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CANADA
DEPARTMENT OF MINES

HON. MARTIN BURRELL, *Minister* R. G. McCONNELL, *Deputy Minister*

MINES BRANCH

Recent Publications

Iron Ore Occurrences in Canada, Vol. II. Compiled by E. Lindeman, M.E., and L. L. Bolton, M.A., B.Sc. Introductory by A. H. A. Robinson, B.A.Sc.

The Copper Smelting Industry of Canada. Report on, by A. W. G. Wilson, Ph.D.

Building and Ornamental Stones of Canada (British Columbia). Vol. V., by W. A. Parks, Ph.D.

Peat, Lignite and Coal; their value as fuels for the production of gas and power in the by-product, recovery producer. Report on, by B F. Haanel, B.Sc.

Annual Mineral Production Reports, by J. McLeish, B.A.

The Coal-fields and Coal Industry of Eastern Canada, by F. W. Gray.

Occurrences and Testing of Foundry Moulding Sands. Bulletin No. 21, by L. H. Cole, B.Sc.

Analyses of Canadian Fuels. Parts I to V, by E. Stansfield, M.Sc., and J. H. H. Nicolls, M.Sc.

Clay Resources of Southern Saskatchewan, by N. B. Davis, M.A., B.Sc.

Summary Report of the Mines Branch, 1917.

The Mineral Springs of Canada. Part II., by R. T. Elworthy, B.Sc.

The Mines Branch maintains the following laboratories in which investigations are made with a view to assisting in the development of the general mining industries of Canada:—

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Applications for reports and particulars relative to having investigations made in the several laboratories should be addressed to **The Director, Mines Branch, Department of Mines, Ottawa.**

GEOLOGICAL SURVEY

Recent Publications

Summary Report. The annual Summary Report of the Geological Survey is now printed in parts. Applicants should therefore, state what particular geologist's report is required, or what subjects they are interested in.

Memoir 95. Onaping Map-Area, by W. H. Collins.

Memoir 98. Magnesite Deposits of Grenville District, Argenteuil County, Quebec, by M. E. Wilson.

Memoir. 101. Pleistocene and recent deposits in the vicinity of Ottawa, with a description of the soils, by W. A. Johnston.

Memoir 105. Amisk-Athapapuskow Lake district, by E. L. Bruce.

Memoir 106. Road materials in a portion of Vaudreuil county, Quebec, and along the St. Lawrence river from Quebec boundary to Cardinal, Ontario, by R. H. Picher.

Map 63A. Moncton Sheet, Westmoreland and Albert Counties, New Brunswick. Topography.

Map 132A. Southwestern portion of Rainy River district, Ontario. Soils.

Map 135A. Lower Churchill river, Manitoba. Geology.

Map 145A. Timiskaming county, Quebec. Geology.

Map 154A. Southwestern Yukon.

Map 157A. East Sooke, Vancouver Island, British Columbia Topography.

Map 165A. Windermere, Kooteney district, B.C. Topography.

Map 174A. Blairmore, Alberta. Topography.

Map 179A. Onaping; Sudbury and Timiskaming districts, Ont. Geology.

Map 183A. Harricanaw-Turgeon basin; Abitibi, Timiskaming and Pontiac, Que. Geology.

Maps 1697 and 1698. Explored routes in a belt traversed by the Canadian Northern Ontario railway,—in two sheets: Sheet 1 Gogama to Missonga, Sudbury district; Sheet 2 Oatland to Penhurst, Algoma district, Ontario.

Map 1690. Whiteburn Gold District, N.S. Geology.

Map 1702. Klotassin, Yukon Territory. Geology.

Map 1710. Bothwell-Thamesville oil region, Kent county, Ontario.

May 1712. Foothills of Southern Alberta, St. Mary river to Highwood river. Geology.

May 1714. The Niagara peninsula, Ontario. Geology.

May. 1715. The Ontario peninsula. Geology.

Applicants for publications not listed above should mention the precise area concerning which information is desired.

Maps published within recent years may be had, printed on linen, at the nominal cost of ten cents each.

The Geological Survey will, under certain limitations, give information and advice upon subjects relating to general and economic geology. Mineral and rock specimens, when accompanied by definite statements of localities, will be examined and their nature reported upon.

Communications should be addressed to **The Director, Geological Survey, Ottawa.**

THE CIRCO PAGE

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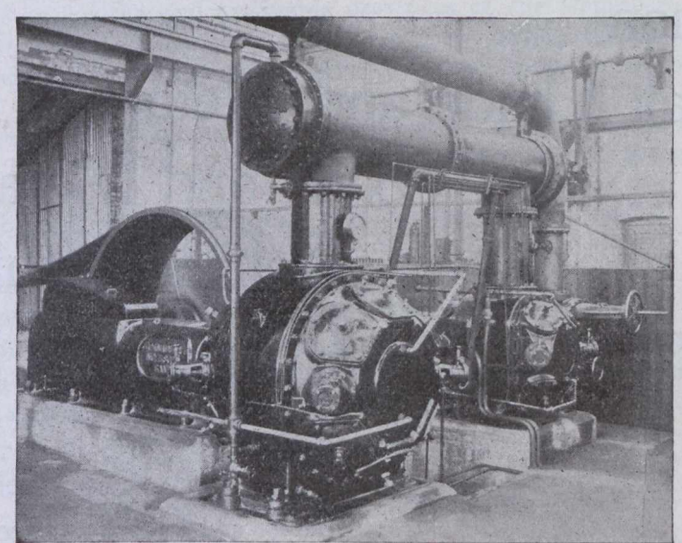

