. E. Segsworth, executive committee.

The Advisory Council for Scientific and Industrial Research has appointed a committee of twenty members to assist the development of the Canadian chemical industries and a committee of the same number to promote the metallurgical and mining industries. The council has also taken over the exhibit of natural resources started by the Arthur D. Little Company at Montreal.

The total production of steel ingots and direct steel castings in Canada in the first six months of the current year amounted to 836,149 short tons, an increase of 246,596 tons, or 42 per cent., over the corresponding period of 1916.

Chemical and Metal Markets

The quotations below represent average prices for the quantities indicated at the time of going to press. Larger amounts, of course, may be obtained at lower figures.

Toronto, October 24, 1917

As forecasted in our September issue the chemical and metal markets have remained firm throughout the past month. This firmness will probably remain for some time yet.

The United States embargo list when first issued permitted the export of caustic soda with a properly endorsed license. This concession has now been withdrawn and export of this substance has been forbidden totally. The action of the American Government is probably due more to a desire to conserve a supply of alkali than to prevent it reaching enemy countries via adjacent neutrals.

Potassium salts are becoming scarcer week by week. Potassium bichromate is practically unobtainable except in very small quantities. Sodium bichromate and sodium permanganate are being placed on the market in larger quantities as a substitute for the potassium salts.

White granular ammonium chloride is at present unobtainable. The "grey variety," however, can be purchased at 15 cents per pound in quantities. Ammonium carbonate is slightly easier at time of writing. Aqua ammonia still maintains its abnormal low price.

Inorganic Chemicals

Alum, lump ammonia	100 Lbs.	$6.50
Aluminium Sulphate, high grade, bags	100 Lbs.	4.00
Ammonium Carbonate	10 Lbs.	1.80
Ammonium Chloride, Grey	Lb.	.15
Aqua Ammonia .880	Lb.	.8
Bleaching Powder, 35% drums	100 Lbs.	4.50
Borax, crystals	Lb.	.10
Boric Acid, powdered	Lb.	.16
Calcium Chloride, crystals fused	100 Lbs.	3.00
Caustic Soda, ground, Bbl	Lb.	.10
Chalk, light precipitated	Lb.	.10
Cobalt Oxide, black	Lb.	2.10
Copper Sulphate (Blue Vitriol)	100 Lbs.	11.00
Fuller's Earth, powdered	100 Lbs.	6.00
Hydrochloric Acid, carboys, 18°	Lb.	.3
Lead Acetate, white crystals	Lb.	.20
Lead Nitrate	Lb.	.30
Lithium Carbonate	Lb.	2.10
Magnesium Carbonate, B.P.	Lb.	.40
Nitric Acid, 36° carboys	100 Lbs.	8.75
Phosphoric Acid, S.G. 1750	Lb.	1.00
Potassium Bichromate	Lb.	.60
Potassium Bromide	Lb.	2.40
Potassium Carbonate	Lb.	1.50
Potassium Chlorate, crystals	Lb.	.85
Potassium Hydroxide, sticks	Lb.	3.00
Potassium Iodide, bulk	Lb.	4.25
Potassium Nitrate	Lb.	.55
Potassium Permanganate, bulk	Lb.	6.00
Silver Nitrate	Oz.	1.00
Soda Ash bags	200 Lbs.	10.00
Sodium Acetate	Lb.	.40
Sodium Bicarbonate	100 Lbs.	4.00
Sodium Bromide	Lb.	.80
Sodium Cyanide, bulk, 98-99 per cent	Lb.	$ .50
Sodium Hyposulphite, bbls	100 Lbs.	3.00
Sodium Nitrate, crude	100 Lbs.	9.00
Sodium Silicate	100 Lbs.	3.00
Sodium Sulphate (Glauber's Salts)	100 Lbs.	1.50
Strontium Nitrate, com	Lb.	.55
Sulphur, ground	100 Lbs.	4.50
Sulphur, roll	100 Lbs.	5.00
Sulphuric Acid, 66°Be, carboys	100 Lbs.	3.00
Tin Chloride, crystals	Lb.	.42
Zinc Oxide	Lb.	.32
Zinc Sulphate, com	Lb.	.6½

Organic Chemicals

Acetanilid, C.P.	Lb.	.90
Acetic Acid, 28 per cent. in bbls	Lb.	.8½
Acetic Acid, glacial, 99½% in carboys	Lb.	.45
Acetone	Lb.	.43
Alcohol, methylated	Gal.	1.50
Alcohol, grain	Gal.	6.00
Alcohol, wood, 95 per cent., refined	Gal.	1.90
Benzoic Acid	Lb.	2.50
Carbolic Acid, white crystals	Lb.	.75
Carbon Bisulphide	Lb.	.15
Chloroform, com	Lb.	1.25
Citric Acid, domestic, crystals	Lb.	1.00
Ether, 725	Lb.	.75
Glycerine	Lb.	.80
Oxalic Acid	Lb.	.55
Salicylic Acid	Lb.	1.80
Sodium Benzoate	Lb.	2.50
Tannic Acid, commercial	Lb.	1.60
Tartaric Acid, crystals	Lb.	1.00

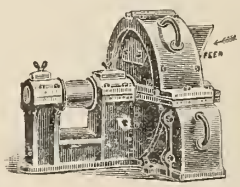
Metals

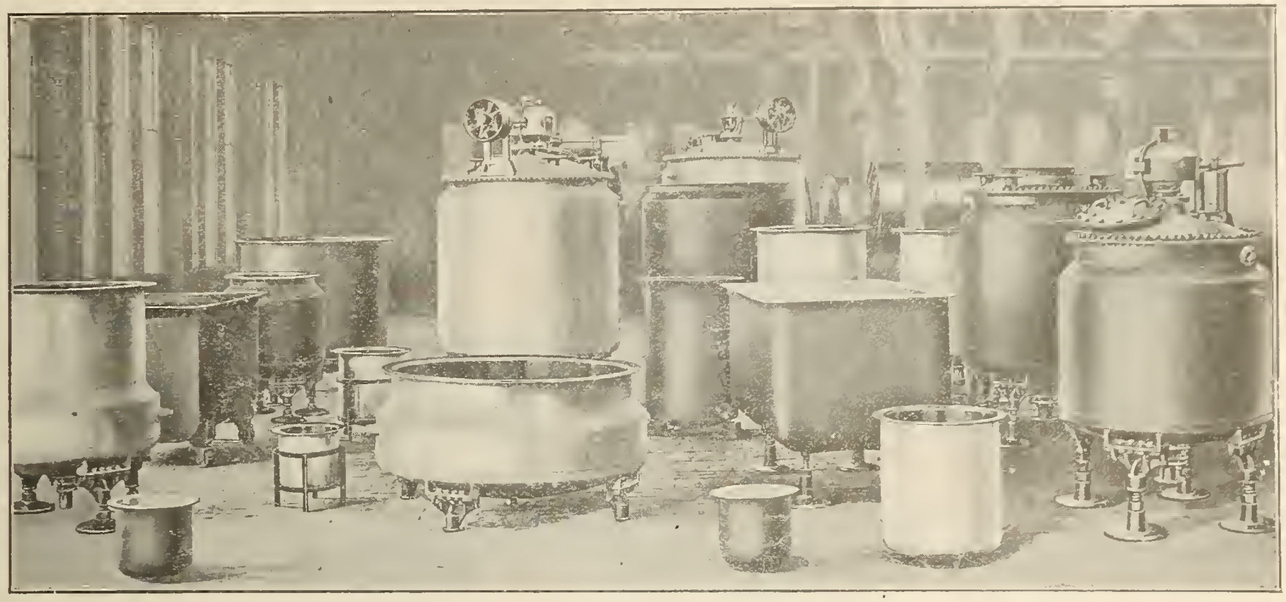
Aluminium	Lb.	.57
Antimony	Lb.	.18
Brass, yellow ingots	Lb.	.22
Cobalt	Lb.	2.25
Copper, casting	Lb.	.32
Copper, electrolytic	Lb.	.33
Lead	Lb.	.11
Magnesium	Lb.	2.50
Mercury	Lb.	2.40
Nickel	Lb.	.48
Platinum, pure	Oz.	105.00
Silver	Oz.	1.00
Spelter	Lb.	.11
Tin	Lb.	.64

Effect of Smelter Gases on Insects

During the last three years the Department of Agricultural Investigations of the American Smelting and Refining Company, has carried out extensive series of experiments to test the effect of sulphur dioxide on various kinds of vegetation. In this connection R. W. Doane has found that there is no basis whatever for the belief that bees or other insects are in any way affected, either as regards numbers or activity, by the presence of 25 parts of sulphur dioxide in 1 million parts of air. This concentration is several times that found in air even quite close to the smelters. Burning sulphur in quantity of 2 pounds per 1,000 cubic feet of space is sometimes recommended for killing insects. This would give about 24,009 parts of sulphur dioxide in 1 million parts of air. In this concentration, even with prolonged fumigation, the insects sometimes survive.

Index of Advertisements





A Group of Characteristic Types

TALKS *with our* FRIENDS

¶ When the Canadian Chemical Journal was projected the publishers were sanguine of its success because of the plain evidence of its need. Its actual reception by the chemical industries proved to be better than we anticipated. Owing to the increase of advertisers and subscribers the Journal has been enlarged three times in the first six months of its existence. It started with a paper of 32 pages besides the cover. It now has 48 pages besides cover.

¶ We have faith in the field of work; we have full conviction of the importance of the mission of the Journal; but we are conscious that without the spontaneous good will of friends from every province this faith would have had mountains of obstacles to overcome. For the early cleaning away of these obstacles we return thanks and must not withold the credit and honor due to those friends who are the real inspiration of the progress the Journal has made.

Our contemporaries have been very generous towards us as recently published extracts from leading Chemical and other Journals have shown. To these friendly notices we add the following from **The Chemical News,** of London, England, edited by Sir William Crookes:

The Canadian Chemical Journal has appeared at an opportune moment, and it is to be hoped that it will have a long and vigorous life, winning success and doing good. Millions are invested in the chemical industries in Canada, and an increasing number of the public are interested in scientific industries generally. It is estimated that Canada possesses 40 per cent. of the water power of the world, and the next few years should witness a great extension of chemical industries in the country, especially the electrolytic preparation of chemicals. From the articles in this copy of the new journal it may be foretold that it is going to have a useful career, and to render valuable assistance in putting a final stop to Germany's monopoly of chemicals and chemical products in the world's markets.

The Canadian Textile Journal—which by the way is the oldest technical Journal in Canada, having been founded in the year 1883—has the following friendly reference :

The first number of The Canadian Chemical Journal, which has just been published, assures us that a real need in the field of technical journalism will be adequately filled. The journal is published by the Biggar Press, of which E. B. Biggar, formerly proprietor and editor of the Canadian Textile Journal, is manager. Mr. Biggar's long association with technical journalism in this country has given him an excellent insight into the field of chemistry applied to various industries. In publishing The Canadian Chemical Journal he no doubt feels that the relationship of chemistry to all branches of industry has been recognized by the manufacturers of this country. The first issue is replete with valuable information relating to Canadian subjects. Mr. Biggar contributes the first of a series of articles on nickel, in which he traces the history and geological distribution of this mineral, and gives us something of Canada's great monopoly of this valuable mineral. Other interesting articles in the first issue are the Romance of Science, by Thomas Bengough; Chemistry in Canadian Woods; and a number of shorter articles relating to developments in chemistry in this country. The magazine is very attractively produced.

MAURICE A. KNIGHT

MANUFACTURER OF

ACID PROOF CHEMICAL STONEWARE

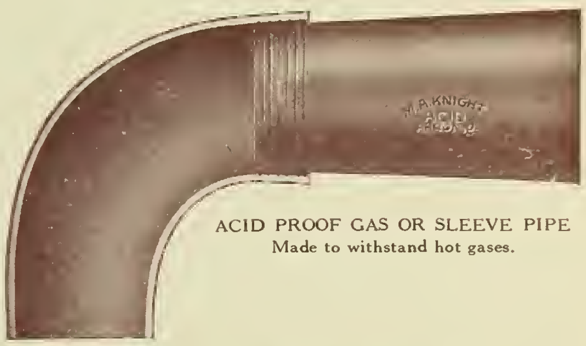
ACID BRICK, SPECIAL WARE AND PIPE

OFFICE AND FACTORY - - KELLEY AVENUE - - EAST AKRON, OHIO

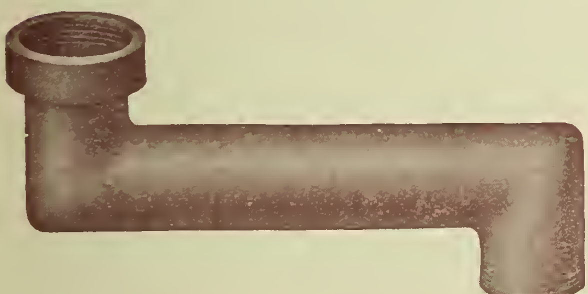
ST. LENGTH SOCKET PIPE
Notice deep and heavy grooved sockets. Standard lengths 1 to 3 ft., special lengths up to 12 ft.

Acid proof "T" Bell and Socket Pipe. We make Acid Proof Pipe in any bore from ¼" up to 42", and with all kinds of fittings.

ACID PROOF "Y" BELL AND SOCKET PIPE
We also make dampers and all kinds of special fittings.



ACID PROOF GAS OR SLEEVE PIPE
Made to withstand hot gases.

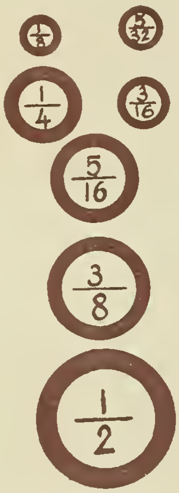


ACID PROOF "S" OR CONDENSING PIPE
Made in any bore and most any center. We also make all kinds of Flanged Pipe in any bore or length, with fittings.

ACID PROOF RETURN BEND OR GOOSE NECK
Made in any bore or center to fit Receivers or Tourill Sockets.

ACID PROOF GROUND AND GROOVED FLANGED PIPE
Showing "P" Trap, Straight "T" and sanitary "T" Fittings. This style of pipe is bolted together with asbestos wicking placed in grooves. Made in any bore up to 6 inches and in all kinds of fittings. Used for waste lines in buildings.

Let us send you circulars and particulars.

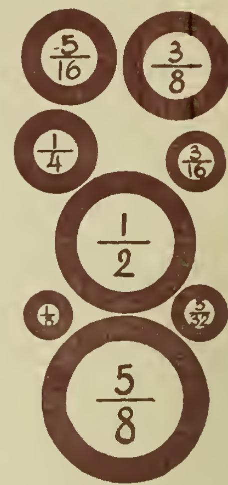


4834—Actual Sizes

SCIMATCO
PITTSBURGH, PA.
LABORATORY TUBING

Scimatco Laboratory Tubing is Acid Cured

Other Rubber Tubing is steam cured



4836—Actual Sizes

There's a Big Difference!

SCIMATCO LABORATORY TUBING is jet black and never blooms or turns gray; it is more elastic and at the same time has greater strength; it resists laboratory fumes and will cling to glass tubing, thereby insuring gas-tight joints. This tubing is satisfactory for connections for sulphur evolutions.

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Thickness of wall, inch	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$
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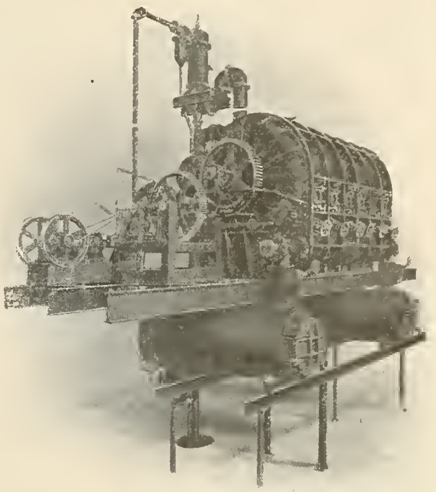

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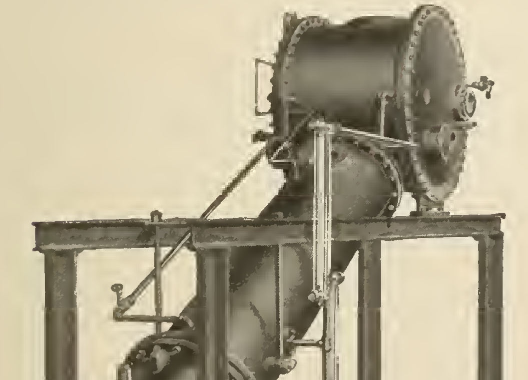

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NOTICE

The Editorial Department of The Canadian Chemical Journal exercises every practicable care to ensure the correctness of the contents of the Journal. In the case of signed articles it is to be distinctly understood that the authors of such articles are alone responsible for the statements which they may contain of fact, opinion or conclusion.

Principal Contents

We hope to go to Press about 20th December for the January issue. Advertisers will oblige by sending changes of copy not later than 10th December.

Correction

In the article on the nitrogen industry by Dr. Charles L. Parsons, on page 140 of the October number, the investment cost per ton of ammonia should have been stated as $340 instead of $540.

THE first volume of THE CANADIAN CHEMICAL JOURNAL closes with the present number, so that the new volume will begin and end with the calendar year. The index of Volume I will be found on the last page of this issue. We are still unable to fill orders for sets of the first volume. Any reader who has copies, in good condition, of any issue from May to August inclusive, will be credited to the extent of double the number sent, if they will forward them to this office, indicating the name of the sender.

German Patents and the Government

ALL interested in the Cobalt mining industry are aware that, for some time past, mining journals and certain others, have been devoting much space to the claim which has been made that the flotation process is controlled by German patents. THIS JOURNAL has abstained from comment on the subject until it was able to offer a constructive contribution. The paper by Messrs. Gilmore and Parsons, the second and concluding portion of which appears in this number, is eminently constructive because it shows that oil, suitable for ore flotation, may be obtained from Canadian wood. The oil hitherto available was prepared from the southern long leaf pine and was, of course, imported.

The question now arises as to what ultimate action the Government will take regarding the flotation patents?

Soon after the outbreak of the war it was announced that, for a small fee, licenses would be granted to manufacture such drugs, chemicals, etc., as were protected by German patents. These licenses, however, were only to operate for the duration of the war. The manufacture of such chemicals is, at best, a risky matter, financially, but, to add to this risk by demanding that the would-be producer enter a guessing competition regarding the duration of the war is to make the whole affair into a gamble. For this reason comparatively few licenses have been issued.

It has been announced recently that the United States have decided to allow German patents to be worked for the period of the life of the patent. This plan is admirable and should soon have beneficial results, especially in connection with the dye industry.

It is to be hoped that the enquiry which the Government is to make into the flotation patents will be brief and thorough, and will be followed by immediate action regarding ALL enemy patents.

Training of Chemists for Industrial Research

IN the last number of this JOURNAL (page 148) we criticized the policy of the Government in establishing scientific fellowships and scholarships, on the ground that, under the present educational conditions, the holders could not receive an adequate or satisfactory training.