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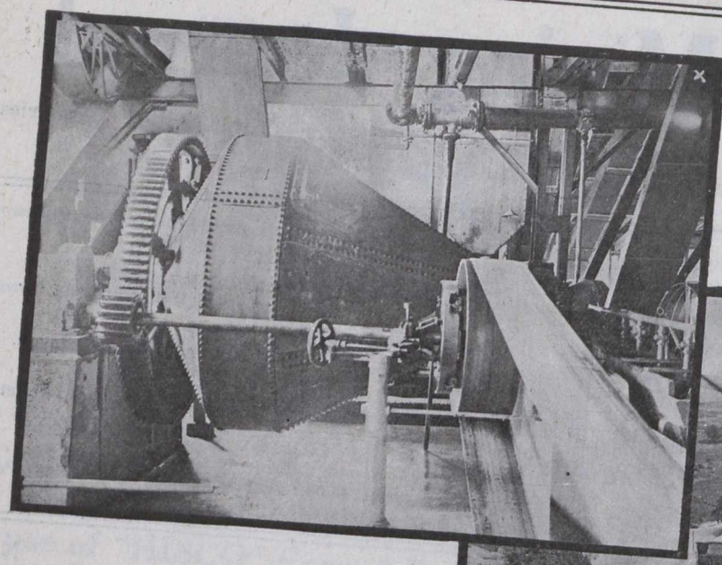
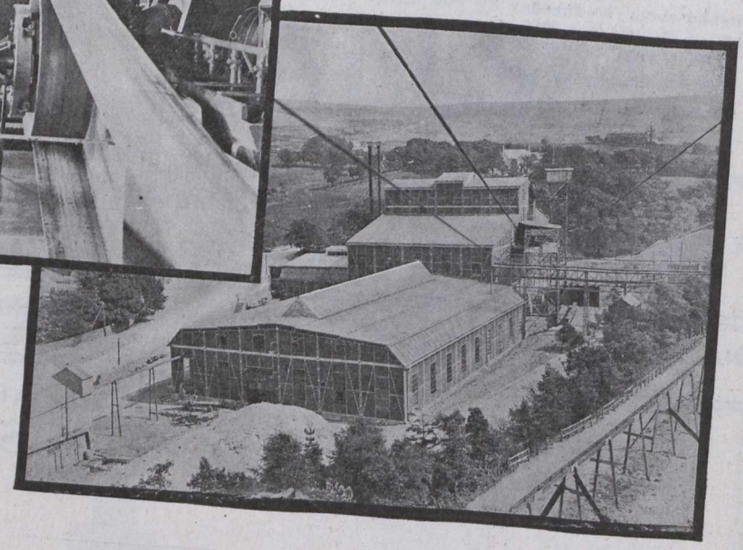
CONTENTS





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EDITORIAL

THE VINDICATION OF SELF-CONTAINED BREATHING-APPARATUS BY USE UNDER WAR CONDITIONS.

There has been a significant coincidence in the attention given at practically all annual meetings of mining societies held since the conclusion of fighting on the western front to the part played by tunnelling corps in sapping and mining operations, and the papers and discussions at these meetings, both on this side of the Atlantic and in Britain, have disclosed the great extent to which use was made of self-contained breathing-apparatus, chiefly of the oxygen cylinder type, and the reliability shown by these devices under the strenuous conditions of war service.

We reproduce in this issue a paper read before a recent meeting of the Western Branch of the Canadian Mining Institute, which deals largely with the standard-type "Gibbs" apparatus which has been developed under the supervision of the United States Bureau of Mines. It is interesting to know that a composite apparatus of similar excellence is a likelihood of the near future in Great Britain.

Speaking to a discussion on Colonel Dale Logan's paper on "The difficulties and dangers of mine-rescue work on the Western Front, and mining operations carried out by men wearing rescue-apparatus" at the Annual Meeting of the Institution of Mining Engineers in London, Sir W. E. Garforth referred to experimental work which had been carried on in England, and forecasted that in another twelve months, with the help of the Home Office Committe, which he believed was quietly doing valuable work, he thought we should have the apparatus which many had been looking forward to for the last thirty or forty years.

On a number of occasions the "Journal" has advocated that some central governmental authority should undertake to do what is now apparently near completion, namely to devise a breathing-apparatus which should avoid the disclosed dangers of the existing types, and should combine the admitted excellences of these types. The British Home Office, when it enforced the compulsory provision of rescue-apparatus at collieries, became morally responsible for the provision of an approved type of apparatus, and we presume that, but for the interruption of the war, some effort of this kind would have been undertaken ere now. When the war had commenced it speedily became aparent that oxygen breathing aparatus would be used on a scale and under conditions of test that would yield far more important experimental results than could be obtained in many generations of peace-time research, and it would appear as if those who had anticipated interesting and valuable disclosures regarding the war-time evolation of self-contained breathing-apparatus are not to be disappointed.

One other important result of the work of the tunnelling corps is the number of trained and resourceful wearers of breathing-apparatus that will return to employment in mining.

One opinion of Colonel Logan will be agreed in by all who have in any way to do with mine rescue-work. This gallant officer said: "We never found a man refuse to go down, but some of the men were quite incapable of carrying on the work of rescue. The ruthless exclusion of men physically or temperamently unfitted for the work was necessary." The specialised nature of mine rescue-work, and the unsuitability of untrained men, combined with a proper sense of the limitations of breathing aparatus, are first considerations, and in their neglect is to be found the foundation of most of the bad things that have been said about the use of these devices.

PRESIDENTIAL ADDRESS, INSTITUTION OF MINING & METALLURGY.

We reproduce in this issue the full text of an address given before the Institution of Mining & Metallurgy in London by Hugh K. Picard. The comprehensive survey of recent metallurgical progress which provides the subject of Mr. Picard's remarks shows how extensive and specialised a science the recovery and refining of metals has become. Mr. Picard's address touches chiefly on the metallurgy of zinc, lead, silver, copper and gold. The references to the metallurgy of iron and steel are few, notwithstanding the great financial importance of this industry and the prominent part it plays in the literature of technical societies, and we believe the wide range of metallurgical subjects reviewed, with scarcely a mention of the technique of underground mining operations, is a fair indication of the importance of modern metallurgy, and of the wisdom of recognizing the fact by including metallurgists by name in the titles of mining societies. The average mining engineer canot hope to become a metallurgical specialist, nor is it required of a metallurgist that he should acquire all the mysteries of the miner's art as practised underground.