The subject is of such prime importance that no excuse is necessary for returning to it. The real question at issue is not one of expending a few thousand dollars per year in one way, or in another way, the vital question is, shall Canada, after the war, return to the condition of chemical servitude which prevailed in ante-bellum times? If Canada is to be free to develop her chemical manufactures to the highest point of efficiency she must have an adequate supply of men trained broadly and intensively in research work.

The combined experience of the United States and of Germany shows that such a training can only be obtained in a properly equipped graduate school. At present Canada has no such school and consequently such of her chemists as desire to develop their abilities to the greatest possible extent proceed to some one of a dozen first-rate graduate schools in the United States. Before the war a few of them went to Germany.

The universities at present existing in the Dominion are organized, staffed and equipped for the training of undergraduates only. Such training is, on the whole, well and faithfully given by men who are none too well paid and whose work is by no means light. We have no thought of criticizing either their efforts or their results. What is needed is to supplement this undergraduate work by a graduate school, or schools.

The question at once arises as to the cost of such graduate instruction. The early history of the chemical departments of Johns Hopkins University, or of the University of Chicago, to take two examples, at random, shows that the cost need not be very great. No new buildings would be required and but very little in the nature of equipment would be necessary in order to make a good beginning. It would, however, be needful to provide adequate salaries for at least three men of the first rank, who had given good evidence of their ability in research. These men should be debarred absolutely from any work with undergraduate students. Their whole time and energy should be devoted to research and the training of graduates.

It is not necessary now to have graduate schools in each province. At present a graduate school attached to one university would be adequate for the Dominion. One may safely assume that were such a school to be established for chemistry, others would soon follow for collateral and related subjects until, finally, the whole curriculum would be included.

The selection of men for such appointments as we have indicated would offer difficulties, but by no means insuperable ones. It would obviously be unwise to appoint to such posts men who have spent years in the training of undergraduates. However good these men may be, whatever they may have done in research (and some have done much) they have acquired a viewpoint different from that necessary for the training of graduate students. Here again the example and experience of Germany and the United States can be utilized with advantage. As is well known, many of the leading universities of these countries have frequently gone outside their own national borders for their research leaders, Van't Hoff for example, although he died Professor at Berlin, made his name internationally famous while living in his native country, Holland. So then, if a graduate school of chemistry were to be established in Canada, its best chance of success would be found by calling its first members from outside the Dominion.

With men of the proper calibre in charge of the work, students would quickly flock to them and a subsidy of fellowships and scholarships would be of relatively little importance.

Oleomargarine, Ice Cream and "Klim"

DURING the past few months this JOURNAL has given a good deal of information on oleomargarine and has urged that Canada should no longer remain the only country in the world which prohibited its manufacture. We have not been alone in advocating that the ban should, under the circumstances of the time, be lifted from a product that would yield a uniformly edible fat, available to people who cannot now supply themselves with good butter. We have had not only the endorsement of high medical and chemical authorities; but even rural communities in the West and other parts of Canada outside of the dairy districts have favored the freedom of such a serviceable industry.

The Dominion Government has already passed an order-in-council permitting any person to make oleomargarine who takes out a license and conforms to the regulations imposed for the manufacture and sale of the article. Full particulars of these regulations may be had from the Veterinary Director-

General, Department of Agriculture, Ottawa, to whom all applicants for licenses to make margarine are referred. Many applications for licenses have already been made, but none have yet been granted, and no doubt the government will see to it that every licensed plant is properly qualified and equipped.

Before the war Canada was importing over seven million pounds of butter from New Zealand, and the war has made such demands here that the exports of Canadian butter this year are over six times those of 1913-4.

The recent expansion of the industry for converting milk into milk powder under the name of "Klim," etc., and the allied industry of condensed milk has affected the butter industry by giving the farmer a good alternative market for his milk; but few will begrudge the cattle raiser the advantage he gets from these developments.

There will be a large and legitimate field for all these industries. There is another trade which, in war time, ought to be suppressed with an unsparing hand—that is the ice cream industry. While men are giving their lives on the battlefields, and families at home are suffering deprivations of the necessary things of life, it is a contemptible spectacle to see groups of full grown women parading the streets sucking at ice-cream cones. Enough has been spent in Canada in the past year on these teeth-destroying effeminacies to feed the starving population of Belgium, Serbia and Armenia combined. Such an ill-timed luxury is without excuse and should be prohibited or taxed out of existence.

THE high cost of coal in Canada brings up again the question of the manufacture of peat fuel from the immense beds of sphagnum moss in various provinces. Extensive experiments were made some years ago by Dr. Haanel, of the Department of Mines, but were not followed up by private manufacturers. The fuel crisis brought about by the war has forced the Scandinavian countries to go anew into peat manufacture. The output of peat fuel in Sweden last year was 22,500 tons but this year it will exceed 100,000 tons. Denmark which produced 200,000 tons in 1916 will have an output this year of over half a million tons. In Norway there are now 217 peat machines working to full capacity. Each of these machines, which cost about $13,500 and can be worked by two men, will turn out 35 to 45 tons per day. It would be well for the Canadian Government to import a couple of these machines, which appear to be standardized for their purpose, and renew the experiments on Canadian peat.

WE learn that a Norwegian company has obtained the right to a large water power in the United States to exploit its process for making nitrates from the air, the products to be used for nitric acid for the explosives industries, for nitrate of ammonia, for the dye industry and for nitrates for fertilizers. This is a reminder to the people and Government of Canada that no time should be lost in establishing a Canadian atmospheric nitrogen industry. The United States Government this year voted $20,000,000, of which $4,000,000 is appropriated to building a plant operated by steam power. Steam power is used only because such a plant can be got into operation more quickly than by water power. But this consideration is just the reason why a start should be made at once in Canada where water power only is the available prime power. An agreement should be reached between the provincial and federal governments on this matter, for atmospheric nitrogen is at once an agricultural problem, an industrial problem and a national problem.

Packing and Handling of Hazardous Chemicals

In the course of a paper on this subject read before the National Safety Council at New York, N. A. Laury pointed out that the mechanical appliances in use for handling carboys are nearly all economical and much safer than the simple picking up of the carboy by one or two men when a loose stopper or defective box may cause injury. The successful use of conveyors, roller skids, derricks with ice-tong grips or the various forms of trucks depends on plant arrangements and the intelligence of the workmen. Two sticks passed under the side cleats and handled by two men may, at times, be the cheapest way and all are safer than direct handling. Full carboys should never be moved unstoppered. If nothing else is available, an inverted tin can may prevent dangerous splashing.

The use of compressed air to empty glass carboys is dangerous. The bottles often burst or some acid is invariably left to be returned in a supposedly empty package. This has caused many accidents, and as it is to the consumer's advantage to keep all of the contents, he should see that returned empties are thoroughly drained.

Breakage of carboys is sometimes caused by partial crystallization of the contents. For example, sulphuric acid of strengths between 60 and 66 degrees Be. and glacial acetic acid easily freeze and may on warming contain part of the acid as a large floating solid mass which easily breaks the bottle, unless it is handled with unusual care or first thoroughly thawed out.

A Neglected Opportunity

The Pulp and Paper Magazine feels like crying over spilled milk. We made no direct appeal to Canadian manufacturers to take advantage of the opportunities offered by the third Exposition of Chemical Industries at New York a month ago. Canada may be justly proud of her accomplishments in chemical, mining and allied machinery fields, yet, with the exception of the three booths of branches of the Dominion Government, there were but but two booths representing the Canadian chemical industry. One was taken by THE CANADIAN CHEMICAL JOURNAL and the other by Process Engineers, Limited. Let us all see to it that next year Canada is properly represented. Let Americans see what Canada has to offer, both in commodities and opportunities and let Canadians see the variety of needful materials that are produced in the Dominion.—*Puly and Paper Magazine.*

Water Powers of the Maritime Provinces

The present series of sketches of the water powers of Canada will close with a brief reference to the powers of the Maritime Provinces.

As the land of Prince Edward Island does not rise much above sea level, and most of the rivers are tidal for a great part of their course, there are not many large units of hydraulic power in this province. New Brunswick and Nova Scotia have numerous rivers and a large annual rain fall, and not only have these provinces large areas of valuable timber, but much mineral wealth in coal, iron, etc., which will help to develop these powers, largely as yet unharnessed. Moreover, most of these powers are near navigable rivers.

In an article contributed to the report on "Water Powers of Canada," (Water Resources Paper No. 16, issued by the Department of the Interior), Mr. K. H. Smith gives the following opinions on the prospective power developments of Nova Scotia and New Brunswick:

Existing developments are mainly of two types: first, those based on timber resources of the country, such as saw mills, pulp and paper mills; second, those developed and used by small municipalities for local lighting and small motor loads. In a few cases too, small water powers are used to drive woolen mills and grist mills. The largest water power plants are used for the manufacturing of pulp and paper. In this field particularly, many excellent opportunities for the use of water power are available. The interior of New Brunswick is one vast forest, with timber especially adapted for pulp and paper making purposes. Large areas could, no doubt, be made to produce pulp wood perpetually by the application of approved forestry methods. The development of small powers for local municipalities is also a promising field, while in some cases, larger powers near the sea coast offer exceptional opportunities for industrial activity.

At Grand Falls, on the St. John River, the largest water power in the Maritime Provinces and one of the largest sites in Canada, a large amount of work has been done by the International Commission pertaining to the St. John River, which latter Commission has collected much valuable hydraulic data in connection with the whole drainage basin of the St. John River. The United States Government, through its Geological Survey, and also the State of Maine for a number of years, have conducted investigations relating to the inland waters of the State of Maine. The St. John River, with a number of its tributaries, has its sources in the State of Maine, while the St. John itself with the St. Croix, forms part of the International boundary between the province of New Brunswick and the State of Maine. Accordingly, the work done by the United States, referred to above, is of great service in connection with the study of water power possibilities in New Brunswick and elsewhere, both directly and by analogy.

The Province of New Brunswick has regulations governing the granting and development of water powers within its borders, while Nova Scotia has appointed a Water Powers Commission to investigate the water power resources of the province and outline a progressive policy in connection with their development.

Developed Water Powers

It is estimated that in New Brunswick there has been developed to date about 13,000 horse power. Of this amount 56 per cent. consists of small saw mills, grist mills and pulp mills, while the balance is made up of small electric plants from 100 to 500 horse power capacity, and one plant with 3,800 horse power installed. This plant, one of the largest single electrical developments in the province, is located on the Aroostook River at Aroostook Falls, but the greater part of the output is used across the border in the State of Maine. Small plants exist at Bathurst, Centreville, Edmunston, St. Stephen, Shediac and Woodstock, all of which are privately owned, except the Edmunston development, which is a municipal enterprise.

In Nova Scotia, about 24,000 horse power has been developed. Of this amount, 14,100 horse power is used in the manufacture of pulp and paper, 3,100 horse power consists of small electric light developments, 1,150 horse power is used for gold mining purposes at Goldenville, Isaac Harbour and Tangier, while the balance is made up of numerous saw mills, and grist mills, and electric light plants.

So far as Prince Edward Island goes, nearly every stream has one or more small water power developments ranging from 5 to 50 horse power. Such developments are used in connection with small mills of various kinds, principally grist mills and woollen mills, and rarely operate throughout the whole year. There is one hydro-electric development on the Montague River, supplying the village of the same name, where 44 horse power is installed. It is estimated that 500 horse power is developed on the Island.

Reversible Falls, St. John River, N.B.

Undeveloped Water Powers

One of the chief assets of the Maritime Provinces in undeveloped water powers lies in the large number of small sites available for domestic use or for small municipalities. One or more such sites exist on practically every stream throughout the district, and a number of municipalities, as outlined above, have already taken advantage of some of these opportunities. There are, however, a number of places where large amounts of power may be developed, some of which have been given considerable attention, and it is only a few of these larger sites that can be mentioned here. There are two outstanding power sites in New Brunswick, Grand Falls on the St. John River, and Grand Falls on the Nepisiguit River.

The St. John River drains by far the largest basin of any river in the Maritime Provinces. The total area of this basin is 26,000 square miles, of which about 5,000 square miles is within the State of Maine. The largest water power in the Eastern part of Canada exists at Grand Falls, on this river, about 200 miles from the City of St. John. A scheme of development has already been outlined, whereby it is proposed to install 80,000 horse power under a head of 140 feet. There is another place on the river, known as the Pokiok site, much nearer St. John, where there is said to be about 30,000 horse power available.

The Nepisiguit, or "River of Foaming Waters," is a very rugged stream in the northern part of New Brunswick, much frequented by hunters and fishermen. Its headquarters adjoin those of the Tobique, a tributary of the St. John, so that these streams offer a water route for sportsmen through the heart of some of the best hunting and fishing grounds in North America. There are a number of rapids and falls on the Nepisiguit, the most spectacular of which is Grand Falls. This is located about 20 miles from the town of Bathurst, and upwards of 10,000 horse power is available with a head of 125 feet.

"Big Falls," east branch of Bear River, N.S.

Such rivers as the Miramichi, Tobique and Aroostook, are also known to have a number of large power sites.

In Nova Scotia, three possible sources of comparatively large amounts of power have been considered, and construction on a fourth has been started. The Mersey River, commercially the most important river in the Province, has exceptional storage facilities in lakes at its headquarters. There is said to exist on it the possibility of developing upwards of 30,000 horse power at several sites. As yet only 4,250 horse power has been developed at three different places. East River, Sheet Harbour, is also said to be capable of producing 16,000 horse power, and has excellent storage facilities on numerous lakes scattered throughout the drainage basin. Data is not at hand to verify the above figure. The Gaspereaux river is also well supplied with storage basins, and according to a scheme outlined by a reputable firm of engineers, it is possible to obtain 8,000 horse power from this river under a head of 450 feet. Such a development in the heart of the best farming district in the province ought to be very valuable, and besides is within transmission distance of the City of Halifax. Work has been started on an unique scheme within twenty miles of Halifax, the output of which is intended to supply that city. This scheme, besides storage, in a number of lakes, involves the entire diversion of one stream into another, and the installation of turbines acting under different heads in the same power house. The combined flow of the two rivers is again to be used in a second powerhouse, situated at tide water, on St. Margaret's Bay. It is estimated that 2,160 continuous horse power may be obtained from this plant as well as 3,210 horse power extra for twelve hours daily

In conclusion Mr. Smith says: "The possibility of obtaining power in commercial quantities from the enormous tides of the Bay of Fundy, which have a range of 40 to 50 feet, has always been most alluring. More attractive still has been the 'Reversible Falls' at St. John, caused by the great fluctuation of the tide; doubtless, however, such schemes will continue to be as disappointing as they are alluring, and the use of the tide for developing power will be confined to such small developments as have been used intermittently for centuries, examples of which are not lacking in the Maritime Provinces."

The Allied Trading Publications, Limited, has been established with the definite object of making known the industrial and commercial resources of Great Britain to each of the countries brought into close relation with her through the war. It is preparing a book in which all the resources of Great Britain will be detailed. This work will be published, in an edition of 40,000 copies, simultaneously in French, Russian and Italian, and will be distributed gratuitously in Belgium, France, Italy, and Russia through the medium of Chambers of Commerce, federations, and industrial associations. The office address is 117 Victoria Street, London, S.W. England.

Dr. Girdwood

Dr. G. P. Girdwood, one of the most eminent men in the medical profession and in chemistry in Canada, died at his residence in Montreal, on the 2nd of October. He was in his eighty-fifth year and had been ill for six years. For the past ten months he had not left his bed.

Although blind for the last five years he took a keen interest in all matters bearing upon medicine and chemistry With the assistance of his devoted wife and daughter he recently made an investigation into the effect of carbonic oxide in coal gas upon public health in England, United States and Canada. The results of this important study were communicated to the Royal Society.

Born in London in 1832, Dr. Girdwood received his early education at a private school and subsequently entered University College and St. George's School of Medicine. He was admitted a member of the Royal College of Surgeons of England in 1854, and for a short time served as house surgeon in the Liverpool Infirmary. In the same year he was gazetted assistant surgeon of Her Majesty's Grenadier Guards.

Came to Canada in 1862

Dr. Girdwood accompanied the 1st battalion of the Grenadier Guards to Canada at the time of the famous Trent affair in

1862, and on its return to England in 1864, retired from the army to take up his permanent residence and practice in Montreal.

In 1865 he took the degree of M.D., C.M., at McGill University. He served for some years as surgeon of the Third Victorian Rifles, and served with that regiment at the front during the Fenian troubles, later receiving the medal. Not long after he was promoted to be a medical staff officer of the Militia of Canada.

Professor at McGill

In 1869 he was appointed lecturer in Practical Chemistry in the Faculty of Medicine at McGill. In 1872 he became Professor of Practical Chemistry, and in 1879 Professor of Chemistry, holding his chair with great advantage to the University until 1902, when he retired from active teaching and was then named Emeritus Professor of Chemistry.

For twelve years he was surgeon to the Montreal Dispensary and to the Montreal General Hospital, and following this service was appointed consulting surgeon to both Institutions. He also became consulting surgeon to the Children's Memorial Hospital; consultant physician in the X-ray Department of the Royal Victoria Hospital, and chief medical officer of the Canadian Pacific Railway.

Received High Honors

Dr. Girdwood was a former president of the Roentgen Society of America; vice-president of the Canadian Branch of the Society of Chemical Industry; a Fellow of the Chemical Society and also of the Chemical Institute of Great Britain.

On the organization of the Royal Society of Canada by the Marquis of Lorne (late Duke of Argyll), then Governor-General, in 1882, Dr. Girdwood was appointed one of the original Fellows of that body.

He was a Member of the College of Physicians and Surgeons of the Province of Quebec, Ontario and British Columbia; of both the British and the American Association of the advancement of Science; of the Montreal Natural History Society; and of the Montreal Microscopical Society, of which he was elected President in 1892.

In his busy life he found time to contribute many valuable articles on professional subjects to the London Lancet, the Montreal Medical Journal and the Transactions of the Royal Society of Canada.

Private Life

Dr. Girdwood in 1862 married Miss Fanny Merriman Blackwell, daughter of Thomas Blackwell, C.E., who was managing director of the Grand Trunk Railway. Mrs. Girdwood survives with five sons and three daughters: G. W. T. Girdwood, of Brazil; F. Logan Girdwood, of Montreal; Kenneth John Girdwood, of Bethlehem, Pa.; Edward P. Girdwood, serving overseas; Robert Frank Girdwood, of Montreal; Miss M. Girdwood, Mrs. Phillips, of Ottawa, and Mrs. Walter Neal, of Salt Lake City.

He held high rank in the Masonic Order, and was a member of the Church of England.

Professional Career

The late Dr. Girdwood was an interesting and conspicuous figure among the scientific men of Canada, especially during the last quarter of the nineteenth century. He was a type which our modern methods of education will not reproduce, the type of the all round scientist, cultured, enthusiastic and interested in all fields of science.

He was very much more than a dilettante in almost every field of natural and experimental science. He had a sound knowledge of medicine, surgery, medical jurisprudence, botany, physics, microscopical technique, including photomicrography, besides being fundamentally a chemist. These varied accomplishments are all the more astonishing when we remember that he began life as an assistant surgeon in a fashionable British regiment, namely, the Grenadier Guards, where he was especially conspicuous as a genial companion and as an all round athlete. Before entering the Army Medical Service and while still a young man he studied chemistry in London and Liverpool. With Mr. Rodgers, a London chemist, he devised the method which is known as the Rodgers and Girdwood method for the detection of strychnine by which it is possible to detect a less than one hundredth thousandth part of a grain of this poison.

During his career as a scientific man and while engaged in general practice he was connected with many important legal cases where his knowledge of medical jurisprudence was of great value to the country. He was not only a good toxicologist, but was the first to use enlarged photographs and the application of reagents for the detection of forgeries, counterfeits and the identification of hand-writing. In this field he was one of the best authorities in America.

He was associated also with the late Dr. Sterry-Hunt in many of his chemical studies, among which was the production of Hunt's Chronium Oxide Green, which is still used as an ink in the printing of bank notes. In the field of microscopy he was an expert in the identification of starch granules and was a pioneer in the stereoscopic photography of crystals under the microscope and also in the application of the stereograph to the study of the photographs produced by Roentgen rays. He was the first to demonstrate that the position of a foreign object in relation to a bone could be shown perfectly by the application of stereoscopic principles in taking roentgen ray photographs.

He was actively engaged in medical education from the time of his resignation from the Guards and was an interesting teacher both of clinical surgery in the hospital and of chemistry in the university.

The introduction of practical chemistry as an integral part of a medical student's education in Canada was first carried out by Dr. Girdwood in some classes which he gave to the medical students of McGill University about 1870. The classes were held in his own home on Craig Street. In 1872 he became Professor of Practical Chemistry and for ten years always gave all of the instruction in Practical Chemistry in McGill University. He subsequently succeeded Dr. Craik to the Chair of Chemistry in the Medical Faculty in 1879, which chair he held up to 1902.

He was very widely known both in Canada and the United States. He was a man of high ideals and one of his great ambitions during his last illness was to obtain legislation to give the profession of chemistry the same legal status as the professions of law and medicine.

His genial, kindly and humorous character won him a host of personal friends in all walks of life.

Associate Committee of Mining and Metallurgy

The following gentlemen have been appointed as the Honorary Advisory Council for Scientific and Industrial Research Associate Committee on Mining and Metallurgy:

Frank D. Adams, Ph.D., D.Sc., LL.D., F.R.S., chairman. Dean of the Faculty of Applied Science, McGill University, Montreal.

S. F. Kirkpatrick, M.Sc., vice-chairman. Professor of Metallurgy, Queen's University, Kingston, Ont.

Major Chas. L. Cantley, B.Sc., acting works manager, Nova Scotia Steel & Coal Company, New Glasgow, N.S.

A. A. Cole, B.Sc., M.A., mining engineer, T. & N.O. Railway Commission, Cobalt, Ont.

C. V. Corless, M.Sc., general manager, Mond Nickel Company, Coniston, Ont.

Th. Denis, B.Sc., superintendent of Mines for the Province of Quebec, Quebec, Que.

Chas. Fergie, Esq., president, Intercolonial Coal & Coke Company, 413 Dominion Express Building, Montreal, Que.

A. R. Globe, Esq., assistant general manager, Hollinger Gold Mines, Limited, Timmins, Ont.

George E. Guess, M.A., professor of metallurgy, University of Toronto, Toronto, Ont.

J. C. Gwillim, B.Sc., professor of Mining Engineering, Queen's University, Kingston, Ont.

E. H. Hamilton, B.Sc., consulting metallurgist to the Consolidated Mining & Smelting Company, Trail, B.C.

H. E. T. Haultain, C.E., professor of Mining Engineering, University of Toronto, Toronto, Ont.

A. Mailhiot, B.Ap.Sc., professor of Geology, L'Ecole Polytechnique, 228 St. Denis Street, Montreal, Que.

E. P. Mathewson, B.Sc., general manager, British American Nickel Corporation, 8 King Street East, Toronto, Ont.

Lieut.-Col. D. H. McDougall, LL.D., general manager, Dominion Steel Corporation, Sydney, N.S.

J. G. Morrow, Esq., inspecting engineer, Steel Company of Canada, Hamilton, Ont.

J. Bonsall Porter, Ph.D., D.Sc., professor of Mining Engineering, McGill University, Montreal, Que.

Fraser D. Reid, B.Sc., manager, Coniagas Mines, Limited, Cobalt, Ont.

W. Fleet Robertson, B.Sc., Provincial Mineralogist, Victoria, B.C.

F. H. Sexton, S.B., president, Nova Scotia Technical College, Halifax, N.S.

A. Stansfield, D.Sc., professor of metallurgy, McGill University, Montreal, Que.

John T. Stirling, Esq., chief inspector of Mines for Alberta, Edmonton, Alta.

R. H. Stewart, B.Sc., consulting mining engineer, 736 Granville Street, Vancouver, B.C.

J. B. Tyrrell, B.Sc., M.A., consulting mining engineer and geologist, 534 Confederation Life Building, Toronto, Ont.

O. E. S. Whiteside, M.Sc., general manager, International Coal & Coke Company, Coleman, Alta.

Canadian Trade in Chemicals

The following is a summary of Canada's trade in chemicals and some raw materials of chemicals, for the fiscal year ending March 31, 1916, the latest date for which official returns in detail are available:

	Imports	Exports
Artificial Abrasives	$37,360	
Ashes, pot and pearl	17,828	$1,577
Ashes, other	......	43,549
Amyl Alcohol	2,552	
Ethyl Alcohol	1,810	
Nitrous Ether and Aromatic Spirits of Ammonia	3,292	
Alcohol, Wood	......	229,978
Total Spirits and Spirituous Liquors, exclusive of Wines	3,402,136	1,419,228
Blueing, laundry	41,103	
Ink, Printing	96,460	
Ink, Writing	27,483	
Clay, China	128,590	
Clay, Fire	104,847	
British Gum and Sizing	94,308	
Cassava Flour for Explosives	3,326	
Crucibles, clay, sand or plumbago	154,948	
Chemicals, Dyes and Drugs not otherwise mentioned	17,091,925	6,449,145
Explosives (powder, nitro glycerine, etc., and ammunition)	975,820	80,985,510
Fertilizers, artificial	741,397	*2,708,472
Glues and mucilage	240,682	35,789
Mineral Oils	8,586,077	67,643
Total Oils other than mineral and fish oil	5,203,548	940,422
Soaps	1,018,234	59,958
Metals and Minerals, including machinery	103,449,489	†124,726,722
Optical and Mathematical Instruments	779,981	55,237
Scientific Apparatus for Hospitals	22,897	
Paints and Varnishes	2,172,706	371,123
Turpentine, tar, pitch and rosin	1,099,387	25,347
Feldspar	......	240,593
Gypsum (sulphate of lime)	8,197	347,795
Stone and Manufacture of	1,085,694	1,094,976
	146,596,077	219,803,364

*All of this consisted of animal manure, except 282 tons of phosphate valued at $3,403.

†These metal exports consisted largely of war material and munitions.

For imports from Great Britain and United States, see page 191.

According to Science, Frederick D. Fuller, formerly chief deputy state chemist of Indiana, and more recently in charge of the scientific and educational department of the American Feed Manufacturers' Association, has been appointed chief of the Division of Feed Control Service, Texas Agricultural Experiment station.

Canadian Wood Oils for Ore Flotation

(Continued from page 157)

Part 2.—Flotation Tests on Cobalt Ore

In all 185 different tests were run, a summary of which is given in Table No. 2. The slime from the Coniagas Mill, Cobalt, Ont., chosen as a representative ore for the camp, was used in these tests. This ore carried 5.7 ozs. of silver per ton and 62 per cent. of the silver was contained in the 200-mesh product. 500 grams of ore, ground to pass 100-mesh, were used in each test. A pulp of one part of water to one of ore along with the carefully measured quantity of oil was ground in a pebble mill for twenty minutes, after which the ground pulp was agitated in the Janney experimental flotation machine for six minutes. The temperature during each test varied between 50°C and 15°C.

The Janney testing machine used throughout this experimental work consists of a cylindrical agitation chamber fitted with baffles and a "spitzkasten" or settling chamber in which the froth collects. The agitation is obtained by an impeller running at 1,800 revolutions per minute. A complete description of this machine can be found in the January 1st, 1916, number of the Mining and Scientific Press.

It has been recognized, especially for Cobalt silver-bearing ore, that both a forthing oil and a collecting oil (or oils) were necessary. The oil mixture* already giving successful commercial results at Cobalt was as follows:

10% pine oil (pure) as selective frothing oil.
80% coal tar creosote }
10% coal tar......... } as selective collecting oils.

Using this as standard oil mixture No. 1 the procedure was as follows:

1. Tried substituting in this standard oil mixture for pine oil to find out frothing value of any new oil. If 10 per cent. was not satisfactory the percentage was raised. This constituted the first series of tests on each of the several and different oil samples.

2. Tried substituting in standard oil mixture for coal tar creosote and coal tar to find out collecting value of any promising oil.

3. Successful frothing substitute and successful collector substitutes were tried together to find out if it was possible to obtain an oil mixture from among the wood oils having both frothing and collecting properties.

*The hardwood oils used in these commercial tests were supplied from the Longford, Ont., plant of the Standard Chemical Iron and Lumber Company of Canada, Limited (head office, Royal Bank Building, Toronto, Ont.)

TABLE NO. 2.—SUMMARIZED RESULTS OF FLOTATION TESTS

OIL MIXTURE *FROTHING OIL	Per Cent.	Collecting Oil	Per Cent.	Per Ton of Dry Ore: Pounds of Oil	Per Ton of Dry Ore: Re-agents	Grams of Froth	Assay Ounces of Silver Per Ton: Con-cen-trates	Assay Ounces of Silver Per Ton: Tails	Average Extraction and Remarks
No. 1 Pine oil; steam distilled (G.N.S., No. 5)	10	Coal tar Coal tar creosote.	10 80	1.5	...	32.0	57.3	1.90	67.5% Average of 20 tests
No. 1 Pine oil; same as above	10	Coal tar Coal tar creosote	10 80	1.5	4 lbs. NaOH	21.0	105.0	1.14	80.0%
No. 3 Pine oil; destructive distillation. (G.N.S. No. 6).	10	Coal tar Coal tar creosote	10 80	1.5	...	29.0	42.3	3.16	45.0%
No. 3 Pine oil. Same as above.	15	Coal tar Coal tar creosote	13 72	1.5	...	31.0	61.1	2.04	67.0%
No. 3 Pine oil. Same as above.	20	Coal tar Coal tar creosote	12 68	1.75	...	49.0	41.7	1.70	72.0% 1 test only
No. 4 Crude oil from southern pine. (P.T.T. No. 350)	25	Coal tar Coal tar creosote	7.5 67.5	1.5	...	45.0	29.4	2.64	52.5%
No. 4 Crude oil. Same as above	100		0	1.5	...	65.0	15.2	4.00	36.0%
No. 14 Crude oil from red pine stumps	100		0	1.5	....	66.0	17.9	4.00	40.5%
No. 17 Crude turps; Western yellow pine stumps.	25	Coal tar Coal tar creosote	15 60	1.5	...	23.0	57.0	2.72	50.0%
No. 18 Crude light oil; western yellow pine stumps	25	Coal tar Coal tar creosote	15 60	2.0	...	35.0	55.6	1.86	69.0%
No. 19 Pine tar oil; western yellow pine stumps	10	Coal tar Coal tar creosote	18 72	1.5	...	40.0	33.0	2.66	50.0%
No. 25 Light hardwood creosote	30	Coal tar Coal tar creosote	7 63	1.5	...	21.0	77.0	1.64	67.5%
No. 25A Light fraction of No. 25	40	Coal tar Coal tar creosote	6 54	1.5	..	8.0	79.0	3.90	25.0% Very little froth
No. 25B. Heavier fraction of No. 25...	30	Coal tar Coal tar creosote	7 63	1.5	...	32.0	59.0	2.1	66.0%
No. 26. Heavy hardwood creosote	40	Coal tar Coal tar creosote	6 54	1.5	...	29.5	63.3	2.13	65.0% Average of 10 tests

*The numbers given for the frothing oils in this column are the serial numbers adopted at the Forest Products Laboratories.

TABLE NO. 2.—SUMMARIZED RESULTS OF FLOTATION TESTS

OIL MIXTURE				Per Ton of Dry Ore		Assay Ounces of Silver Per Ton			Average Extraction and Remarks
*FROTHING OIL	Per Cent.	Collecting Oil	Per Cent.	Pounds of Oil	Re-agents	Grams of Froth	Con-cen-trates	Tails	
No. 26. Same as above	40	Coal tar Coal tar creosote	30 30	1.75	...	30.0	70.3	1.54	72.0%
No. 26. Same as above	30	Coal tar Coal tar creosote	7 63	1.5	4 lbs. NaOH	7.0	222.5	1.80	63.0%
No. 26. Same as above	40	Coal tar	60	1.5	...	28.0	48.0	2.70	52.0%
No. 26A. Heavy hardwood creosote distilled	30	Coal tar Coal tar creosote	15 55	1.5	...	22.5	79.3	2.20	63.0%
No. 27. "Acid oil (or hardwood creosote)	40	Coal tar Coal tar creosote	6 54	1.5	...	15.0	139.0	1.8	70.0%
No. 28. Heavy ketone oil	40	Coal tar Coal tar creosote	6 54	1.5	...	8.0	173.7	3.02	50.0% Very little froth
No. 28. Same as above...............	26	Coal tar Coal tar creosote	7.4 66.6	2.0	4 lbs. NaOH	10.0	235.0	1.3	79.0% Average of 6 tests
No. 29. Ketone residue No. 30. Hardwood tar	15 15	Coal tar creosote	70	1.5	...	...	42.1	1.96	69.5% Surplus froth
No. 29. Ketone residue	20	Coal tar Coal tar creosote	8 72	1.5	...	21.0	84.7	2.04	64.5%
No. 29. Ketone residue	30	Coal tar Coal tar creosote	7 63	1.5	...	38.0	55.0	1.64	72.0%
No. 30A. Hardwood tar distillate No. 31. Hardwood creosote mixture	50 50		0	1.0	...	52.0	25.4	2.72	52.0%
No. 31. Hardwood creosote mixture	30	Coal tar Coal tar creosote	7 63	1.5	...	20.0	87.7	2.34	61.0%
No. 31. Same as above No. 29. Ketone residue	25 25	Coal tar creosote	50	1.5	...	35.0	56.7	2.00	70.5%
No. 31A. Hardwood creosote mixture distilled	30	Coal tar Coal tar creosote	20 50	1.5	...	15.5	110.6	2.54	57.3%
No. 39. First fraction of 31A (28% acidic)	40	Coal tar Coal tar creosote	10 50	1.5	...	6.5	192.4	3.32	43.0% Very little froth
No. 40. Second fraction of 31A (33.0% acidic)	40	Coal tar Coal tar creosote	10 50	1.5	...	22.0	83.3	2.10	66.0%
No. 41. Third fraction of 31A (66% acidic)	40	Coal tar Coal tar creosote	10 50	1.5	...	37.0	45.3	2.44	60.0%
No. 42. Fourth fraction of 31A (69% acidic)	40	Coal tar Coal tar creosote	10 50	1.5	...	44.0	42.5	2.12	66.0%
No. 43. Fifth fraction of 31A (50% acidic)	40	Coal tar Coal tar creosote	10 50	1.5	...	40.0	37.4	2.60	55.6%
No. 32. Light oils from red pine stumps.	10	Coal tar Coal tar creosote	10 80	2.0	...	6.0	232.3	2.76	50.5%
No. 33. Rosin oils from red pine stumps.	10	Coal tar Coal tar creosote	10 80	1.5	...	...	...	4.46	Scum only
No. 34. Wood turpentine from red pine stumps	10	Coal tar Coal tar creosote	10 80	1.5	...	...	...	...	No froth
No. 35. Crude pine oil from red pine stumps	20	Coal tar Coal tar creosote	8 72	1.5	....	32.0	63.3	2.00	68.5% Average of several tests
No. 35. Same as above	10	Coal tar Coal tar creosote	10 80	1.5	4 lbs. NaOH	9.0	23.50	1.52	74.0%

TABLE NO. 2.—SUMMARIZED RESULTS OF FLOTATION TESTS

OIL MIXTURE				PER TON OF DRY ORE		ASSAY OUNCES OF SILVER PER TON			Average Extraction and Remarks
*FROTHING OIL	Per Cent.	Collecting Oil	Per Cent.	Pounds of Oil	Re-agents	Grams of Froth	Con-cen-trates	Tails	
No. 36. Light rosin oil from red pine stumps	30	Coal tar Coal tar creosote	8 72	1.5	...	31.0	35.1	3.06	42.5%
No. 37. Light hardwood creosote. (G.N.S. No. 17)	30	Coal tar Coal tar creosote	7 63	1.5	...	31.0	51.0	2.76	55.0%
No. 38. Heavy hardwood creosote G.N.S. No. 18)	40	Coal tar Coal tar creosote	6 54	1.75	...	27.0	65.3	2.00	65.0%
No. 44. Crude pine oil from western yellow pine stumps	20	Coal tar Coal tar creosote	13 67	1.5	...	32.0	48.9	2.44	58.0%
No. 45. Heavy pine oil from western yellow pine stumps	25	Coal tar Coal tar creosote	11 64	1.5	...	26.0	73.3	1.76	69.5%
No. 47. Hardwood neutral oil from 31A 65° C-290°C	37	Coal tar Coal tar creosote	6.5 58.5	1.5	...	23.0	72.6	2.34	60.0%
No. 47A. Hardwood neutral oil from 65°C-150°C	35	Coal tar Coal tar creosote	6.5 58.5	1.5	...	15.0	65.1	3.20	38.5%
No. 47B. Hardwood neutral oil. 150°C-200°C	35	Coal tar Coal tar creosote	6.5 58.5	1.5	...	16.0	81.2	3.08	46.5%
No. 47C. Hardwood neutral 200°C-280°C	35	Coal tar Coal tar creosote	6.5 58.5	1.5	...	13.0	128.4	2.00	63.0
No. 48. Hardwood acidic oil from 31A	35	Coal tar Coal tar creosote	6.5 58.5	1.5	...	42.0	46.0	2.00	67.5
No. 48A. Acidic oil from 26A and 27A	35	Coal tar Coal tar creosote	6.5 58.5	1.5	...	32.0	56.7	2.00	66.0
No. 49. Hardwood neutral oil from 26A and 27A	35	Coal tar Coal tar creosote	6.5 58.5	1.5	...	26.0	65.7	2.40	60.0

The Results

The aim throughout these experiments was to produce comparative results only, using pine oil and coal tar products as frother and collector, respectively, as a standard oil mixture. In this connection the reader must recall that no special effort was made to produce high grade concentrates or to obtain high extractions. A rougher tailing and a rougher concentrate only were produced. Commercial tests on the more promising hardwood oils have already been made, the results of which are given in Part 3 of this paper.

The results of individual tests varied a great deal and extractions as high as 80 per cent. were averaged with tests giving as low as 60 per cent. extraction. To the mining man the efficiency of an oil or oil mixture will be more apparent by comparing the amount of froth floated off and the minimum assay of the tailings.

The more striking features of the results summarized in the above table are as follows:

1. 67.5 per cent. was the average extraction of 20 different tests using pure pine oil (C.N.S. No. 5), where the tails averaged 1.90 ozs. from 5.7 ozs. heads.