We believe the change of the name of the American Institute of Mining & Metallurgy was an overdue recognition of the growing importance of the metallurgist, and, if the Canadian Mining Institute should decide to also change its name so as to more adequately express

the composition of its membership, the decision of the members will be as time goes on recognized as a just and proper one.

CORRESPONDENCE.

Kirkland Lake, Ont.
July 14, 1919.

The Editor,
The "Northern Miner."
Dear Sir,—

A lengthy and entirely misleading statement has recently appeared in the press purporting to put forward the miner's side of the Kirkland Lake strike, and as the actual facts have never been published, I am directed to lay these before you and correct some of the erroneous statements referred to in the public interest. Many hard working and contented men earning good wages have been victimized by the tyrrany of the local union and are suffering in common with the whole mining industry on this new and promising gold field; it is no doubt in an endeavour to placate these victims who are showing signs of active opposition to the extreme agitators who engineered this ill-starred strike.

The statement referred to says in effect:—

(1) That the state of unrest was caused by the increased cost of living—the fact is that the vast majority of the men were boarded and housed for $1.00 per day by the Companies regardless of the cost of commodities; and Union officials specifically stated that "Recognition of the Union" was the real bone of contention. Wages, so far as remaining stationary as alleged, showed a continuous rising tendency.

(2) That the District Union endorsed the wage scale demanded by the Local Union. Did the District Union, however, endorse the demand for Saturday afternoon holidays with full pay; the discharge of all non-union men; $135.00 a month and room and board for cooks; and the other demands of which no mention is made?

(3) That the recent meeting was unanimous to go back to work—(if and when it can be provided, it should have added)—pending the award of a Board of Conciliation, and expressed its willingness to abide by the decision of the Board—This meeting was a frame-up as the result of a meeting held just beforehand in the Union Hall. The proviso is carefully suppressed, "That the decision of such a Board must however be unanimous," or in other words in agreement with the Union nominee on the Board; in fact a pure farce..

(4) That the men are taking a firm stand not to accept anything but the wages demanded by them—If this is true it is no wonder that they made the proviso (suppressed), in the previous paragraph, but the fact is that numbers of men would gladly go back to work if there was any going; meanwhile many are working on the road at much less than they earned at the mines.

(5) That the men are always willing to negotiate—their whole statement shows that the Mine Managers have always been perfectly willing to negotiate too with their own men collectively. The manager will not, however, negotiate with a Union which is definitely proved to have Bolshevik influence back of it.

(6) That any mines working are doing so with the full sanction of the Union—this is wholly untrue, and we defy the Union to name any such mine in Kirkland Lake.

The simple facts are that this strike has been brought about by a number of men, many of whom are notorious agitators and draft-evaders, by the preaching of rank treason, rebellion, revolution, and sedition and terrorism of the most pernicious kind, which prevents men who want to earn decent livings from doing so. Some samples of the printed literature posted up in a mine building will give some idea though a very slender one, of what kind of poison has been at work—"The New Morality" says, "Damn interest, Damn rent, Damn profits, Damn agreements.

"We've damned well enough to do to look after ourselves and families.

"The power must be taken out of the policeman's club.

"How? Anyhow.

"Why? Because it hurts our class and is therefore immoral.

"The guns mustn't point our way if they aren't spiked, because they are liable to go off and hurt us, and that would be immoral. So we must spike the guns or turn them around.

"Strike when the boss has a big order which he must fulfil. It will hurt him more and us less, and that is moral. Tie up the industries in town, all the industries in all the towns, in the whole country, or in the whole world if necessary."

Bolshevik influence is at the head of the local Union, and we defy the Union to deny it, that is a deliberate statement and we hold the proof. It has proved that it is uncontrolled by the Headquarters of the Union by its action in calling this admittedly illegal strike which has entailed heavy loss on the whole community, and the mines will certainly not attempt to restart operations until the issue has been disposed of as to whether Bolshevism or decently organized and controlled labor is to hold sway in the field.

Yours truly,
KIRKLAND LAKE MINE MANAGERS ASSOCIATION.
J. E. Grant, Secretary.

HIS MAJESTY THE MINER.

How is his majesty, the coal miner, this morning? Most fervently do we hope that he slept well and awakened kindly disposed towards his humble subjects, the people of the Commonwealth. To him we make obeisance, and express the hope that he spent an enjoyable week-end — that he had a good day at the races, that he was lucky at his fishing, his cards, and his love-making; that his vegetable garden flourished, that his fowls laid many eggs, and that the beer was good; in short, that he rejoiced in whatever he did. His majesty, the coal miner, has made his periodical toll upon his subjects, and we loyally, and resignedly, proceed to pay it at the behest of the Government through which his majesty rules the people. We, therefore, trust that his majesty is now in a contented frame of mind, that he shows no signs of unrest, lest he should make a further toll upon his subjects. His well-being is of so much importance that everything we can do to promote it will be done right willingly.—The "Australasian" by way of Rossland "Saturday Night Miner."

Development and Improvement of Breathing Apparatus

By H. H. SANDERSON.

(Read before Western Branch, C. M. Inst., Nanaimo, June 4th and 5th, 1919.)*

Self-contained breathing-apparatus, more often called, "rescue-apparatus," is designed for the purpose of saving live and property when endangered by fire, smoke, fire damp or other poisonous gases, either above or below ground. The portable apparatus is one which enables the wearer to penetrate the irrespirable gases without being supplied with air from any outside source. It is therefore essential that such apparatus should provide the wearer in these circumstances, with good air, by continuously rendering the exhaled air fit for reinhalation, that is to say, it must be provided with means for renewing the consumed oxygen in a continuous manner and in sufficient amount, besides making harmless the carbon-dioxide produced in the lungs. At the same time the apparatus must not form a hindrance in the performance of work.

Breathing-apparatus of the self-contained type was first introduced into the United States in 1907, following which the Proto, Draeger and Westfalia apparatus were installed at various mines and plants throughout the United States and Canada. The Proto apparatus was manufactured in England, while the latter types came from Germany. Little change has been made in the Proto apparatus up to the present time, although several more or less important improvements have been made on the Draeger. The Westfalia did not meet with great success, and the sale of this type was soon abandoned.

Importation of these types of apparatus continued until 1914, when it became necessary for the American representatives to manufacture for themselves. Considerable difficulty was experienced in this work for some time. Investigations conducted by the United States Bureau of Mines demonstrated very forcibly that there was considerable room for improvement in the various types of European made apparatus, and the work was commenced by the various engineers, physiologists and chemists of the Bureau of Mines for the development of an improved type of oxygen breathing-apparatus which will be referred to later in this paper.

Before taking up the question of improvements on the various types of apparatus let us look for a few minutes at the principal defects in the three types previously mentioned. In January, 1917, the United States Bureau of Mines published Technical Paper No. 82, written by Yandell Henderson and James W. Paul. The purpose of this publication, or report, was to supply information regarding the relative merits and defects of the various types of apparatus then in use. With this in mind I trust that I may be pardoned if I quote from this report, for I feel that after the thorough investigation which these men made, no one is better qualified to present this matter to the public, and so in pointing out the limitations of the apparatus in use in 1917, I will use their report.

*Reprinted from the Canadian Mining Institute Bulletin for July, 1919.

In developing self-contained breathing-apparatus the real problem is not only to make an efficient and reliable device, but also to fit it to the peculiar and varying needs of the wearer. It is important if a man is to wear breathing-apparatus for even a few minutes, and essential if he is to depend on it to keep him alive for several hours, and do also considerable work, that the condition in his lungs should be essentially similar to those when breathing normal air. The apparatus must adjust itself to the respiratory needs of the wearer, and also to wide variations in these needs. Until recently, however, the wearer has been expected to adjust his breathing to the apparatus. To forget, or fail to do this even for a few minutes, might cause his death.

One of the principal defects of former types of rescue apparatus as usually arranged, was that the oxygen supply was set at a fixed amount per minute, and that this amount, although more than sufficient to cover the requirements of the wearer while resting, was quite insufficient to allow him to make vigorous physical exertion.

Oxygen is often spoken of as a food. In one sense this is correct, but the demand for oxygen differs from the demand for food in the fact that the supply of oxygen must be continuous. A man may go without eating for several days, and still be able to do considerable work. After being properly fed he may be none the worse for his experience. Conditions as regards the oxygen supply are far more peremptory. The amount that the body uses in any one minute it needs and must have within that minute, or at least during the next succeeding minute. Even a slight deficiency in oxygen impairs intelligence and judgment, and produces almost immediately a condition of intoxication or delirium, rendering the subject incapable of intelligent action and paralyzing the muscles so that he cannot stand or walk. If this deficiency is continued for even a few minutes serious and often permanent injury to the nervous system (or even death) results. These considerations have not heretofore been adequately taken into account.

This insidious effect of breathing air deficient in oxygen cannot be over-emphasized. The symptoms are in practically all respects identical to those of breathing carbon-monoxide, and in some respects resemble those of alcoholic intoxication. The peculiar danger in breathing such air lies in the fact that discretion and judgment are quickly impaired. Moreover, in many individuals, perhaps in most men, the breathing is at first so little affected that the man remains unwarned of his danger until his legs give way and he falls helpless.

Secondly in importance to a sufficient supply of oxygen is an efficient arrangement for absorbing from the air in the apparatus the carbon-dioxide that the wearer produces. One of the most important facts demonstrated by recent advances in physiology is that in normal men and animals, under ordinary conditions, the amount of breathing is principally regulated, not

by the oxygen consumption, but by the carbon-dioxide produced. For this reason it appears improbable that any apparatus for use in poisonous gases can ever be devised for use for more than a few minutes at a time with which the wearer will not do any rebreathing whatever. It is especially important, therefore, that the alkali should be so arranged as to absorb as completely as possible the carbon dioxide-exhaled by the subject into the bags before he again inspires the air.

In the former types of Draeger and in the Westfalia apparatus the expired air was drawn through the absorber and into the inspiratory bag by means of an injector through which the oxygen enters the circulation system. Natural circulation, that is, movement of air produced by the subject's breathing, as in the Fluess-Proto apparatus—is to be preferred to automatic circulation induced by an injector. One particular advantage of natural circulation is that if the wearer happens to become imprisoned in "bad air" he can make his oxygen supply last for many hours by turning off the fixed feed on the oxygen cylinder and using the by-pass at intervals to supply the relatively small oxygen consumption during rest hours. Otherwise the supply would run out at the end of two hours, and the man might lose his life. With apparatus of the automatic circulation type, such conservation of oxygen is impossible, for turning off the oxygen feed stops the absorption of carbon dioxide and makes the breathing much harder.

No subject in regard to rescue apparatus has been more debated than the use of the helmet. Many practical mining men insist that the helmet is advantageous in that it allows the wearer to speak more distinctly and to breathe through the nose, a more natural method of breathing than with the mouthpiece and nose clip. It necessitates the wearer's breathing into a "dead space" greater than the volume of an ordinary deep breath. The air that the wearer expires into this space he is obliged, in good part, to reinspire from it. The defects of the helmet are serious, but the greatest objection to its use is the danger of leakage. I am glad to say at this point that the officials of the British Columbia Government, realizing the inefficiency of the helmet, were among the first to install the mouth-breathing apparatus.