2. Tails as low as 1.14 ozs. were obtained by the use of 4 lbs. of NaOH per ton of dry ore under the same conditions as above.

3. Pine oil (G.N.S. No. 6) by destructive distillation gave satisfactory results on raising its percentage to 15-20 per cent. of the total oil mixture with over 12 per cent. of the coal tar present.

4. The crude oil distillate from the destructive distillation of both western yellow pine and red pine stumps used alone was quite unsatisfactory giving 4.00 ozs. tails.

5. Crude turps No. 17 from western yellow pine and a corresponding "light oil," No. 32 from red pine both had too brittle a froth and left 2.7 ozs. tails.

6. Pine tar oil No. 19 from western yellow pine and corresponding oils, Nos. 33 and 36, from red pine could not be utilized as frothing oils since they lifted too much gangue.

7. Crude pine oils Nos. 44 and 45 from western yellow pine stumps and No. 35 from red pine stumps gave satisfactory results when they comprised 20-25 per cent. of the total oil mixture. Crude light oil No. 18 from western yellow pine gave comparable results.

8. Results using the three different hardwood creosote oils, namely Nos. 25, 26 and 27, show up well. Extractions from 65 to 75 per cent. were obtained with tails as low as 1.59 ozs. Of the three heavy oils heavy hardwood creosote No. 26 gave the best all-round results. Each of the individual creosote oils gave better results than No. 31, the combination of all three.

9. Oils Nos. 25A and 39 are very similar and deserve attention. They are the hardwood oil fractions distilling below 150°C and having gravity below 0.89. This fraction has a disagreeable penetrating odor and its removal greatly improves oils Nos. 25 and 31 in this respect. The flotation value of this lighter and low boiling point fraction is low, giving 3.9 ozs. tails.

10. In general the hardwood creosote oils gave better results in the crude state than when refined by primary distillation.

11. Of the oils, Nos. 39 to 43, inclusive, which are fractions distilled from No. 31 (hardwood creosote mixture), all except the lowest boiling fraction, No. 39, just mentioned, gave approximately the same results.

12. Of the neutral hardwood oil, No. 47, (see description) the fraction No. 47C distilling above 200°C. gave good standard results, while the fractions, Nos. 47A and 47B distilling below 200°C were non-selective, as shown by 3.0 ozs. tailings.

13. Oils Nos. 48 and 48A being the phenolic and creosotic content of the crude hardwood creosote oils and practically all distilling above 200°C, gave approximately the same satisfactory results as neutral oil No. 47C, having the same boiling point range.

14. Yellow ketone oil, No. 28, used alone gave very poor results, but the greatly improved results obtained in a pulp alkaline with NaOH were remarkable, where the extraction averaged nearly 80 per cent.

15. Ketone residue No. 29, which is neutral in character, when used to the extent of 20-30 per cent. of the total oil mixture, gave results comparing favorably with both destructively distilled pine oil and the hardwood creosote oils.

16. Increasing the percentage of coal tar up to 25-30 per cent. of the total oil mixture invariably gave improved results.

17. By the use of crude hardwood creosote oils the proportion of coal tar creosote could be reduced to 60 per cent. of the total oil mixture and still give satisfactory results, but all attempts to eliminate coal tar creosote as the selective collecting oil proved unsatisfactory.

18. Best results were obtained with a cold pulp and at the beginning of the series of tests. The Janney flotation machine gradually decreased in efficiency under continual operation for over five months. This fact lends all the more reason for considering the above results as comparative only.

Conclusions

1. Laboratory results show that crude hardwood creosote oils can be satisfactory substituted for pine oil as a suitable frothing agent for Cobalt silver ore.

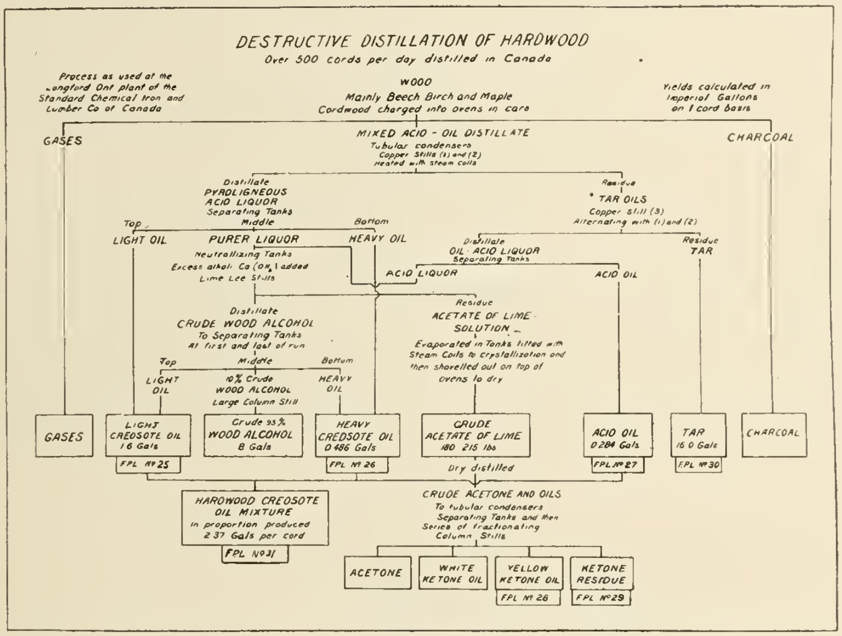
2. Crude ketone residue from the refining of gray acetate of lime is also a satisfactorily frothing oil for Cobalt ore; heavy yellow ketone oil gives highly satisfactory results when used in a pulp alkaline with caustic soda.

3. The use of NaOH (not more than 4 lbs. per ton of dry ore) gave an almost incredible improvement in extraction and grade of concentrate in all oil mixtures tried.

4. "Pine oil" from the destructive distillation of Canadian resinous wood waste (western yellow pine and red pine stumps) gave results comparing fairly well with pine oil from longleaf southern pine. Double the quantity, however, of the Canadian product was required.

5. All attempts to utilize the whole crude oil distillates from the destructive distillation of Canadian resinous woods met with failure, as they were non-selective in action. This was also found true of the turpentine and rosin oil fractions of the crude oil.

6. The use of coal tar creosote was found indispensable as a selective collecting oil and all attempts to substitute hardwood tar were unsuccessful. By the use of hardwood oils, however, the proportion of coal tar creosote necessary could be reduced considerably.



The above diagram should take the plan of that previously given on page 151. The diagram on page 151 is hereby cancelled.

Part 3—Commercial Flotation Tests on Hardwood Oils*

According to the original plan the most promising wood oils have been tried out at Cobalt under commercial conditions. Three hardwood oils were given a thorough trial at the Buffalo mines in comparison with a standard pure pine oil (G.N.S. No. 5). They are as follows:

F.P.L. No. 26. Heavy hardwood creosote oil.
F.P.L. No. 27. Acid (creosote) oil.
F.P.L. No. 29. Ketone residue.

These oils, which have been fully described in Table No. 1 and Figures Nos. 3 and 4, are quite uniform in the crude state as produced and can be considered standard flotation oils.

Removal of the Aqueous Fraction Advisable.—Samples of the three oils mentioned above when examined at the Forest Products Laboratories showed 8.55 per cent., 5.25 per cent. and 2.55 per cent. water content, respectively. The aqueous fractions of the first two oils were distinctly acid in nature and strong enough to have corroding action on ordinary iron metal containers. The water content of the ketone residue was neutral. Although these hardwood oils can be used with the small percentage of water present mostly as an emulsion, the removal of the aqueous fraction seems strongly advisable, not only on account of the above objections but by reason of the fact

*According to information lately received the majority of the mills have increased the percentage of pine oil to 20 per cent. of the total mentioned and are obtaining much better results.

that the acetic acid and its homologues forming the acid content are essentially of no flotation value.

The higher aqueous content of heavy hardwood creosote oil No. 26, compared with acid oil No. 27 is due to its lighter specific gravity. As has been suggested the mixing of these two oils in the proportions in which they are produced commercially would be advisable, since their flotation values are equally satisfactory. In this way a better gravity separation of the water content could be effected than would be possible with oil No. 26 alone.

The yields of these two oils, Nos. 26 and 27, as already given are respectively 0.486 and 0.284 Imperial gallons per cord. Figuring on 500 cords of hardwood distilled per day, this means 385 Imperial gallons of this Canadian wood oil product available. For about 2,000 tons of silver ore treated daily at present, only slightly more than 25 per cent. of this oil supply can be used in the Cobalt camp. Should the demand for these hardwood creosote oils become greater than the supply it is interesting to note that oil No. 25B according to laboratory results is equally satisfactory. As yet hardwood creosote oil mixture No. 31, comprised of oils Nos. 25, 26 and 27, in proportion produced, has not been tried commercially at Cobalt. Although small scale laboratory experiments on this creosote oil mixture in the crude state show good comparative results, indications are that after the removal of that fraction distilling below 150°C with gravity below 0.89 the mixed residue corresponding to oils Nos. 25B, 26, and 27 would give excellent results with Cobalt ore. Treating oil No. 31 in this way by a preliminary distillation would also remove all the aqueous content and give a very desirable water-free flotation oil. The commercial supply of this crude hardwood creosote mixture after such treatment would be over 500 Imperial gallons per day in Canada.

Proposed Specifications for Hardwood Creosote Oils.—Oils Nos. 26 and 27 with 17.5 per cent. and 10.0 per cent., respectively, distilling below 150°C, including 8.55 per cent. and 5.25 per cent. aqueous content have been found to give satisfactory flotation results when used in the crude state. Calculating to the water-free oil basis this means that these two crude oils contained respectively 9.8 per cent. and 4.9 per cent. of moisture-free oil distilling below 150°C, according to the standard method of fractional distillation for the examination of crude oils already proposed.

Taking these two crude oils somewhat as a standard and keeping in mind the hardwood creosote oil mixture No. 31 with the aqueous and lighter oil fractions removed as suggested above, it would seem that the following general specifications would be fair restrictions to propose for the buying of hardwood creosote oils, for the purpose of using as selective frothing agents for Cobalt ore.

1st. The aqueous content shall be less than 5 per cent. of the crude oil as received.

2nd. Not more than 10 per cent. of the water-free oil shall distill below 150°C (corrected temperature) and with specific gravity below 0.89 at 15°C according to the standard method of fractional distillation already outlined.

3rd. At least 65 per cent. of the water-free oil shall distill between 200°C and 265°C, where the gravity shall be between 0.975 and 1.065.

4th. Not more than 15 per cent. of the water-free crude oil shall remain as a hard pitch or coke residue.

These specifications would not apply to ketone residue which is somewhat different in nature from the creosote oils. Where a high-grade concentrate is not desired and the aim would be to lift considerably more mineral bearing gangue particles in order to reduce the tailings assay, considerably more pitch residue than indicated in the fourth specification above may be used. This, however, may be accomplished by adding hardwood tar as such, containing over 70 per cent. pitch residue, to the total oil mixture.

Commercial Tests.—The commercial tests, carried on during 42 continuous shifts, were run in the large Callow cells without interruption of the general procedure. During the first 26 shifts the standard pine oil—coal tar products mixture was used. In Tables Nos. 3 and 4 the results are given in full. In the remaining 16 shifts the hardwood oils were substituted for pine oil in order as follows: heavy hardwood creosote oil, No. 26 in 6 shifts, acid oil No. 27 in 5 shifts and ketone residue No. 29 in the last 5 shifts. Tables Nos. 5, 6 and 7 give the respective results when using these three different hardwood oils.

TABLE NO. 3

Oil Mixture—Pine Oil (G.N.S. No. 5).—20 per cent.
Coal Tar Creosote.......60 "
Coal Tar...............20 "
Pounds of oil mixture per ton of dry ore—0.98.

Date—1917	Shift	Tons of Ore Treated	Assay Ounces of Silver Per Ton: Heads	Tails	Middlings	Concentrates	Per Cent. Extraction
April 16	7 – 3	378	9.8	1.2	16.4	488.0	87.7
	3 – 7		7.0	1.0	22.2	345.5	85.7
April 17	7 – 3	294	9.4	1.2	20.0	480.0	87.2
	3 – 7		7.6	1.0	13.4	398.0	86.8
April 18	7 – 3	347	9.2	1.0	12.8	500.0	89.1
	3 – 7		6.9	1.0	12.0	306.0	85.3
April 19	7 – 3	275	9.8	1.0	12.6	440.0	89.8
	3 – 7		7.4	1.0	14.0	444.0	86.5
April 20	7 – 3	310	10.4	1.3	14.4	571.5	87.5
	3 – 7		6.8	1.0	10.6	421.5	85.3
April 21	7 – 3	270	9.6	1.2	11.4	586.0	87.5
	3 – 7		6.4	1.0	8.8	490.0	84.4
April 22	3 – 7	120	7.0	1.0	11.6	402.0	85.7

TABLE NO. 4

Oil Mixture—Pine Oil (G.N.S. No. 5).—20 per cent.
Coal Tar Creosote.......60 "
Coal Tar...............20 "
Pounds of oil mixture per ton of dry ore—0.98.

Date—1917	Shift	Tons of Ore Treated	Assay Ounces of Silver Per Ton Heads	Tails	Middlings	Concentrates	Per Cent. Extraction
April 23	7 – 3	284	6.2	0.9	8.4	381.0	85.5
	3 – 7		6.8	1.0	20.0	417.5	85.3
April 24	7 – 3	327	9.0	1.0	9.8	392.0	88.9
	3 – 7		8.6	1.0	10.0	480.0	88.4
April 25	7 – 3	316	8.6	1.0	10.4	421.0	88.4
	3 – 7		8.8	0.9	12.8	528.0	89.8
April 26	7 – 3	283	8.2	0.9	8.0	355.0	89.0
	3 – 7		7.8	0.9	10.0	365.0	88.5
April 27	7 – 3	265	7.8	1.0	8.0	481.5	87.2
	3 – 7		9.0	0.9	14.9	473.1	90.0
April 28	7 – 3	297	8.2	0.9	9.0	465.0	89.0
	3 – 7		7.8	0.9	11.6	447.0	88.5
April 29	3 – 7	247	9.0	1.0	16.0	462.5	88.9

TABLE NO. 5

Oil Mixture—Heavy Hardwood Creosote Oil (F.P.L. No. 26).—40 per cent.
Coal Tar Creosote..............................50 "
Coal Tar.......................................10 "
Pounds of oil mixture per ton of dry ore—1.06.

Date—1917	Shift	Tons of Ore Treated	Assay Ounces of Silver Per Ton Heads	Tails	Middlings	Concentrates	Per Cent. Extraction
May 1	3 – 7	172	8.2	1.1	16.0	611.0	86.8
May 2	7 – 3	263	9.4	1.1	17.8	318.0	88.6
	3 – 7		8.6	1.0	10.0	436.5	88.6
May 3	7 – 3	278	8.8	1.1	15.4	265.0	87.9
	3 – 7		6.8	1.0	11.2	349.0	85.5
May 4	7 – 3	94	8.9	1.2	18.4	243.5	86.8

TABLE NO. 6

Oil Mixture—Hardwood Acid (creosote) Oil (F.P.L. No. 27)...40 per cent.
Coal Tar Creosote..............................50 "
Coal Tar.......................................10
Pounds of oil mixture per ton of dry ore—1.06.

Date—1917	Shift	Tons of Ore Treated	Assay Ounces of Silver Per Ton Heads	Tails	Middlings	Concentrates	Per Cent. Extraction
May 4	3 – 7	187	12.0	1.1	92.0	900.0	90.8
May 5	7 – 3	283	9.6	1.2	15.2	320.0	87.9
	3 – 7		7.0	1.0	22.8	732.5	85.8
May 6	3 – 7	125	8.8	0.9	10.6	435.0	89.9
May 7	7 – 3	80	8.8	0.8	10.6	344.0	91.1

TABLE NO. 7

Oil Mixture—Keytone Residue (F.P.L. No. 29)...25 per cent.
Coal Tar Creosote.................65 "
Coal Tar..........................10 "
Pounds of oil mixture per ton of dry ore—1.06.

Date—1917	Shift	Tons of Ore Treated	Assay Ounces of Silver Per Ton Heads	Tails	Middlings	Concentrates	Per Cent. Extraction
May 7	3 – 7	160	7.8	1.2	26.6	173.0	85.0
May 8	11 – 7	212	9.4	1.0	14.0	317.0	89.6
May 9	7 – 3	277	9.2	1.1	13.0	267.5	88.4
	3 – 7		8.2	0.9	7.4	290.0	89.3
May 10	7 – 3	90	8.8	0.9	87.6	382.0	90.0

The tables speak for themselves. It is interesting to note that these commercial tests gave more than 20 per cent. higher extractions than were obtained in small scale laboratory tests. this should be borne in mind in studying the comparative results on the fifty different wood oils examined during this investigation.

The operation of the commercial flotation machines needed no special attention during the runs on the hardwood creosote oils, Nos. 26 and 27.

When using ketone residue, however, care had to be taken to keep out traces of foreign oil such as lubricating oil which had a deleterious action on the somewhat sensitive though heavy froth.

Conclusions

1. Crude hardwood oils, the supply of which is abundant, can be substituted for pine oil as a selective frothing agent in the commercial flotation of Cobalt silver ores.

2. Heavy hardwood creosote oil, F.P.L. No. 26 and acid (creosote) oil F.P.L. No. 27, give equally satisfactory results and a mixture of these two oils in proportions as produced is recommended as a standard hardwood flotation oil.

3. Ketone residue in the crude state can also be considered a satisfactory flotation oil for commercial use on Cobalt silver ore.

Hardwood Flotation Oils for Other Canadian Ores.—Hardwood creosote oils have been tried out on the laboratory scale on copper ore from Bruce Mines, Ont. From ore assaying 7.9 per cent. copper a mixture of 40 per cent. heavy hardwood creosote oil, F.P.L. No. 26, 54 per cent. coal tar creosote and 6 per cent. coal tar gave 93.1 per cent. extraction, leaving tails analyzing 0.8 per cent. copper. Other hardwood oils should give equally satisfactory results.

Ketone residue has proved satisfactory for the flotation of low grade copper-nickel ore of the Sudbury district and a commercial demand for the oil has already been effected as the result of this investigation.

Hardwood creosote oils, especially light hardwood creosote oil, F.P.L. No. 25, has promising qualities for treatment of the lead-zinc ores and copper ores of British Columbia.

Further investigations of the commercial flotation problems of other Canadian ores, especially those from British Columbia, are now being carried out in the Ore Dressing Division of the Mines Branch, where a full collection of the Canadian crude wood oils and their fractions is on hand.

Acknowledgments

This investigation was made possible by the hearty support of the Hon. Dr. W. J. Roche, Minister of the Interior, to whom the flotation oil situation was presented by the Cobalt mining companies. The authors wish to express their indebtedness to John S. Bates, Ph.D., Superintendent of the Forest Products Laboratories of Canada, for efficiently planning and directing the investigation throughout and also to Mr. G. C. MacKenzie, Chief of the Division of Ore Dressing and Metallurgy, Mines Branch, for his co-operation. The commercial tests were made at the Buffalo Mines, Cobalt, with the generous co-operation of Mr. T. R. Jones and his staff. The valuable services of Mr. A. A. Cole, President of the Canadian Mining Institute, are also hereby acknowledged.

This paper is published with the permission of the Director of Forestry and the Director of the Mines Branch, Ottawa.

Analyses of Black Pepper

The laboratory of the Inland Revenue Department reports as follows on 345 samples of black pepper purchased during the first quarter of 1917: 258 samples were genuine; 30 were doubtful; 48 were adulterated and 9 were collected in error. Black pepper is the most generally adulterated spice offered for sale, the adulteration being usually pepper shells and their adherent dirt, ground olive stones, cocoanut shell and starch.

Coal Distillation Under Pressure

In the course of an investigation of this subject, J. H. Capps and G. A. Hulett have obtained the following results:

1. Pressures up to 20 atmospheres decrease the amounts of high-boiling compounds and increase the amounts of low-boiling compounds in the condensable vapors evolved from coal below 600°C. Also pressure causes an increase of low-boiling aromatic bodies in these oils.

These results are directly attributable to cracking or thermal decomposition which is brought about by subjecting the vapors of heavy compounds to temperatures considerably higher than their boiling points, as the increased partial pressures of these constituents retard their vaporization.

Pressure also decreases, in most cases, the amounts of phenols and acid substances in the oils. The reasons for this are not clear.

2. Pressure increases the amount of coke left as residue and also the per cent. of fixed carbon in the coke. These are effects of cracking oils in contact with the coal. The calorific value of the coke is increased and the nitrogen, oxygen, sulphur and volatile matter are decreased.

This decrease of nitrogen, sulphur and oxygen in the cokes is probably due to increased partial pressure of hydrogen in contact with the hot coke.

3. Pressure causes an increase in the volume of gas evolved from coal below 600°C.

Up to 20 atmospheres it increases the per cent. of hydrogen in these gases at 500° and decreases it at 550° and 600°. The increase at 500° is probably due to cracking of heavy hydrocarbons. The decrease at 550° and 600° is attributed to the action of hydrogen at high concentration on nitrogen (and sulphur and oxygen) in the coke and upon unsaturated products of cracking. Increase of ethane and methane in the gas seems to bear out this last view.—Jour. Ind. Eng. Chem.

Tar Varnish for Iron Work

The South African correspondent of the Iron and Coal Trades Review recommends from personal experience the following prescription for tar varnish for preserving iron work: Heat about 100 gallons of tar to a low boiling point and add 100 pounds of freshly slaked lime sifted over the top and then worked down. Boil the mixture until it becomes pasty. Let it settle for a few minutes and then add 20 pounds of tallow and 5 pounds of powdered resin. Stir until thoroughly mixed and all the ingredients are dissolved; then allow to cool. The mixture should not be raised to a higher temperature than 100°F. Should the preparation be too thick, it can be thinned down with paraffin or naphtha. This gives a beautiful finish like a stove enamel. The works in which this is used are situated right on the edge of the sea and the southeast winds corrode iron work very quickly. All gasholders, galvanized iron roofs and galvanized sides of buildings are painted two coats with this tar varnish and then whitewashed over this, which protects them thoroughly from the weather and salt air. The varnish is elastic and will stop corrosion. A similar mixture was used with excellent results for coating the girders of all the bridges on a railway in the north of England.

Prevention of Leakage Through Cement

To stop leakage through cement, such as tunnel walls, clean the walls thoroughly and paint with a solution consisting of 8¾ pounds of zinc sulfate dissolved in a gallon of water. Another method is to use one part water glass (sodium silicate) to five parts of water and apply a coat with a brush; this is allowed to dry for about six hours and another coat is applied, repeating until four coats have been put on, with not more than twenty hours between the applications of the separate coats.

The Complexity of the Chemical Elements

By Prof. Frederick Soddy, M.A., F.R.S.

(Continued from page 148)

The Chemical Elements Not Necessarily Homogeneous

I pass now to the second and most novel sense in which the elements, or some of them at least, are complete. In their discovery of new radioactive elements, M. and Mme. Curie used radioactivity as a method of chemical analysis precisely as Bunsen and Kirchoff, and later Sir William Crookes, used spectrum analysis to discover caesium and rubidium, and thallium. The new method yielded at once, from uranium minerals, three new radio-elements, radium, polonium, and actinium. According to the theory of Sir Ernest Rutherford and myself, these elements are intermediate members in a long sequence of changes of the parent element uranium. In a mineral the various members of the series must co-exist in equilibrium, provided none succeed in escaping from the mineral, in quantities inversely proportional to their respective rates of change, or directly proportional to their periods of average life. Radium changes sufficiently slowly to accumulate in small but ponderable quantity in a uranium mineral, and so it was shown to be a new member of the alkaline-earth family of elements, with atomic weight 226.0 occupying a vacant place in the Periodic Table. Polonium changes 4,500 times more rapidly, and can only exist to the extent of a few hundredths of a milligrm. in a ton of uranium mineral. Actinium also, though its life period is still unknown, and very possibly is quite long, is scarce for another reason, that it is not in the main line of disintegration, but in a branch series which claims only a few per cent. of the uranium atoms disintegrating. In spite of this, polonium and actinium have just as much right to be considered new elements, probably, as radium has. Polonium has great resemblances in chemical character both to bismuth and tellurium, but was separated from the first by Mme. Curie and from the second by Marckwald. In the position it occupies as the last member of the sulphur group, bismuth and tellurium are its neighbors in the Periodic Table. Actinium resembles the rare-earth elements, and most closely lanthanum, but an enrichment of the proportion of actinium from lanthanum has been effected by Giesel. The smallness of the quantities alone prevents their complete separation in the form of pure compounds as was done for radium.

The three gaseous members, the emanations of radium, actinum, and thorium, were put in their proper place in the Periodic Table almost as soon as radium was, for, being chemically inert gases, their chacterisation was simple. They are the last members of the argon family, and the fact that there are three of about the same atomic weight was probably the first indication, although not clearly appreciated, that more than one chemical element could occupy the same place in the Periodic Table.

The extension of the three disintegration series proceeded apace; new members were being continually added, but no other new radio-clements—new, that is, in possessing a new chemical character—were discovered. The four longest-lived to be added, radio-lead or radium D, as it is now more precisely termed, and ionium in the uranium series, and mesothorium-I and radiothorium in the thorium series, could not be separated from other constituents always present in the minerals, radium-D from lead, ionium, and radio-thorium from thorium, and mesothorium-I from radium. An appreciable proportion of the radio-activity of a uranium mineral is due to radium-D and its products, and its separation would have been a valuable technical achievement, but, though many attempts have been made, this has never been accomplished, and, we know now, probably never will be.

Seven years ago it was the general opinion in the then comparatively undeveloped knowledge of the chemistry of the radio-elements, that there was nothing especially remarkable in this. The chemist is familiar with many pairs or groups of elements, the separation of which is laborious and difficult, and the radio-chemist had not then fully appreciated the power of radioactive analysis in detecting a very slight change in the proportions of two elements, one or both of which were readioactive. The case is not like that of the rare-earth group of elements, for example, in which the equivalent or atomic weight is used as a guide to the progress of the separation. Here the total difference in the equivalent of the completely separated elements is only a very small percentage of the equivalent, and the separation must already have proceeded a long way before it can be ascertained.

Human nature plays its part in scientific advances, and the chemist is human like the rest. My own views on the matter developed with some speed when, in 1910, I came across a new case of this phenomenon. Trying to find out the chemical character of mesothrium 1, which had been kept secret for technical reasons, I found it to have precisely the same chemical character as radium, a discovery which was made in the same year by Marckwald, and actually first published by him. I delayed my publication some months to complete a very careful fractional crystallization of the barium-radium-mesothorium-I chloride separated from thorianite. Although a great number of fractionations were performed, and the radium was enriched, with regard to the barium, several hundred times, the ratio between the radium and mesothorium-I was, within the very small margin of error possible in careful readioactive measurements, not affected by the process. I felt justified in concluding from this case, and its analogy with the several other similar cases then known, that radium and mesothorium-I were non-separable by chemical processes, and had a chemical character not merely like but identical. It followed that some of the common elements might similarly be mixtures of chemically identical elements. In the cases cited, the non-separable pairs differ in atomic weight from 2 to 4 units. Hence the lack of any regular numerical relationships between the atomic weights would on this view follow naturally (Trans. Chem. Soc., 1911, xcix., 72). This idea was elaborated in the Chemical Society's Annual Report on Radioactivity for 1910, in the concluding section summing up the position at that time. This was I think the beginning of the conception of different elements identical chemically, which later came to be termed "isotopes," though it is sometimes attributed to K. Fajans, whose valuable contributions to radioactivity had not at that date commenced, and whose first contribution to this subject did not appear till 1913.

In the six or seven years that have elapsed the view has received complete vindication. Really, three distinct lines of advance converged to a common conclusion, and, so far as is possible, these may be disentangled. First, there has been the exact chemical characterization from the new point of view of every one of the members of the three disintegration series, with lives over one minute. Secondly, came the sweeping generalisations in the interpretation of the Periodic Law. Lastly, there has been the first beginnings of our experimental knowledge of atomic structure, which got beyond the electronic constituents and at the material atom itself.

In pursuance of the first, Alexander Fleck, at my request, commenced a careful systematic study of the chemical character of all the radio-elements known of which our knowledge was lacking or imperfect, to see which were and which were not separable from known chemical elements. Seldom can the results of so much long and laborious chemical work be expressed in so few words. Every one, that it was possible to examine, was found to be chemically identical either with some common element or with another of the new radio-elements. Of the more important characterizations, mesothorium-II was found to be non-separable from actinium, radium-A from polonium, the three B-members and radium-D from lead, the three C-members and radium-E from bismuth, actinium-D and thorium-D from thallium. These results naturally took some time to complete, and became known fairly widely to others working in the subject before they were published, through A. S. Russell, an old student, who was then carrying on his investigations in radioactivity in Manchester. Their interpretation constitutes the second line of advance.

Before that is considered, it may first be said that every case of chemical non-separability put forward has stood the test of time, and all the many skilled workers who have pitted their chemical skill, against Nature in this quest have confirmed it. The evidence at the present day is too numerous and detailed to recount. It comes from sources, such as in the technical extraction of mesothorium from monazite, where one process is repeated a nearly endless number of times; from trials of a very great variety of methods as, for example, in the investigations on radium-D and lead by Paneth and von Hevesy; it is drawn from totally new methods, as in the beautiful proof by the same authors of the electro-chemical identity of these two isotopes; it is at the basis of the use of δ radioactive elements as indicators for studying the properties of a cmmon element, isotopic with it, at concentrations too feeble to be otherwise dealt with, and from large numbers of isolated observations, as well as prolonged systematic researches. One of the finest examples of the latter kind of work, the Austrian researches on ionium, will be dealt with later. The most recent, which appeared last month, is by T. W. Richards and N. F. Hall, who subjected lead from Austrian carnotite, containing therefore radium-D to over a thousand fractional crystallizations in the form of chloride, without appreciably altering the atomic weight or the β-activity. So that it may be safely stated that no one who has ever really tested this conclusion now doubts it, and after all they alone have a right to an opinion.

This statement of the non-separability by chemical methods of pairs or groups of elements suffers perhaps from being in a negative form. It looks too much like a mere negative result, a failure, but in reality it is one of the most sweeping positive generalizations that could be made. Ionium we say is non-separable from thorium, but every chemist knows thorium is readily separated from every other known element. Hence, one now knows every detail of the ehemistry of the vast majority of these new radio-elements by proxy, even when their life is to be measured in minutes or seconds, as completely as if they were obtainable, like thorium is, by the ton. The difference it makes can only be appreciated by those who have lived through earlier days, when, in some cases, dealing with the separation of radio-constituents from complex minerals, after every chemical separation one took the separated parts to the electroscope to find out where the desired constituent was.

As the evidence accumulated that we had to deal here with something new and fundamental, the question naturally arose whether the spectrum of isotopes would be the same. The spectrum is known, like the chemical character, to be an electronie rather than mass phenomenon, and it was to be expected that the identity should extend to the spectrum. The question has been tested very thoroughly by A. S. Russell and R. Rossi in this country, and by the Austrian workers at the Radium Institut of Vienna, for ionium and thorium, and by various workers for the various isotopes of lead. No certain difference has been found, and it may be concluded that the spectra of isotopes are identical. This identity probably extends to the X-ray spectra. Rutherford and Andrada having shown that the spectrum of the γ-rays of radium-B is identical with the X-ray spectrum of its isotope, lead.

The Periodic Law and Radioactive Change

The seeond line of advance interprets the Periodic Law. It began in 1911 with the observation that the product of any a-ray change always oceupied a place in the Periodic Table two places removed from the parent in the direction of diminishing mass, and that in subsequent changes where a-rays are not expelled the product frequently reverts in chemical character to that of the parent, though its atomic weight is reduced 4 units by the loss of the a-particle, making the passage across the table curiously alternating. Thus the product of radium (Group II.) by an a-ray ehange is the emanation in the zero group, of ionium (Group IV.), radium, and so on, while, in the thorium series, thorium (Group IV.) produces by an a-ray change mesothorium-I (Group II.), which, in subsequent changes in which no a-rays are expelled, yields radio-thorium, back in Group IV. again. ("Chemistry of the Radio-Elements," p. 29, 1st Edition, 1911). Nothing at that time could be said about β-ray changes. The products were for the most part very short lived and imperfectly characterized chemically, and several lacunæ still existed in the series masking the simplicity of the process. But early in 1913 the whole scheme beeame clear, and was pointed out first by A. S. Russell, in a slightly imperfect form, independently by K. Fajans from electro-chemical evidence, and by myself, in full knowledge of Fleck's results, still for the most part unpublished, all within the same month of February. It was found that, making the assumption that uranium-X was in reality two successive products giving β-rays, a prediction Fajans and Gohring proved to be eorrect within a month, and a slight alteration in the order at the beginning of the uranium series, every a-ray change produced a shift of place as described, and every β-ray ehange a shift of one place in the opposite direction. Further and most significantly, when the successive members of the three disinegration series were put in the places in the table dictated by these two tubes, it was found that all the elements occupying the same place were those which had been found to be non-separable by chemical processes from one another, and from the element already occupying that place, if it was occupied, before the discovery of radioactivity. For this reason the term "isotope" was coined to express an element ehemically non-separable from the other, the term signifying "the same place."

So arranged, the three series extended from uranium to thallium, and the ultimate product of each series occupied the place occupied by the element lead. The ultimate products of thorium should, because six a-particles are expelled in the process, have an atomic weight 24 units less than the parent, or about 208. The main ultimate product of uranium, since eight a-particles are expelled in this case, should have the atomic weight, 206. The atomic weight of ordinary lead is 207.2, which made it appear very likely that ordinary lead was a mixture of the two isotopes, derived from uranium and thorium. The prediction followed that lead, separated from a thorium mineral, should have an atomic weight about a unit higher, and that separated from uranium minerals about a unit lower, than the atomic weight of common lead, and in each case this has now been satisfactorily established.

The Atomic Weight of Lead from Radioactive Minerals

It should be said that Boltwood and also Homes had, from geological evidence, both decided definitely against it being possible that lead was a product of thorium, because thorium minerals contained too little lead, in proportion to the thorium, to accord with their geological ages. Whereas, the eonclusion that lead was the ultimate product of the uranium series had been thoroughly established by geological evidence, and has been the means, in the hands of skilful investigators, of ascertaining geological ages with a degree of precision not hitherto possible. Fortunately I was not deterred by the non possumus, for it looks as if everybody was right! An explanation of this paradox will later be attempted. In point of fact, there are exeeedingly few thorium minerals that do not eontain uranium, and since the rate of change of uranium is about 2.6 times that of thorium, one part of uranium is equal as a lead-produeer to 26 parts of thorium. Thus Ceylon thorianite, one of the richest of thorium minerals, containing 60 to 70 per cent. of ThO_2, may contain 10 to 20 and even 30 per cent. of U_3O, and the lead from it may be expected to consist of very similar quantities of the two isotopes, to be in fact very similar to ordinary lead. I know of only one mineral which is suitable for this test. It was discovered at the same time as thorianite, and from the same locality—Ceylon thorite, a hydrated silicate containing 57 per cent. of thorium and 1 per cent. of uranium only. In the original analysis no lead was recorded, but I found it contained 0.4 per cent., which if it were derived from uranium only, would indicate a very hoary ancestry, comparable, indeed, with the period of average life of uranium itself. On the other hand, if (1) all the lead is of radioactive origin, (2) is stable, and (3) is derived from both constituents, as the generalization being discussed indicated, this 0.4 per cent. of lead should consist of 95.5 per cent. of the thorium isotope and 4.5 per cent. of the uranium isotope. Thorite thus offered an extremely favorable case for examination.

In preliminary experiments in conjunction with H. Hyman, in which only a grm. or less of the lead was available, the atomic weight was found relatively to ordinary lead to be perceptibly higher, and the difference, rather less than one-half per cent., was of the expected order.

It was so fortunate as to secure a lot of 30 kilos, of this unique mineral, which was first carefully sorted, piece by piece, from admixed thorianite and doubtful specimens. From the 20 kilos. of first grade thorite, the lead was separated, purified, reduced to metal, and cast in vacuo into a cylinder, and its density determined together with that of a cylinder of common lead similarly purified and prepared. Sir Ernest Rutherford's theory of atomic structure, to be dealt with in the latter part of this discourse, and the whole of our knowledge as to what isotopes were, made it appear probable that their atomic volumes, like their chemical character and spectra, should be identical, and therefore that their density should be proportional to their atomic weight. The thorite lead proved to be 0.26 per cent. denser than the common lead. Taking the figure 207.2 for the atomic weight of common lead, the calculated atomic weight of the specimen should be 207.74.

The two specimens of lead were fractionally distilled in vacuo, and a comparison of the atomic weight of the two middle fractions made by a development of one of Stas's methods. The lead was converted into nitrate in a quartz vessel, and then into chloride by a current of hydrogen chloride, in which it was heated at gradually increasing temperature to constant weight. Only single determinations have been done, and they gave the values 207.20 for ordinary lead, and 207.694 for the thorite lead, figures that are in the ratio of 100 to 100.24. This, therefore, favored the conclusion that the atomic volume of isotopes is constant.

At the request of Mr. Lawson, interned in Austria, and continuing his researches at the Radium Institute under Prof. Stefan Meyer, the first fraction of the distilled thorite lead was sent him, so that the work could be checked. Prof. Honigschmid has carried through an atomic determination by the silver method, obtaining the value of 207.77 (plus or minus) 0.014, as the mean of eight determinations. Hence, the conclusion that the atomic weight of lead derived from thorite is higher than that of common lead, has been put beyond reasonable doubt.

Practically simultaneously with the first announcement of these results for thorium lead, a series of investigations were published on the atomic weight of lead from uranium minerals, by T. W. Richards and collaborators at Harvard, Maurice Curie in Paris, and Honigschmid and collaborators in Vienna, which show that the atomic weight is lower than that of ordinary lead. The lowest result hitherto obtained is 206.046, by Honigschmid and Mlle. Horovitz for the lead from the very pure crystallized pitchblende from Morogoro (German East Africa), whilst Richards and Wadsworth obtained 206.085 for a carefully selected specimen of Norwegian clevite. Numerous other results have been obtained, as, for example, 206.405 for lead from Joachimsthal pitchblende, 206.82 for lead from Ceylon thorianite, 207.08 for lead from monazite, the two latter being mixed uranium and thorium minerals. But the essential proportion between the two elements has not unfortunately been determined. Richards and Wadsworth have also examined the density of their uranium lead. In every case they have been able to confirm the conclusion that the atomic volume of isotopes is constant, the uranium lead being as much lighter as its atomic weight is smaller than common lead. Many careful investigations of the spectra of these varieties of lead show that the spectrum is absolutely the same so far as can be seen.