The importance of having all valves, tubing, and openings as large and as free from resistance as possible has not, until recently, been adequately appreciated either by the manufacturers or users of breathing apparatus. When one puts on any of the three types of apparatus previously mentioned, he finds that he can breathe quietly back and forth into the bags without noticable effort. Even if directed to breathe vigorously for a few seconds, most subjects declare that they feel no considerable resistance. If, however, the wearer is required to exert himself so vigorously as to induce heavy breathing, he finds a resistance so exceedingly annoying that it soon occupies his mind to the exclusion of everything else, and he is strongly tempted to tear off the apparatus.

Safety demands that when the water of an apparatus is surrounded by an atmosphere containing poisonous gasses there should be no leakage inward. With the injector type of apparatus it is particularly important that no negative pressure should occur at any point where the outside atmosphere may be drawn in. As formerly constructed the injector of the Draeger drew air through the absorber. In case the absorber or the tube leading to it was cracked, poisonous gasses could enter. A life has been lost in this way. This defect has been to a considerable extent remedied by so placing the injector of the Draeger apparatus that the air is forced through the absorber under a slight positive pressure. In any arrangement of this sort, however, there must always be a greater or less area of negative pressure on the side from which the injector draws. This is an additional reason for abolishing the artificial circulation and giving up the injector entirely. A natural circulation depending upon the respiratory movements of the wearer is altogether preferable.

It is an advantage to have a slight positive pressure in the apparatus, although it must of course not be of such amount as to impede the wearer's expiration — above 0.5 centimeter, or at most 1.0 centimeter, water gage. Even the best constructed apparatus is liable to leak slightly, and all leaks should be outward instead of inward. One of the principal reasons for recommending a greater supply of oxygen in the apparatus of the fixed-feed type is the fact that there will then be a continual slight leakage outward of the excess. On the other hand, when the supply is insufficient, and the breathing bags are sucked flat at each breath, the negative pressure so produced may draw in the surrounding poisonous atmosphere.

As regards joints and connections of these three types of apparatus, the Fluess excels both the Draeger and Westfalia. The many joints on the Draeger apparatus require careful inspection to insure their being made fast. Screws having a cross arm for turning admit of making the joint reasonably tight, but thumbscrews with a circular milled head are not so reliable, as a heavy glancing blow will often loosen them. Such screws have frequently been found loose both in training and in actual rescue work. In many instances loosening has been due to the metal part of the tube not having a locked seat so that a slight movement of the metal part has worked the screw loose.

The reducing valves of the former types of apparatus also were frequently a cause of trouble, as a result often of the deterioration of the rubber diaphragm. One of the most serious difficulties in the way of devising and constructing a reliable mine rescue apparatus is the necessity of using rubber. So called pure gum rubber remains soft and elastic in Europe for months, but in the dry and brilliant climate in which most of the American mines are located it becomes stiff and brittle in as many weeks. It appears at present impossible to avoid entirely the use of rubber, but it is evident that the parts composed of rubber should be as few as possible.

Impelled largely by the observations made by Doctors Henderson and Paul, the Bureau of Mines undertook to develop a breathing apparatus that should embody the recommendations of these men, and consequently in 1914 W. E. Gibbs, a mechanical engineer of experience and skill especially suited to the task, started, with their assistance, to design what is now known as the Gibbs apparatus.

Two years later, during a period while Mr. Paul was not connected with the Bureau of Mines, and while he was affiliated with Mr. Clarence Hall, who had previously left the Bureau of Mines service, Mr. Paul took out the patents on the details of construction of an oxygen breathing-apparatus which is now known as the Paul Apparatus.

Both the Gibbs and Paul apparatus have now been perfected, and placed on the market. The machines

show considerable improvement over the former types. In the first place the former type of fixed-flow reducing-valve has been replaced by a feed which delivers the oxygen to the wearer as it is required. The efficiency of the regenerating cartridge has been greatly increased, and the circulation throughout the apparatus is maintained at a practically normal rate.

The use of the helmet has been discontinued in favor of the mouthpiece, which is a decided improvement over former types of mouthpieces in that the breathing is much easier and the saliva is readily disposed of.

The danger of negative pressure has been eliminated and the outlet openings on the reducing valve of the Gibbs apparatus have been considerably enlarged. There are no rubber parts in or around the valve to deteriorate. The number of working parts and connections have been reduced to a minimum, and the use of rubber has been cut to the very smallest possible amount. Simplicity means safety. The weight on the Gibbs apparatus has also been reduced to 35 pounds.

Through an act of Congress, approved February 25th, 1918, the Bureau of Mines set about to establish a schedule for the official test and approval of breathing-apparatus. This schedule, known as No. 13, was first published in March of this year, and the Bureau is now engaged, at their testing station in Pittsburgh, in testing apparatus for approval. According to this schedule, No. 13, all breathing-apparatus which passes their test and requirements will carry an approval plate marked as follows:—

"Permissable Mine Rescue Breathing Apparatus U. S. Bureau of Mines. Approval No. ——"

In conclusion, let me say that never in the history of breathing apparatus in this country have there been such marked improvements as in the last 18 months. This has been brought about principally by the work of the Bureau of Mines and also by the urgent call received from General Pershing for 500 sets of Gibbs Apparatus for service in France, the Gibbs having already been perfected by the Bureau.

It is hoped that the possibility of having approved apparatus on the market in the near future will do much to increase the confidence of mining men in the use of such equipment, and also to stimulate interest in the training of men to wear the apparatus when the occasion demands.

CASSEL CYANIDE TO INCORPORATE CANADIAN COMPANY.