The Coniagas Companies

At the annual meeting of the Coniagas Mines, held at St. Catharines, Ont., Col. R. W. Leonard, the president, reviewed the business of the year.

The mining operations at Cobalt have progressed steadily, with an average of slightly over one hundred men employed, and the mine will have produced about 1,250,000 ounces of silver during the year, which is less than previous years on account of the decrease in the production of high-grade ore.

The operations of the Coniagas Reduction Company, Limited, (the stock of which is owned by the Coniagas Mines, Limited), have been materially restricted owing to the difficulty at times in obtaining supplies due to war conditions.

At the same time the reduction company has found it advantageous, for the future operations of the smelter, to purchase more ore than usual from other mines, the reduction of which has largely appropriated the smelter's capacity, and has thus resulted in the accumulation at the smelter of a large stock, which accumulation (much of it at low prices) now amounts to over 2,000,000 ounces of silver in process of reduction and refining, on which profitable prices should be realized.

At Porcupine three claims, known as the "Ankerite," near the Dome Mines, have been purchased at $150,000, and two claims lying to the west of the Ankerite, have also been bought. These and other developments will require an investment of $150,000,000 during the coming year.

This work is under the supervision of Clifford E. C. Smith, member of council, Canadian Mining Institute, on whose recommendation the properties have been purchased.

Reporting on the work of the Coniagas Reduction Company, which the company controls at Thorold, Ont., the president said there was a good demand for cobalt owing to the large requirement of the munitions plants for high speed tools, and this has taken the place of the market normally existing for the oxide for ceramic purposes. The price of white arsenic has been well maintained owing to the disturbed conditions of Europe and Mexico, and some metallic arsenic has been marketed in Europe. The silver mined and shipped during the year was over 1,750,000 ounces compared with two million ounces in the previous year. The addition to the mill for treating slimes by cyanide has been in operation since February last and has already paid the cost of construction. The cost of living is having its effect on cost of operation. For silver the cost of shipping, smelting, refining and marketing was 4.27 cents per ounce against 3.25 in the previous year; while the cost of mining and concentrating, including royalties and other expenses outside of smelting, refining, etc., was 15.24 cents compared with 13.61 per ounce the year before.

The Pfaudler Company, of Rochester, N.Y., have established a branch sales office at 440 Pierce Building, St. Louis, Mo., in charge of Mr. George E. Gray, who has, for some time, been connected with the company's Chicago offices. An agency for the Pfaudler Company products has been granted to C. M. Jackson Company, 512 Gould Building, Atlanta, Ga.

Low Temperature Distillation of Lignite Coal

H. K. Benson and L. L. Davis draw the following conclusions from their experiments on this subject:

1. The maximum yield of lignite oils is obtained by distilling at 380°C. 2. About 5.5 per cent. of the coal may be obtained as raw oils. 3. These raw oils are more similar to petroleum and shale oil than to coal tar, there being no benzol or benzol derivatives present. 4. Lignite raw oils will give valuable solvents, burning oils, engine fuel oils, and lubricating oils. 5. About seven pounds of paraffin wax per ton of coal may be obtained. 6. The gas resulting from the low termperature distillation of lignites is of low heat value and is small in volume. 7. Small quantities of ammonia can be obtained from lignite tar water. 8. The residue from lignite distillation is a valuable fuel having a calorific value of over 12,000 B.t.u. per pound. 9. Due to the small unit used it is impossible to determine the commercial feasibility of lignite distillation, but sufficient data have been obtained to warrant a semi-commercial test to be made upon the Tono lignites.—Jour. Ind. Eng. Chem.

Municipal Preparedness and the Chemist

By T. Linsey Crossley, A. M. Soc. C.E.

This war has been called "a war of chemists."

Forty years of drill and training was not all the tale of Germany, but forty years of chemistry and theory. When the military party in Berlin rang up the curtain, everything was ready, or was it? One thing was forgotten. Such years of faith in theory and drill had blinded the eyes of the system's devotees; soul and spirit, love and laughter were lacking as factors in it. Loyalty they had not analyzed. They had put the cart before the horse, that's all.

The cart's all right in its way. If the science cart was considered of supreme importance in preparing for war, it may be concerned in preparing for peace, but only in its proper place. A pack-horse is sufficient in the mountains, but on the plains a cart of some kind is an economic proposition. The horse being motive is, however, the first consideration. Lest we digress too far, we will stop just now, and say that, for many years, we have tried the cartless horse method of municipal activity. We have thought that our leading men should be elected to manage our community interests on the basis of faith, hope and charity. The ideal is right, but in practice, the objects upon which the faith, hope and charity of our elected representatives have been exercised have not coincided with the public welfare.

To an increasing degree we are involved in a municipal technology. When we have a toothache, we do not go to a poet or a minister, however highly we respect and love their lofty ideals. We go to a man who knows the difference between a biscuspid and a butterfly. We would not engage a real estate agent to run a dynamite factory.

We do expect the following to run a town—when they feel inclined: One lawyer, one farmer (retired), one general storekeeper, one lumber dealer, one hotelkeeper, one undertaker.

We wonder if our town would not better be run by: One engineer, one chemist, one doctor (medical), one business man, one lawyer.

At once we are asked: Are these men to be paid? Who's to pay them? Where's the money to come from? Of course the communities should be so distributed as to population and revenue that these questions could be settled offhand. This is not the case. What next? Why, let's pay for part of their time. Let us retain them for certain definite times and occasions, less or more, according to population and work required. This is done to some extent now in the cases of: Engineer, medical man and lawyer.

Look over the list of "Good" things we want, and ask ourelves why not also retain a chemist to round out the group? The word "chemist" hardly describes the man who would be useful in the chemical situations that arise in connection with towns—Chemical Engineer comes nearer. He must be a man of broad general experience and knowledge; he must know not only how to make certain tests and determinations, but must be conversant with the technical point of many trades and industries.

He has to co-operate with the engineer in the laying of roads and sidewalks, the digging of drains, the painting of bridges and fences, testing paints, oils, fuel, asphalt, cement, sand and stone, and in the preparation of specfications.

He has to co-operate with the medical man in the analysis and bacteriology of water, milk and foods, the testing and valuation of disinfectants.

He has to co-operate with the business man in the selection of materials for the use of the town; that these shall be of maximum value for the money spent. He must be able to advise the town with reference to help for proposed new industries. He has to co-operate with the public departments in the supply of material for their special uses; with the police in prevention of adulteration, and frequently in the prosecution of criminals; with the fire department in examination of hose, sprinkler heads, extinguishers, rubber for hose and salvage covers.

He can co-operate with the farmer in the analysis of soils, fertilizers and insecticides.

He can co-operate with the local industries in their purchasing and maintenance.

He can assist the schools and churches in matters of ventilation and sanitation.

The large cities maintain laboratories and chemists as a matter of necessity. The smaller cities, towns and villages do not, owing to lack of funds, or rather failure to see the necessity.

Every city of 50,000 or more should have its own laboratory and a good chemist. The equipment and maintenance should not cost more than five cents per capita. In a city of 50,000 this would provide for a chemist at $1,500 per annum, an assistant at $600 per annum, and leave $400 for equipment and expense account.

The assistant need not be engaged for the first year, and this would provide $1,000 for apparatus and equipment with which to start. Subsequently, $250 per annum would be enough for supplies and new apparatus. The balance, $150, could be set aside to provide a fund for extension later. Any city which was enterprising enough to do this would, of course, be in the growing class, and would soon see results. Much depends on the personality, education and ambition of the chemist himself. With the proper man, the institution would soon be found a necessity.

For the smaller cities and the towns, it would, perhaps, be found too expensive to maintain a laboratory. There are in Canada at least five firms of consulting chemical engineers, who give special attention to municipal work. These firms embrace chemists, metallurgists, food specialists, and engineers, and make contracts with muncipalities and industries to carry on such tests and investigations as may be called for.

The value of a retaining contract lies not so much in having the work done without extra bookkeeping and differing prices for each piece of work, but in the fact that a scientific organization is making the interest of the town a part of its regular business system.

Even rural communities and county councils would find it to their advantage to take up this line of work. The writer has in mind one county council which built a stretch of road at a cost of $150,000. It was specified that this was to be macadam and made of a special hard stone that was to produce a nearly dustless road. The contractor ignored that specification, and laid a road with a soft limestone, with the result that the new road was even more dusty than the old one. A hundred dollars' worth of inspection and analysis would have prevented this.

Small industrial communities might be able to raise enough money to pay for equipping a laboratory, and part of a chemist's salary; the chemist being allowed to undertake work for the local industries. In some places the expense on chemist account could be kept down by encouraging citizens to bring in samples for analysis at special rates. In dairying centres, for instance, the municipal chemist would be useful as a referee between milk producers and buyers.

In conclusion, do not expect to find your chemist in possession of King Midas's touch. Sometimes he is able to indicate and help to carry out very direct savings. Generally he is regulative and preventive The value of a cure need not be estimated, if the prevention is effective!

T. Linsey Crossley, the writer of the thoughtful article quoted from the Canadian Municipal Journal, is a member of the firm of J. T. Donald & Company, consulting engineers of Montreal and Toronto. He was assistant to Dr. J. T. Donald, 1897-1901, in that laboratory. He was appointed chemist and draughtsman to the Riordon Paper Mills, Hawkesbury, Ont., 1901-1906, and at a later date chemist and draughtsman to the Nashua Paper Company, of Pepperell, Mass. In 1909 he became associated with Dr. J. T. Donald in the firm of J. T. Donald & Company. After taking a course in chemistry in Bishop's College, medical faculty, with first-class honors, Mr. Crossley was demonstrator in that faculty for three years, 1898-1901. He took a special course in advanced organic chemistry at McGill University in 1899 and 1900, and was appointed professor of chemistry in the Montreal College of Pharmacy, 1912, remaining with that institution till 1916. Mr. Crossley has recently removed to Toronto, as resident representative of Messrs. Donald & Co.

American Chemical Progress

George Iles, a former resident of Montreal, well known to many of our readers, makes the following reflections on the chemical exposition at New York:

"On all sides proof abounded that America has shaken herself free from German chemical manufacture. Three years ago there were only seven American factories of dyestuffs. To-day there are sixteen times as many, led by the Duponts of Delaware, supreme in technical mastery, and of wealth untold. In other fields, as important, long strides have been taken by American chemists since 1914. Glass of all kinds, optical, photographic or flame-proof, is now produced in New York and Pennsylvania, rivaling in quality the famous output of Jena. At Niagara Falls cheap electricity takes common air and yields nitrates for soil enrichment; or breaks up common salt into soda and bleaching powders. As fuels and ores have arisen steadily in price, new economies have been introduced by researchers at Pittsburg, Cleveland and other centres of steel-making and of copper reduction. By-products of combustion, thrown away when coal was cheap, are now converted into road-making materials, lubricants, or fertilizers. Here are new and useful alloys of iron, of copper, of aluminum, thousands of patient experiments in commonwealths as far apart as Montana and Maryland.

"With its home market of one hundred millions, the chemists of this country apply every economy to production on a gigantic scale. Before Germany began war in 1914, her wages stood at levels much lower than those of America. That advantage has now passed away. When peace follows war, Germany will find America in possession of the world market for chemicals. Why? Because America adopts machinery to the utmost feasible limit, always directed by that sweep of gaze, that mastery of minute details, which flowers in 'scientific management.'

"As I was leaving the chemical show I met an old friend, for years in a Dupont dynamite mill. I asked, 'What will you do when the war is over?' 'Come and see,' said he. I was shown an elaborate demonstration of dynamite at work for farmers, shattering boulders, ejecting stumps, digging wells and drains, and bringing hard and dry soils within reach of underlying moisture. Here, indeed, was a noteworthy gift to peace from the hard clutch of war."

Imports from Great Britain and United States

In the total imports of various items relating to the chemical industries for the year ending March, 1916, the following shows the share taken by Great Britain and the United States. In another issue we will show the development of the trade of other countries with Canada since the war:

	Great Britain	United States
Abrasives, artificial	12,423	494,205
Ashes, pot pearl, etc	4,429	96,514
Blackings and Polishings	66,408	102,222
Blueing, laundry	34,691	6,412
China Clay	50,618	77,972
Fire Clay	24,014	80,801
British Gum and Sizing	9,012	85,297
Cassava Flour for Explosives	......	3,326
Crucibles (Clay, Sand and Plumbago)	14,620	140,328
Chemicals, Dyes, Drugs and Medicines	2,525,560	12,955,876
Explosives, powder and ammunition	175,084	793,030
Fuller's Earth	7,476	4,366
Oils, Grease and Wax	773,516	14,605,552
Metals and Minerals	5,976,213	96,250,836
Optical and Mathematical Instruments	101,191	662,442
Scientific Apparatus for Hospitals	200	22,686
Paints and Varnishes	335,734	1,811,630
Turpentine, Tar, Pitch and Rosin	33,310	1,065,974
Stone, Marble and Slate Manufacturers	193,947	887,041
	10,338,446	$130,146,510

It is reported that the Brandam-Henderson Paint Company, of Halifax, N.S., will erect a white lead plant at Kamloops, B.C. It is also stated by the Mining Engineering Record, of Vancouver, that the Martin-Senour Paint Company, of Montreal, contemplate a paint works in British Columbia, and that the patented process for the manufacture of white lead hitherto operated by Metal Corroders, Limited, Main Street, Vancouver, B.C., has been taken over by Seattle capitalists and will be considerably extended both in British Columbia and elsewhere.

Canadian Textile Institute

In the early part of the year a movement was started to establish a Canadian Textile Institute, to be modeled on the lines of the British Institute. At an organizing meeting in Toronto in March an executive council of twelve prominent men in the textile industries was nominated, F. G. Daniels, of Montreal, being president, and C. M. Heddle, Paris, Ont., vice-president, and E. S. Bates, of the Canadian Textile Journal, Montreal, secretary. A branch for Montreal was then formed with G. A. Robertson, as secretary, and one for Toronto with Alfred Burton as secretary.

The main objects of the Institute as set forth in its constitution are: (1) to extend and encourage investigation and experiment in scientific methods of textile manufacturing; (2) to gather and promulgate information concerning textile manufacturing and arts; (3) to promote social intercourse among persons engaged in textile manufacturing and kindred or allied pursuits; (4) to establish and maintain schools and libraries of works on textile and kindred or allied arts; (5) to broaden the knowledge of its members as to improved methods of manufacturing and development of all kinds of textile manufacturing. Membership is open on equal terms to employes and manufacturers; and it is expected that Provincial Governments will join the Dominion Government in encouraging research and establishing textile schools, or departments affiliated with the universities, which would enable students to take technical courses in textiles in connection with arts and sciences; also to provide day and night classes for textile workers.

Personals

The following have been awarded Government studentships and fellowships, on the recommendation of the Honorary Council of Scientific and Industrial Research: Studentships—W. H. Hatcher, B.A., McGill University; R. J. Clerk, B.A., McGill; H. H. C. Ireton, M.A., University of Toronto; J. F. T. Young, M.A., Toronto; O. J. Bridgeman, B.A., University of Saskatchewan; R. Hamer, M.A., Toronto. Fellowships—A. D. Hone, M.A., University of Toronto; A. J. Walker, B.A., University of Saskatchewan; Geo. H. Henderson, M.A., B.Sc., Dalhousie University.

The seventieth birthday of Professor S. Hoogewerff, formerly rector of the Technical High School of Delft, was celebrated recently by the foundation of a prize at the School. Upwards of $40,000 was contributed by Dutch chemical firms. Professor Hoogewerff is best known for his investigations, jointly with the late Dr. Van Dorp, on cinchona alkaloids, on isoquinoline and on the production of anthranilic acid from phthalimide. This latter reaction is a step in the manufacture of synthetic indigo.

W. H. Fegely, instructor in chemistry and assistant director of the laboratories at Alleghany College, has resigned to take charge of the research laboratories of the Erie Malleable Iron Company, Erie, Pa.

W. A. Lawrence, assistant in chemistry at McMaster University, has been appointed research chemist to the Toronto Carpet Manufacturing Company.

The following appointments of its graduates are announced by the chemical department of Mount Allison University: Fred Rand, '15, chemist with the Nova Scotia Steel and Coal Company, at Wabana, Newfoundland; H. H. Hetherington, '15, chief chemist with the Hewitt Steel Company, Newark, N.J.; Harry J. Rowley, '16, Hersey Research Fellow at Queen's University, under Professor Goodwin.

Dr. Ralph H. McKee, formerly professor of chemistry at the University of Maine, and during the past year in charge of the research department of the Tennessee Copper Company, has been appointed associate in chemical engineering at Columbia University, N.Y.

Le Roy Brown, a graduate of Toronto University, is engineer in charge of the construction and operation of the hydro carbon recovery plant of the Toronto Chemical Company at Sault Ste. Marie.

On the recommendation of Dr. Hastings, Fred Hanan, an honor graduate in chemistry of the London University, has been appointed to a position in the Toronto filtration plant laboratory at a salary of $1,400 per annum.

E. R. Barker has been appointed manager of the new Matagami Pulp and Paper Company's new mill at Smooth Rock Falls, Ont. Mr. Barker is a chemist and has had special experience in bleaching processes and the recovery of by-products. He developed a process known as the Barker acid system.

Fred D. S. Robertson has been appointed chief chemist at the new works of the British Forgings, Limited, of Toronto. Mr. Robertson studied at Glasgow University and subsequently acted as an assistant in the laboratories of Sir William Crookes, F.R.S., and Sir Charles A. Cameron, respectively. He has made a special study of the rarer metals, their production, alloys, and uses. He is an authority on molybdenum, having patented processes for the concentration of this element from its ores. He had been engaged, under M. J. O'Brien, of Ottawa, in the latter connection prior to the war. On the outbreak of hostilities he enlisted in the 48th Highlanders of Toronto and went to France with the 1st Canadian Contingent. He was gassed and wounded, and finally sent back to carry on scientific work in Canada. He was appointed chief chemist of the British Forgings, Limited, on November 1st, succeeding S. B. Koch, who returns to the United States. Mr. Robertson's latest publication was, "Practical Agricultural Chemistry," published by Baillie, Tindall & Cox.

Green Sands

As the result of his examination of the green sands of New Jersey and Delaware, George H. Ashley, reports to the United States Geological Survey that the best greensands are in New Jersey and Delaware, the deposits in places having a maximum thickness of 20 or 30 feet, though as a rule it is less. These deposits have a horizontal extent of many miles, but the quantity varies both in different parts of the section of the bed at the same place and from place to place. In the main these beds outcrop at the surface and have a cover as a rule not more than their own thickness. Locally these deposits carry more than 7 per cent. of potash, and over large areas they carry from 5 to 7 per cent. of potash. Many of the deposits are close to transportation and so situated that they could be mined by dredge or steam shovel readily and cheaply.