J. A. McRAE.

Official information has just been received that the Cassel Cyanide Company, Ltd., of Glasgow, Scotland, has, on the recommendation of Mr. Neill, managing-director, decided to incorporate a subsidiary company in Ontario to be called "The Cassel Cyanide Company of Canada, Limited." Mr. Neill has just reached Scotland after having completed one of his periodical tours of Canada and Mexico and was so favorably impressed with the splendid mineral resources of Northern Ontario as well as with the opportunity that exists for industrial development throughout the Dominion, that he most strongly recommended his co-directors to give this country an especial amount of their business attention.

The object of incorporating a subsidiary Company in Canada is primarily to bring the parent organization into more direct touch with the requirements of Canadian mining interests, but the further outlook is along the lines of general metallurgical and allied industrial development. Three members of the Glasgow board will be on the directorate of the Canadian company. All are highly successful business men, each being a specialist in the section of the organization to which he has given a life-long study.

Mr. William Neill, the managing director of the Glasgow company, will discharge similar duties in Canada and will be more frequently on this side of the Atlantic than formerly. He has been associated with cyaniding since Mr. John S. McArthur, the original managing director of the Cassel Company invented and developed the cyanide process which has been of such inestimable benefit to the gold and silver mining industry.

Sir George Beilby is the inventor of the process for manufacturing cyanide which the Cassel Company adopted over twenty-seven years ago. During the war he patriotically devoted much of his energy toward developing methods of extracting oil from coal, so as to render the British navy less dependent on foreign countries for the fuelling of oil-burning high-speed naval vessels. In recognition of his many discoveries and of his scientific attainments he received, two years ago, the honor of knighthood. Sir George has devoted much of his spare time to the study of radium, especially in its metallurgical extraction and in its application to the treatment of diseases. He is president of the British Radium Institute.

Sir Edward Allen Brotherton, another director, is a chemical manufacturer and the private owner of many large acid plants in various parts of England. His specialty lies along the lines of saving waste by-products and turning them to profitable account. He has several times been Lord Mayor of Leeds, and, at the commencement of the war, raised and equipped the regiment of which he is honorary Colonel. He was created a baronet slightly more than six months ago.

One unique feature in the operating of the parent company as regards gold and silver mining has been the acquiring of interests in properties of potential merit and of helping mines which may be unable to reach the profit-earning basis for no other reason than that of lacking a treatment plant. Mr. W. E. Simpson, who joined the original Cassel Company nearly twenty-four years ago, has, during the past seven years, attended to this part of the company's affairs from the practical standpoint and has spent much of his time in examining properties and, where need be, of installing the necessary plants.

Canada welcomes the arrival of the organization and, for many reasons, especially in the interests of its own development, heartily wishes the Cassel Cyanide Company of Canada, Limited, every success. The service rendered in the time of war has not been forgotten—that service wherein the mines of Canada were supplied with cyanide requirements at a price lower than the average in any other of the British Dominions.

PERSONALS.

R. B. Watson, general manager of the Nipissing mine, left Tuesday evening on a trip to various points in the United States.

W. E. Simpson is now en route to Glasgow, on board ss. "Cassandra." Mr. Simpson expects to return to Canada later in the summer.

Homer L. Gibson, broker, of Toronto, is in the Porcupine district this week in connection with the development of the Clifton-Porcupine mine.

Presidential Address by Hugh K. Picard

INSTITUTION OF MINING AND METALLURGY, LONDON.

Introduction. In addressing you to-night I propose to follow the course taken by my predecessors in giving a brief survey of recent metallurgical progress, in so far as such has come within the purview of my particular character on matters affecting our industry. In normal times it would be a simpler task to follow and record such developments, but the War has imposed entirely new conditions which increase the difficulty of a review, such as secrecy (in order to prevent leakage of information to the Enemy), urgency (wherein economics have been thrown to the winds in the materialization of a desired military result), an entire re-grouping of the factors of chemical and metallurgical supply and demand, and, finally, the promise of revolutionary changes in regard to labor.

As to the first of these it is to be hoped that, as the necessity for secrecy no longer exists, many of the great advances in technical and metallurgical science evolved under the stimulus of war may now become known for the early benefit of our national industries.

Further, it is much to be desired that such industries as have sprung up in response to our urgent necessities (other than those concerned with the production of purely war material) will not only be retained by us, but will continue to develop to the advantage of the country and the nation. Certain of these have been re-created in an artificial atmosphere of State support or subsidy; several, with such assistance, having reached a stage of technical efficiency, it appears to be of vital importance that further encouragement should be afforded them for such periods as will secure their permanence or of their requiring a minimum of external support.

Tungsten. A typical example of this is the tungsten industry, about which so much has been made public. Even the non-technical reader is now familiar with the general facts regarding this metal, while a certain amount of information as to its production has also become known through the technical press. It will be sufficient for me to refer to Julius L. F. Vogel and A. F. MacLaren, whose able work resulted in the production of this essential metal—essential not only in war, when its supply was a vital necessity to the country, but also in time of peace. Its importance is well expressed by the American metallurgist, Colin Fink, who says: "It may some day be said that tungsten made democracy possible." Through the efforts of these metallurgists and their associates we are now independent of foreign supplies and, moreover, the quality of the British production is superior to that previously imported from Germany.

Flotation. In regard to recent metallurgical advance during the past few years it will probably be conceded that the practice of flotation has brought about greater progress in metallurgy than any other single invention. At the inception of the froth-flotation process in 1905, oils, such as oleic acid (then deemed to be insoluble), were used. As careful analysis showed the mineral so frothed to be intimately associated with the insoluble oil employed, the impression was gained that this had uniformly coated the particles which had been floated, and that the air bubbles had become attached to such oiled particles. As the amount of oils used was relatively minute, say 2 lb. to the ton of ore, while the aggregate surface of the particles oiled is enormous, calculation showed it to be questionable whether an oil could be distributed qua 'oil' in such extreme tenuity and still retain its original physical properties.