The deposits examined south of Delaware are of lower grade. It is probable, however, that all of those examined have a sufficient extent for commercial use, if a cheap method of obtaining the potash can be found.

Pure Alloys for Magnetic Purposes

At the Pittsburg meeting of the American Electro-chemical Society, Trygve D. Yensen, of the University of Illinois, described an electrolytic plant for producing pure iron and discussed the reasons why pure iron and iron containing elements which do not separate its crystals from each other have great magnetic permeability and low hysteresis losses. Ordinary and vacuum electric furnaces for making the alloys at temperatures up to 1,800° C. were described; also annealing furnaces for heat treatment of the alloys produced.

A special committee appointed by the Commonwealth Advisory Council of Science and Industry to consider and investigate the question of alcohol fuel and engines has issued its first report. It is endeavoring to develop stationary engines of slow speed.

Industrial News Items

The B. J. Johnston Soap Company, of Toronto, are erecting a $100,000 factory on Natalie Street.

The Liquid Air Society of Toronto will erect a $3,000 addition to their plant at 16 Boler Street.

J. C. Beidelman, of Montreal, is opening up a graphite deposit in Lyndoch township, Renfrew County, Ont.

Several car loads of high-grade chromite ore have been shipped from a deposit opened last winter near Richmond, Que.

The United Rubber Manufacturing and Reclaiming Company, of Toronto, will erect a $15,000 rubber factory at Whitby, Ont.

Fire completely destroyed the Cluff Ammunition Works at 28 Atlantic Avenue, Toronto, recently. Total loss is estimated at $200,000.

The Plumbago Syndicate, which took over the properties of the Dominion Graphite Company, at Buckingham, Que., is making shipments of flake graphite for crucibles.

The British Government has recently created a Belgian Trade Committee to examine the means to favor the development of trade between Great Britain and her Allies.

The Standard Molybdenite Company, Limited, is being organized with a capital of $150,000, to secure mining rights in Wright County, Que., with offices at 265 Queen Street, Ottawa.

A sum of £10,000 a year for five years has been set aside for the purposes of research, and education, by the directors of Tootal Broadhurst, Lee & Company, Limited, cotton spinners, Manchester, England.

The Dominion Steel Products Company of Brantford, Ont., has a contract for the heavy machinery for upwards of one hundred merchant ships now being constructed in ship yards throughout the United States. Extra land has been acquired to extend the plant, and to carry out this plan New York capitalists have formed a company called the American Steel Products Corporation, with a capital of $1,000,000. The officers are W. P. Kellett, president; D. O. Johnston, vice-president; treasurer, M. M. McGraw; secretary, P. H. Scord, all of Brantford.

From one ton (2,240 pounds) of each of the following substances there can be obtained commercially the number of Imperial gallons of 95 per cent. alcohol stated: maize, 80 to 83; wheat, 80 to 85; barley, 65 to 70; molasses, 65 to 70; sawdust (soft wood), 20; grapes, 18; potatoes, 16 to 24; beet, 12 to 16; grass tree, 12; apples and pears, 9 to 14; apricots and peaches, 9 to 13. The relative cost of alcohol produced from these materials has not been determined.

Recent Incorporations

Standard Molybdenite Company, Limited, Montreal, Que., $1,000,000.

Aluminum Ware Manufacture Company, Oakville, $100,000.

International Rubber Goods, Limited, Toronto, $40,000.

Alberta Lea Gas and Electric Light Company, Limited, Moose Jaw, $75,000.

Rockwood Oil and Gas Company, Limited, Toronto, Ont., $1,000,000.

Spruce Falls Pulp and Paper, Limited, Spruce Falls, Ont., $3,500,000.

Montreal, Que.—Canadian Union Iron Mines Corporation, Limited, $1,000,000. A. Savard, N. Terk, T. F. Lyon.

Montreal.—The Standard Molybdenite Company, Limited. $1,000,000. E. Ray, O. H. Letts, C. J. E. Charbonneau.

Montreal, Que. Union Iron Mines Corporation, Limited, $1,000,000. A. Savard, N. Tirk, T. F. Lyon.

Montreal.—The Standard Molybdenite Company, Limited, $1,000,000. E. Roy, O. H. Litts, C. J. E. Charbonneau.

Montreal.—Canadian Proprietory Corporation, Limited, $1,500,000.

Moyie, B.C.—Guindon Mining and Milling Company, Limited, $1,000,000.

Vancouver, B.C.—Simplex Smelter Company, Limited, $100,000.

Cobalt, Ont.—Kerr Lake Mines, Limited, $3,000,000; S. Lovell, W. Bain, R. Gowans.

Toronto, Ont.—Alloy Steel Works, Limited, $2,000,000; R. H. Parmenter, A. J. Thomson, S. D. Fowler,

Toronto.—Asquith Gold Mining Company, Limited, $2,000,000; G. A. Young, H. Young, E. Whitehead.

Toronto.—Cane Silver Mines, Limited, $1,500,000. H. J. Martin, T. N. Poole, A. D. Parker.

Toronto.—Consolidated Metals Corporation, Limited, $3,000,000. M. Macdonald. E. Smiley, D. I. Grant.

Toronto.—Dominion Kirkland Gold Mines, Limited, $2,000,000. A. G. Slaght, W. E. Wilson, K. L. Johnston.

Toronto.—Mingo Pulp, Paper and Land Company, Limited, $1,000,000. H. R. Armstrong, I. Hickey, G. L. Lee.

Recent Canadian Patents

Of Interest to the Chemical and Metallurgical Industries

The following patents have been recently granted in Canada:

No. 178,644. A process for making tartaric acids and their compounds. The Royal Baking Powder Company, New York.

No. 178,645. A process for making glyoxylic acid. Royal Baking Powder Company, New York.

No. 178,626.—An apparatus for ageing plastic articles. De Nard W. B. Young, Philadelphia, Pa.

No. 178,748.—A method of ageing plastic material. De Nard W. B. Young, Philadelphia, Pa.

No. 178,884.—A process of making ammonium nitrate. Hydro-elektrisk Kvaelstofaktieselskab, Kristiania, Norway.

No. 178,830.—An apparatus for cambering and quenching. Zenas B. Leonard, Cleveland, Ohio.

No. 178,871.—A Detonator. Canadian Explosives, Limited, Montreal, Que.

Nos. 178,891 and 178,892.—An apparatus for destructive distillation. The Seaman Waste Wood Chemical Company, New York.

No. 178,912.—A method of distilling liquid mixtures. Hilding Olaf Vidar Bergstrom, Stockholm, Sweden.

No. 178,851.—A process of distilling coal. Walter Thomas, Nanaimo, Vancouver Island, B.C.

No. 178,565.—The electrical treatment of liquids. Jacob E. Bloom, New York, N.Y.

No. 178,594.—A electrolytic apparatus. Jas. Thomas King, Toronto, Ont.

No. 178,572.—A method of making formaldehyde. George Calvert, London, England.

No. 178,977.—A furnace to effect reactions between one or more solid substances and one or more gaseous substances. Aktiebolaget Nitrogenium, Stockholm.

Nos. 178,805 and 178,806.—An electric furnace. John W. Brown, Lakewood, Ohio.

No. 178,927.—A process of refining metal in an electric arc furnace. Joseph Lawton Dixon, Detroit, Mich.

No. 178,624.—A process of metal extraction. John Martin Witmer, Lancaster, Pa.

No. 179,008.—A method of making peat fuel. Wetcarbonizing, Limited. Westminster, London, S.W.

No. 179,009.—A filter press. Henry R. Worthington, New York, N.Y.

The new sulphite plant of the Lincoln Paper Mills Company, at Merritton, Ont., giving a capacity to the mill of nearly forty tons of sulphite pulp, is now in operation.

Foreign Trade Enquiries

The names and addresses of the firms making these inquiries can be obtained only by those especially interested in the respective commodities upon application to "The Inquiries Branch, The Department of Trade and Commerce, Ottawa." In writing correspondents should quote the number of the enquiry. The initials, "B.T.C." indicate that the enquiry for the address should be directed to the British Trade Commissioner in Canada, 363 Beaver Hall Square, Montreal.

1374. An English house at Buenos Aires wishes to represent Canadian manufacturers of following lines: heavy chemicals, iron and steel and railway supplies.

1392. A Durban, Natal, firm of import merchants requests supply of chemicals, caustic soda, 89 .90 per cent., bicarbonate of soda, arsenic of soda, phosphoric acid powder, 42 per cent. soluble in water.

1405. A South African firm requests direct communication from manufacturers of carbide for acetylene lighting and oxy-acetylene welding and cutting work.

1415. A firm in St. John's, Newfoundland, would like to get in touch with Canadian dealers in veneers, inlays, compo and chemicals for dyes and stains.

1418. A metal merchant in Milan, Italy, with good references, desires to buy nickel (pure, in cubes, grains, etc.); also nickel salts, such as suphate of nickel, and cobalt metal and salts.

1437. A commission house in Boston, Mass., with connections in England wishes Canadian connections to supply the following: chemicals, bleach, glue, waste, clays, pulps, colors and compounds.

1451. A firm in Cape Town wishes catalogues and price lists of starch-making machinery, tartaric acid and grain alcohol machinery.

1456. A firm in Johannesburg wishes the agency for Canadian made carbons, dry cells, brushes and projector and bioscopic carbon.

1457. A firm in Transvaal is on the market for the following articles: creosote, tars, wax, glue, saffron, resin, oils, grease, anthracene, carbonate of soda and silicate of soda. Quotations are asked for.

A firm in England wishes to buy the following articles: cream of tartar substitutes, tannic acids, formaldehyde and pharmaceutical products. (B.T.C.)

A London, England, firm desires to appoint agents in Canada for the sale of its products—disinfectants, sulphur candles, etc. (B.T.C.)

Organized Knowledge and National Welfare

In the course of an address on the above topic, given before the Associated Engineering Societies of Worcester, Mass., Dr. P. G. Mitting pointed out that the research by which organized knowledge is increased will doubtless always be carried on chiefly by three distinct types of research organizations; research by the government in national laboratories; research by the universities in connection with the work of instruction and research by industrial laboratories in connection with the interests of manufacturing concerns. Aside from these three main classes of laboratories there will always be large, privately endowed research organizations, dealing with neglected fields of remote commercial interest, private industrial laboratories supported by consulting fees and co-operative testing laboratories, also self-sustaining.

National, industrial and university research follow three essentially different lines. There is considerable overlapping in the fields, it is true, but each is centered on a different kind of research. The proper function of national research is the solution of such problems as concern the nation as a whole, affect the general interests of all classes of individuals; it is the custodian of standards, it develops methods of precise measurements and investigations, it is trouble engineer for the solution of very difficult problems or the problems of producing units so small as not to be able to have their own research laboratories.

It is the proper guardian of the public health. It solves problems connected with contagious and vocational diseases.

It develops methods of making good roads, increasing the fertility of the soil and stocking waters with fish. National research is of all grades from that dealing with fundamental principles up to that relating merely to lessening the costs of production.

University research must always, in the very nature of things, be concerned chiefly with the advancement of the various sciences as such, and with the development of the fundamental principles of each science.

The best university instruction is along these lines and investigators and students in close touch with them will naturally have most new ideas in close connection with fundamental principles. University research is necessarily one of small jobs and the best minds and is without very much continuity. The advanced student is interested in a research just long enough to make it acceptable as a doctor's thesis. The instructor is too burdened with teaching to give more than a margin of time to research. Only a very small part of the university research is extended year after year covering a wide field. This is quite as it should be, the university looking after those fields of research of little commercial value, on the one hand, and not directly affecting the interests of the nation as a whole, on the other, but of fundamental and far-reaching importance to all.

Industrial research takes the middle ground and has already become a distinct profession. It is in close touch with practical commercial application, on the one hand, and with fundamental principles on the other.

Its proper field is anything between elimination of works troubles and the investigation of fundamental principles. The staff of the ideal industrial research laboratory is composed of experts of wide experience who can serve the manufacturing departments in a consulting capacity without sacrifice of time.

We may perhaps best summarize the preceding statements by describing the ideal research man and the ideal research laboratory.

Some writers have spoken of the investigator as a rare individual to be sifted out from educational institutions with great care for a particular line of work.

My personal opinion is that a large percentage of the men students are fitted for research work if properly started along the right line.

The investigator should have a mind at once fertile and well trained. His mind should be teeming with new ideas, but he should possess unerring judgment to reject those which are not logical or promising.

We are often asked what sort of preparation in physics would be best for men intending to take up research as a life work.

It has even been proposed to give courses in "Applied Physics" for benefit of those intending to take up industrial research. Our invariable reply is that the best preparation for a research man is a thorough grounding in the fundamental principles of his science: physics, chemistry or whatever it may be. If he has a thorough knowledge of fundamental principles it is safe to say that in any properly organized research laboratory with the proper leadership and companions, such a student will have many times as many useful ideas as he can himself possibly follow up with research. Hardly any one who has completed advanced work in a science can read, say an abstract journal, without thinking of many problems which he would like to investigate.

Fertility of mind is not so much an inborn quality of the mind itself as of the training and association which that mind has had.

Notes From New York

(From Our Own Correspondent)

NEW YORK, November 22nd, 1917.

One of the chief subjects of conversation here is the scarcity and high cost of foods, and in consequence in chemical circles problems related to foods are receiving a great deal of attention.

At a recent meeting of the American Chemical Society, held at the Chemists' Club the following topics were discussed:

Mr. H. A. Baker, of the American Car company, gave a paper on the canning industry from the point of view of food conservation. Mr. Baker told some very interesting things about the work of the National Canners' Laboratory. He showed how the amount of tin used in canning could be largely decreased, and also how many valuable by-products could be used. Mr. Baker is a graduate of the University of Toronto. Dr. David Wesson, of the Southern Cotton Oil Company, condemned the use of edible oils in soap, etc., wherever satisfactory non-edible substitutes can be found. He also pointed out how the Government was hindering economy by laws that tended to create a prejudice against many new food products which are perfectly good and healthy substitutes for more expensive fats. Dr. T. B. Wagner, of the Corn Products Refining Company, said that over 150,000,000 bushels of corn were now used annually in the production of corn products, and gave some interesting information about new developments in that industry.

One of the chemists from the laboratory of the Plant Chemistry Department at Washington, also spoke and other contributions were made by Messrs. L. P. Brown, J. T. Atkinson and McKeekan of the New York City Bureau of Foods and Drugs.

The meeting was preceded by an informal dinner and Dr. C. H. Herty, chairman of the New York Section, acted as chairman.

The growing scarcity of foods is having a great influence on the oil trade. Many oils previously little used for food purposes, and almost entirely used for manufacturing and technical purposes, are now to-day being dealt in as raw materials for food substances. This movement has been aided by the encouragement given to promoters of hydrogenation enterprises through the recent decision in the case between Procter & Gamble, and the Berlin Mills Company, wherein it was established that it was legal to hydrogenate oils for sale and produce lard-like substances as long as one particular private process was not used.

Furthermore, the Government, through bulletins and other means, has been breaking down the prejudices against these newer fats and encouraging the use of refined oils instead of lard and butter.

It is now hard to get coaocnut oil for soap-making, so much is being used in a refined condition as an edilble product.

Soya bean oil is in exactly the same position and many manufacturers are engaging in the refining of this article. The increased price which the highly refined product brings makes the refining profitable.

Preparations are being made to turn out corn oil on an even larger scale than has ever been done in the past. Two of the larger corn products concerns have been operating corn oil refining plants for quite a few years, and it is now expected that these plants will be enlarged and that other manufacturers will take up this line of work. Needless to say, the corn starch and the glucose will also play an important part in relieving the wheat flour and sugar shortages, respectively.

One of the largest and most efficient glass plants in the world is soon to commence operations at Glassboro, N.J. This is the plant of the Whitney Glass Company. The plant has cost over one million dollars to build and has taken almost a year for its construction. Modern labor-saving machinery, much of it specially designed for this plant, will take care of every stage of the processes and will reduce operating expense to a minimum.

By a recent ruling of the War Trade Board the following coal tar products cannot be shipped out of the United States without an export license. Most of these, however, can still be exported to Canada under the special license obtainable through the Customs Service. The following is the list:—acetanalid, aniline oil, aniline salt, amidoazobenzol, p-amidophenol, benzol, B-naphthol, phenol, (carbolic acid), monochlorbenzol, cresol, dinitrobenzol, dinitrochlorbenzol. dinitrophenol, dimethylaniline, diphenylamine, paranitroacetanilid, nitroanilin,e nitrobenzol, nitrophenol (paranitrophenol), nitrotoluol (para- and ortho-), nitroxylol, nitrocresol, nitronapthalene, p-nitrochlorbenzol, nitrosodimethylaniline, naphthalene, paranitraniline, tetranitroaniline, tetranitromethylaniline, tetranitroetyhlaniline, toluol, trinitrotoluol, toluidin (ortho- and para-), xylol, xylidene. A great many other chemicals and metals, such as potash salts, cobalt, copper, nickel, electrodes of graphite (such as are used in electrochemistry), mercury, tin, tungsten, phosphorus, etc., are also on the list.

The Germans have long been noted for their contributions to industrial chemistry. The following list of some of their more recent contributions to American chemical industry (selected from the New York Tribune, for Sunday, November 18th) may serve to keep us awake to the danger, if we cannot quite admire the zeal of the perpetrators:

May 12, 1915.—Anderson Chemical plant at Wallington, N.J., wrecked; three dead.

December 1, 1915.—Explosion in du Pont plant at Wilmington; thirty-one lives lost.

June 14, 1917.—Explosion in American Sugar Refinery, Brooklyn, N.Y. Injured, 100.

July 9, 1917.—Dye plant of Seydel Manufacturing Company, Jersey City, blown up with damage of $100,000.

August 24, 1917.—Explosion in du Pont plant, Brunswick, N.J., injuries to 100.

September 9, 1917.—Explosion in drying-room Frankford Arsenal, 3 killed, 23 injured.

November 5, 1917.—Three explosions in plant of American Aluminium Company, New Kensington, Pa. Five killed.

A regiment to be known as the "Gas and Flame" regiment is being recruited by the 30th Engineers. This unit will be sent to France almost immediately and will take charge of gas attacks and liquid fire attacks on the portion of the Front manned by American troops. Naturally, it will consist largely of technical men, and a special call is being circulated among chemists, chemical engineers, pipe fitters, men experienced in handling liquefied gases, plumbers, boiler makers, workers in explosives, etc. This work will require technical skill, courage and a taste for "desperate adventures" and American citizens possessing these requisites and desirous of serving should communicate with Col. A. A. Fries, Engineers, N.A., Commanding Officer of the 30th Engineers or else Major E. J. Atkisson, Corps of Engineers, Camp American University, Washington, D.C.

The Aluminium Company of America has added another to its collection of huge plants, the latest being situated at Badin, in North Carolina. The other metal manufacturing plants are at Niagara Falls, N.Y., Maryville, Tenn., Messina, N.Y., and Shawinigan Falls, Que. Besides these there is a bauxite refining plant at East St. Louis, Ill., which is often spoken of as an aluminium works, and a large new reduction works in building near Baltimore, Md.