With the discovery, some four years later, that other and wholly-soluble frothing-agents were found equally and sometimes even more effacious, the conception that oil was primarily essential to frothing was necessarily modified, and the process became more widely known as that of 'froth-flotation.' With later discoveries as to the partial solubility of essential oils, of the beneficial effect of certain insoluble oils in 'stabilizing' the froths and of sub-aeration procedure, the elimination of any need for pulp-heating, or in many cases for acidification, together with the use of alkaline circuits, etc., modern flotation has made remarkable advances.

Broadly speaking, the essential conditions for effective flotation appear to be that the material to be floated must be capable of flocculation, while that not to be floated must be brought as nearly as possible to the reverse state. This is achieved by the addition to the ore-pulp of reagents which by adsorption or sorption at the surfaces of the various particles increase such differentiation. Acids, alkalis, and certain alkaline salts act in the direction of wetting the gangue by water more profoundly, producing a deflocculation effect, whereas the adsorption or sorption of a minute amount of an immiscible oil at the mineral surface renders this still less capable of being wetted by water, and thus stabilizes a mineral-coated bubble in water.

The water-soluble portion of an oil, or a water-soluble substance such as cresol, amyl-alcohol, etc., reduces the tension of water, and thus permits the latter to form an extended froth surface for occupation by the less water-wetted floatable mineral. Certain oils may thus pay a dual part in flotation. Variations in ore constitution — both physical and chemical in the nature of the water, in choice or limitation of reagent, and in local conditions generally—are so wide that each one will present a flotation of its own, requiring individual study. Where the factors are so varied flotation must in large degree remain an art, as well as a growing science. This condition, however, governs applied science generally, and metallurgical processes form no exception to the rule.

I understand that contributions to the more scientific aspects of flotation may be expected shortly, which will, no doubt, go far to elucidate the fundamental principles on which the process is based.

Since the outbreak of war flotation methods have been widely, indeed almost universally, adopted. During this period, the greatly extended use of this process in the United States is the most notable feature, and it is hardly too much to say that concentration practice has been revolutionized: in addition to the increased recoveries of mineral due to the ability of this method to deal effectively with slime, its adoption has led to a general simplication of concentration procedure, with a corresponding reduction of working cost.

In modern installations, such as that of the Inspiration Consolidated Copper Co., at Miami, Arizona, where the plant was specially designed for flotation, the current practice is to limit the units to the smallest number possible. At this mill the ore, first crushed by disc-crushers, is passed to tube-mills, working in closed circuits; the pulp is then immediately sent to flotation units with the consequent elimination of all intermediary steps in the concentration. The re-treatment of any middling products and the enrichment of the primary concentrates is also effected by flotation, resulting in a simple flow-sheet.

Froth-flotation has developed the use of settlers and vacuum-filters, which are now indispensable units in concentration plants adopting this process. The settlers are in some instances employed for the re-utilization of plant-water, and in others for the thickening of concentrate prior to vacuum-filtration; their usual size is from 30 to 50 ft. in diameter, but in some instances settlers of over 200 ft. in diameter are in use. The shallow 'tray' settler is also employed where the physical character of the ore permits; these consist of units 3 to 4 ft. in depth superimposed on a common shaft to economize space and secure increased capacity.

Similar progress has marked the evolution of the flotation-units themselves. In the Mineral Separation type, for example, the driving gears have in some instances run continuously for over three years. These units are self-regulating, the supply of reagents being automatic, so that in practice it is not uncommon to find one man per shift operating units dealing with between 3000 and 4000 tons of ore per 24 hours.

Everywhere the tendency is toward the elimination of hand-labor; thus, besides ore, the concentrate and tailing are handled by settlers and belt-conveyors, whereas the grouping of all units is designed with the object of reducing labor, space, and construction cost to a minimum. The result has been a reduction in cost which, in many instances, has rendered obsolete the best of the older gravity concentration systems.

Some comparative figures as to the advantages of flotation may be of interest. The total tonnage of ore treated by water concentration at the Anaconda plant from February 1902, to December 1915, was approximately 36,000,000 tons, carrying 1,250,000 tons of copper, of which the actual recovery was approximately 900,000 tons. In 1916, flotation was installed, from the results of which it is estimated that had it been used during the earlier period 175,000 additional tons of copper would have been saved, capable of realizing, less cost of treatment, a further profit of nearly £8,000,000. In 1913, when water or gravity concentration had attained perhaps its high-water mark of efficiency, the five largest disseminated copper mines in the United States produced approximately 162,000 tons of copper, but discarded about 83,000 tons in tailing, the average recovery of copper at these mines being about 66%; had flotation been employed it is now demonstrable that their increased recovery for that year alone would have exceeded £3,500,000. In its turn, however, flotation has introduced new smelting problems, mainly due to the fineness of the material to be handled; the International smelter, at Miami, which now represents the latest copper-smelting practice in America, has been specially designed to deal with this type of concentrate. Hand-labor here has also been practically superseded by mechanical appliances; specially designed cars handle the concentrate and facilitate loading and unloading, prior to its passage to the roasting-plant. The roasters are fired either by oil, or coal-dust, the latter having now proved the more economical; the Cottrell process here becomes a necessary adjunct, preventing dust losses with practical completeness. Again, progress in one department of metallurgy has imposed conditions which have led to improvement in another, thus the cost of smelting the fine concentrate, originally so difficult to handle, is now reduced to between 5 and 6 shillings [1.25 to $1.50] per ton of charge.

Though the theoretical principles underlying flotation are still unsolved, progress in this direction is being made and it is one of the most remarkable features of this process that its use has been so greatly extended while its full scientific basis is yet unestablished. Callow, whose contribution to the technique of the art deserves special mention, calculates that with four different oils, three oil-percentages, two pulp-densities, and two changes of temperature, the possible communtations are no less than 59,284. This gives some idea of the difficulty experienced in arriving at the effect of any given change of conditions, but in spite of this over 400 flotation plants have been installed on the North American continent alone.