The North Carolina plant gets its power from a huge development owned by the Tallassee Power Company. This development was started by a French syndicate, who abandoned operations at the outbreak of the war. The American company who took over the job were able to make use of very little of the construction done by the French people. Ninety-thousand horsepower are developed and there is further opportunity to develop over thirty thousand more.

The aluminium company has started a model town, which now has about 3,000 inhabitants, good schools, a theatre and other civic attractions. The climate is healthful, the scenery as fine as any in America, and food plentiful and varied.

This is only one of the mighty water powers of the Appalachian region of the South, which have long been awaiting attention. As others are developed, and with the location of the Government nitrogen plant in the South, it will not be surprising if that section of the United States soon becomes one of very great importance in the chemical industry.

F. M. TURNER, Jr.

Report of the Committee of the British Council for Scientific and Industrial Research

This is the second annual report of the Research Department, which, under all the disadvantages of the strain of war and the shortage of workers, is trying to provide a permanent basis for research in this country, and to co-operate with similar attempts in the Dominions.

The report indicates that there are three ways of organizing industrial research. The simplest is the case where a single firm can work out a problem and itself fully exploit the results. In most cases, however, problems of industrial research will concern many firms—sometimes many industries; they will require the expenditure of large sums of money and the co-operation of many workers for long periods of time. But if successful the result will be of immense value.

Most individual firms cannot undertake this long and costly process. Yet why should the State pay for the whole cost of winning new knowledge which will be valuable to business men? It is hoped that the way out of this dilemma will be found by the establishment of "trade research associations," to be constituted as needed for each industry or group of industries, on which are to be represented when possible capital, management, science, and labor, and which are to be aided out of the million grant to be administered by the Department for the express purpose of establishing such research associations. One association is just about to be constituted for the cotton industry, others are being brought into existence for the wool, flax, shale oil, and photographic industries.

There are also many cases where the problem is so complex or else so immediately concerns the consumer rather than the producer, that co-operation between manufacturing firms is not possible. This is obviously the case with fuel. Hence the establishment of the Fuel Research Board, which, under the direction of Sir George Beilby, will itself conduct research. So, too, with the problems of fire-resisting materials and the determination of standards and constants. All this is direct work for the whole community acting through its special organ of research.

The main lines of policy of the Deprtment are being slowly worked out. But it is also not neglecting immediately pressing problems. In glass, for instance, a great deal has been already done—three completely new kinds of optical glass have been discovered by Prof. Jackson. A research on light alloys (aluminium, zinc, copper) will be of the utmost importance for the future of aeronautics. A new hard porcelain from purely British materials has already been produced. Researches into the recovery of tin are expected to save the Cornish tin industry £30,000 ($150,000) a year. A large number of other researches are being aided or carried out by the Department.

At a considerable number of the universities researches, aided or initiated by the Department, are now going on. At the universities too the future research workers receive their training, and 36 (who would otherwise have drifted into immediately remunerative work) were aided by grants from the Department in 1916-17.

The report ends by noting the altered attitude of manufacturers and men of business towards the claims of research and education, and reiterates the conviction that a sure advance in industrial science can only be made when the field of work is adequately surveyed beforehand, and an organized plan of attack worked out.—Chemical News.

Rubber Tree Seed for Oil Production

A preliminary inquiry into the possibility of the commercial utilization of the seed of the rubber tree for oil production has been undertaken by the agricultural authorities of the Federated Malay States, according to the British Board of Trade Journal. From time to time suggestions have been made for the utilization for this purpose of the seeds of the cultivated Para rubber tree, as large quantities of the seed go to waste on the rubber plantations of the Middle East. Experiments have proved that not only is the oil extracted from the seed suitable for various purposes, but that the residue can be used for cattle food or as a fertilizer.

In his report on agriculture in the Federated Malay States the Director of Agriculture states that with the co-operation of a number of estate owners near Kuala Lampur, who supplied seed at the cost of collection and packing, shipments aggregating twenty-five tons were sent to Hull, England, where a firm of oil-seed crushers has undertaken to advise on the economic possibilities of the oil and as to the plant necessary for its extraction. It is not considered that it will be economically possible to ship seed to the United Kingdom to be crushed there, but that one of more crushing plants might be established in the Federated Malay States, and the oil would be shipped to the United Kingdom, the residue being marketed locally.

In order to test this proposition a motor has been ordered to complete the oil-crushing plant which was installed by the department prior to the war, and it is hoped to carry out some experimental crushings on a commercial scale in the course of the present year. Investigations as to the effect of prolonged storage on the oil content and acidity of the seed are also being made by the department.

Production of Potash in the United States

The United States Geological Survey gives the following summary of the production of potash, January to June 1, inclusive, 1917:

	Available Potash K_2O	Value at Point of Shipment
Natural salts or brines	7,749	$2,808,240
Alunite and dust from cement mills and blast furnaces	1,867	746,576
Kelp	2,143	1,348,095
Distillery slop, wool washings and miscellaneous industrial waste	2,153	876,714
Wood ashes	111	84,414
Total	14,023	$5,364,039

No production is reported from feldspar or other silicate rocks, but that from kelp was about 15 per cent. of the total, as in 1916.

The prices quoted range from $3.50 to $6.00 "a unit." A unit is 1 per cent. of potash (K_2O) in a ton of material as marketed, thus a product containing 25 per cent. K_2O would sell for $100 per ton if the market price were $4.00 per unit.

Clifton W. Sherman, of Hamilton, is an example of a chemist and metallurgist who has achieved success as an organizer and administrator. He was formerly in the employ of the Illinois Steel Company, and came to Canada four years ago. He organized the Dominion Steel Foundry Company at Hamilton and is now its president. His company is preparing to enlarge its business in the making of steel plates, bars, etc.

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Contributed Articles

Lieut.-Colonel Thos. C. Irving

The Canadian Casualty list of last month contains the name of Lieut.-Colonel Thos. C. Irving, son of Mr. T. C. Irving, the well known general manager of the Bradstreet Company, Toronto. Colonel Irving volunteered with the First Canadian Engineers at the outbreak of war, and got his first promotion in the work of laying out the military camp at Valcartier, Que., camp. He received the decoration of the D.S.O. and was then made a Lieut.-Colonel. Col. Irving was a member of the Canadian Society of Civil Engineers and devoted a good deal of study to metallurgy, being a promoter of the firm of the Moffat-Irving Steel Works, Ltd., of Toronto and Hamilton. Before joining the army he was also vice-president of R. W. Hunt & Company, chemical engineers and metallurgists, Montreal and Toronto.

Chemical and Metal Markets

The Quotations below represent average prices for the quantities indicated. Larger quantities may be obtained at lower figures.

Toronto, November 24, 1917

The chemical market has been quieter of late with comparatively few fluctuations in price, although the prices of some articles are steadily creeping up. Silver took a sensational rise and sold in New York for $1.16 per oz., the highest known in this generation, and declined as quickly as it went up. Evidently there are speculators in other items than food stuffs. Tin has gone up and tin chloride is now 48 cents per lb. Sulphur, lead and bluestone have all gone up.

Opium and its salts are very high. It is almost impossible to get morphia sulphate. Castor oil is a luxury as far as price is concerned and as an article of export from England to United States, is prohibited. Quinine is advancing due to large war orders. Potash salts are more difficult to get and are rising in price accordingly. Nitric acid remains firm, advancing ½ cent per lb. With cooler weather the price of bleaching powder is becoming firm, but as the United States will probably be needing lots of liquid chlorine, the price of bleach will no doubt advance as there will be less on the market. The United States Government has five hundred chemists on the problem, as chlorine is the base of all noxious gases used in warfare. They have also bought a lot of aqua ammonia and it has advanced considerably there, but is at its normal price in Canada, as it is a prohibited export. Lime (caustic soda) maintains its very strong position, owing to the rumored heavy purchases of the United States Government and to the fact that it is a prohibitive export from Great Britain.

All spraying materials will be higher this year than they have ever been. Quebracho, a new tanning material, sells for 4½ cents per lb. Chestnut extract powder is now 7½ cents per lb.

Inorganic Chemicals

Alum, lump ammonia	100 Lbs.	$7.00
Aluminium Sulphate, high grade, bags	100 Lbs.	3.00
Ammonium Carbonate	10 Lbs.	.40
Ammonium Chloride, Grey	Lb.	.15
Aqua Ammonia .880	Lb.	.8
Bleaching Powder, 35% drums	100 Lbs.	4 00
Borax, crystals	Lb.	.10
Boric Acid, powdered	Lb.	.16
Calcium Chloride, crystals fused	100 Lbs.	2.00—3.00
Caustic Soda, ground, Bbl	Lb.	.10
Chalk, light precipitated	Lb.	.07—.08
Cobalt Oxide, black	Lb.	2.10
Copper Sulphate (Blue Vitriol)	Lb.	.12—.14
Fuller's Earth, powdered	100 Lbs.	6.00
Hydrochloric Acid, carboys, 18°	Lb.	.3
Lead Acetate, white crystals	Lb.	.20
Lead Nitrate	Lb.	.30
Lithium Carbonate	Lb.	2.10
Magnesium Carbonate, B.P.	Lb.	.18
Morphia Sulphate	Oz.	22.50
Nitric Acid, 36° carboys	100 Lbs.	9.25
Phosphoric Acid, S.G. 1750	Lb.	1.00
Potassium Bichromate	Lb.	.60
Potassium Bromide	Lb.	2.25
Potassium Carbonate	Lb.	1.50
Potassium Chlorate, crystals	Lb.	.85
Potassium Hydroxide, sticks	Lb.	3.00
Potassium Iodide, bulk	Lb.	4.75
Potassium Nitrate	Lb.	.55
Potassium Permanganate, bulk	Lb.	6.00
Silver Nitrate	Oz.	1.00
Soda Ash bags	Lb.	.04
Sodium Acetate	Lb.	.40
Sodium Bicarbonate	100 Lbs.	4.00
Sodium Bromide	Lb.	.85
Sodium Bichromate	Lb.	.28
Sodium Cyanide, bulk, 98-99 per cent	Lb.	$ .50
Sodium Hyposulphite, bbls	100 Lbs.	3.00
Sodium Nitrate, crude	100 Lbs.	9.00
Sodium Silicate	100 Lbs.	3.00
Sodium Sulphate (Glauber's Salts)	100 Lbs.	1.50
Strontium Nitrate, com	Lb.	.55
Sulphur, ground	100 Lbs.	4.50
Sulphur, roll	100 Lbs.	5.00
Sulphuric Acid, 66°Be, carboys	100 Lbs.	3.00
Tin Chloride, crystals	Lb.	.48—.49
Zinc Oxide	Lb.	.18
Zinc Sulphate, com	Lb.	.6½

Organic Chemicals

Acetanilid, C.P	Lb.	70—1.00
Acetic Acid, 80 per cent pure	Lb.	.33
Acetic Acid, glacial, 99½% in carboys	Lb.	.45
Acetone	Lb.	.36—.43
Alcohol, methylated	Gal.	1.70
Alcohol, grain	Gal.	6.00
Alcohol, wood, 95 per cent., refined	Gal.	1.55
Asperin (acetyl salicylic acid)	Lb.	4.50
Benzoic Acid	Lb.	3.25—4.00
Carbolic Acid, white crystals	Lb.	.75—1.00
Carbon Bisulphide	Lb.	.15—.20
Chloroform, com	Lb.	1.25
Citric Acid, domestic, crystals	Lb.	1.00
Ether, 725	Lb.	.75
Glycerine	Lb.	.80
Oxalic Acid	Lb.	.55
Salicylic Acid	Lb.	1.80
Sodium Benzoate	Oz.	.25
Tannic Acid, commercial	Lb.	1.60
Tartaric Acid, crystals	Lb.	1.25

Metals

Aluminium	Lb.	.45—.50
Antimony	Lb.	.18—.20
Brass, yellow ingots	Lb.	.20
Cobalt	Lb.	2.25
Copper, casting	Lb.	.32
Copper, electrolytic	Lb.	.33
Iron, refined bars	Lb.	.04—.5¼
Lead	Lb.	.08—.10
Magnesium	Lb.	2.50
Mercury	Lb.	2.15
Nickel	Lb.	.48
Platinum, pure	Oz.	105.00
Silver	Oz.	1.00
Spelter	Lb.	.10—.11
Steel, sheet	Lb.	.08—.10
Tin	Lb.	.66—.75
Zinc, sheet	Lb.	.21

J. V. Dickson, who graduated in chemistry last year at the University of Toronto, and who has been for the past year doing special work for the Imperial Munitions Board at the South Behtlehem, Pa., steel works, has returned to Toronto and has been appointed assistant research chemist under Dr. Boswell, University of Toronto, who is in charge of a new organization formed this year and known as the School of Engineering research.

Index of Advertisements

SOCIETY OF CHEMICAL INDUSTRY

CANADIAN SECTION

Affiliated with the Society of Chemical Industry of Great Britain.

A Society organized for the promotion of Chemical Science and Industry in the Dominion of Canada. Meetings held fortnightly from October to April, inclusive.

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British Columbia Section:—J. A. DAWSON, 249 Hastings St., Vancouver, B.C.

TALKS *with our* FRIENDS

¶ When the Canadian Chemical Journal was projected the publishers were sanguine of its success because of the plain evidence of its need. Its actual reception by the chemical industries proved to be better than we anticipated. Owing to the increase of advertisers and subscribers the Journal has been enlarged three times in the first six months of its existence. It started with a paper of 32 pages besides the cover. It now has 48 pages besides cover.

¶ We have faith in the field of work; we have full conviction of the importance of the mission of the Journal; but we are conscious that without the spontaneous good will of friends from every province this faith would have had mountains of obstacles to overcome. For the early clearing away of these obstacles we return thanks and must not withold the credit and honor due to those friends who are the real inspiration of the progress the Journal has made.

Our contemporaries have been very generous towards us, as recently published extracts from leading Chemical and other Journals have shown. To these friendly notices we add the following from **The Chemical News,** of London, England, edited by Sir William Crookes:

The Canadian Chemical Journal has appeared at an opportune moment, and it is to be hoped that it will have a long and vigorous life, winning success and doing good. Millions are invested in the chemical industries in Canada, and an increasing number of the public are interested in scientific industries generally. It is estimated that Canada possesses 40 per cent. of the water power of the world, and the next few years should witness a great extension of chemical industries in the country, especially the electrolytic preparation of chemicals. From the articles in this copy of the new journal it may be foretold that it is going to have a useful career, and to render valuable assistance in putting a final stop to Germany's monopoly of chemicals and chemical products in the world's markets.

PERSONAL OPINIONS.

I consider this Journal ought to fill a long felt want in Canada and I am enclosing cheque for $2 subscription.

FRED. BARNES,
Chief Chemist,
Belgo-Canadian Pulp & Paper Co.

I am sure there is need for this magazine in Canada, and I am much pleased with the contents of the numbers received.

L. C. HARLOW,
Professor of Chemistry,
Agricultural College, Truro, N.S.

I think The Canadian Chemical Journal is a mighty good thing and I am strong for making it pro-Canadian.

G. E. WESTMAN,
Assistant Chemist,
Dépt. of Inland Revenue.

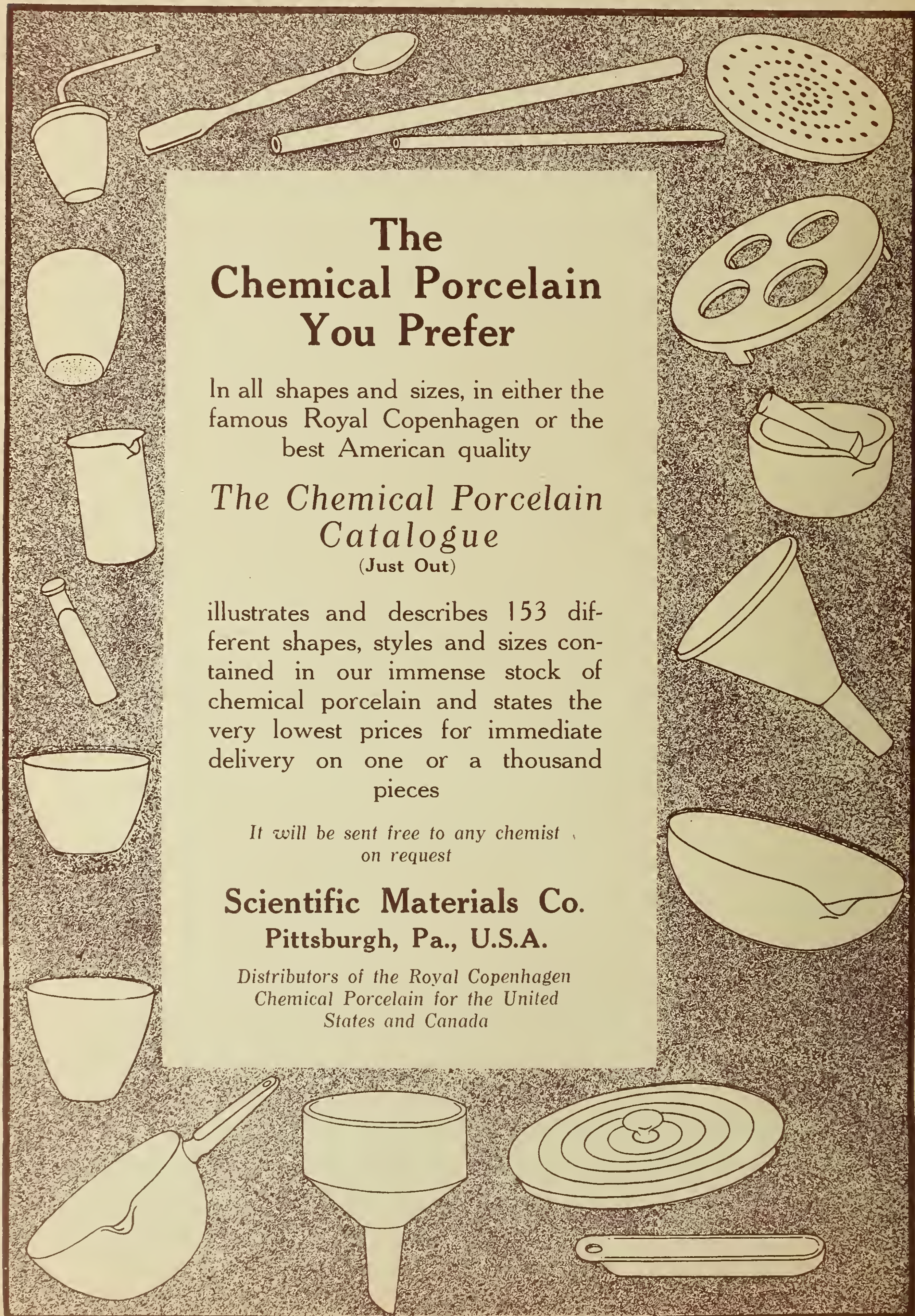
I did not think, at first, there was much scope for a new Journal, but now believe your publication will fill a need, and more particularly give Canadian Chemical Manufacturers a Journal in which to advertise.

L. F. GOODWIN,
Professor Industrial Chemistry,
Queen's University, Kingston.

I was very pleased with the "Sample Copy" of The Canadian Chemical Journal and find it full of information even to a student in chemical engineering. Please enroll me as a subscriber for one year commencing October.

CLIFTON D. PHILLIPS,
Clavet, Sask.

Classified Index of Advertisements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