Zinc. Passing to the metallurgy there has not been any marked improvement of first importance in smelting during recent years, though general advance in matters of detail may be recorded. The problem of the mechanical roasting of the ores cannot yet be considered as completely solved, especially for the more refractory type, such as Broken Hill concentrate, which forms so large a proportion of the world's supply of raw material. Though improvement has been effected in this direction, as exemplified by the Ridge and Spirlet furnaces, it is significant that in the latest zinc works to be erected in this country, the management have adopted the hand-rabbled Delplace furnace as being the type best suited to their requirements. These works, situated at Avonmouth, are being constructed by the National Smelting Co., and are designed for an ultimate output of 50,000 tons of zinc per anum. These when completed, with extensions of other existing works, should go far toward establishing the industry in this country on a much sounder basis that existed before the war. No effort is being spared to make the Avonmouth works thoroughly efficient and up-to-date. The general arrangement is well designed, and provision is made for future extensions. The pottery has a capacity of 45,000 retorts, and is arranged for convenient handling in and out; two hydraulic pot-presses are to be installed (one of which is already erected), which will supply the retorts for the 16 retort-furnaces contemplated. These are of modern gas-fired type, the retorts being arranged in four rows back-to-back. The air is pre-heated in regenerative chambers under the furnaces, and are protected from injury due to slag from broken pots by the interposition of a layer of chrome-iron ore between the regenerators and the retort-chamber. Five gas-producers are provided for each pair of furnaces, two being in regular use for each furnace, the fifth being a spare one which can be turned on to either furnace as may be required.

Though Delplace furnaces are being installed for roasting, the management is erecting one of special design, upon the results of which future additions will

depend. The former are of large type, having six muffle-hearths each with 18 sections, and should be capable of dealing with 20 tons of raw concentrate per day. Special care has been taken in the design to ensure easy renewal of the hearth as required.

The acid plant, of platinum "contact" type, was originally built by the Government, and has been used for the manufacture of sulphuric acid from Sicilian sulphur. With the necessary additions for cleaning the roaster gases from arsenic, etc., this plant will be available to deal with the sulphur di-oxide evolved from the 20 roasting-furnaces it is proposed to erect.

In view of the present high cost both of labor and material and the improved extraction now called for, much attention has lately been given to the question of treating retort-residues for their metallic contents, both as to still contained zinc, and other metals such as lead and silver, if present. It has been proposed to blow such residues on Wetherill grates, but this yields a mixed product of zinc oxide and lead sulphate and affords only an incomplete elimination of the silver. Other objections are the inferior quality of the product (due to a certain amount of fine grit being carried over with the fume), while if silver be present the blown fume acquires a pinkish tint, rendering it unsuitable for paint purposes; further, the silver, both in the fume and the ultimate residues is lost. In the absence of silver, a market exists for the zinc oxide-lead sulphate product, if free from grit and carrying about 20% of lead; such a mixture makes a paint of covering power superior to pure zinc-white, besides being cheaper. For ores of a less complex character, 'blowing' the residue offers fair possibilities, and it has even been proposed to modify the usual distilling practice in the direction of only recovering the more easily distilled portion of the zinc, calling for the employment of a smaller amount of reducing coal and leaving a richer zinc-residue for blowing. Such a procedure would increase the capacity of the distilling furnace and result in longer life of retorts, as they would not require to be submitted to the high final temperature necessary to drive off the last units of zinc.

Wet Processes for zinc extraction with the subsequent recovery of the metal by electrolysis have not become firmly established; Ashcroft's pioneer work in this direction will be remembered. The conditions necessary for success, notably roasting at a low temperature to avoid the formation of insoluble ferrite, and the subsequent perfect purification of the solution are now well understood, the latter condition being demanded by the necessity for keeping the deposited zinc in a passive state to prevent re-solution. As a necessary consequence electrolytic zinc will always be highly pure compared even with the re-distilled zinc producible from retorted metal. Much discussion has taken place as to the possibility of the electrolytic process displacing the older method; but it seems probable that for some years to come both processes will survive, and that local conditions with regard to nature of ore, power-cost and facilities, etc., will determine which method shall be adopted for any particular case. It may be said for the electrolytic process that it certainly permits the utilization of low-grade and complex zinc ores which could never be available to the retort process. As an example, the Consolidated Mining & Smelting Co. is treating ores by this method at Trail that assay as low as 20% zinc and carry 14% of lead. Further, combination dry-and-wet processes are likely to develop wherein the zinc oxide (and lead if present) are concentrated as a 'fume' for subsequent treatment by solution of the zinc followed by electrolysis. Such methods have the advantage of yielding a zinc solution requiring the minimum of purification, while leaving other metallic contents in a form recoverable by smelting.

At Anaconda, Laist has proceeded in a reverse direction, by first extracting roasted flotation concentrate with acid, electrolyzing the purified solution, and treating the residue by volatilization in a reverberatory furnace, the contained zinc being recovered as oxide. According to recently published information, Laist no longer recovers the zinc by volatilization, confining this operation to the saving of the lead, while the zinc passes into the slag. How far this is due to more perfect original extraction of the zinc in solution in the previous operation is not stated.

These developments are due in large degree to the work of American metallurgists, who have at their disposal large supplies of ores of varying character offering scope and opportunity for special methods of treatment. But in this country also zinc has been regularly produced by electrolysis from ores, though on a smaller scale; given, however, equal opportunity we may certainly claim to possess the necessary technical knowledge to compete with foreign producers.

The War brought about a large demand not only for the highly-pure electrolytic zinc of 99.95% grade, but also for metal of 99.9% purity obtainable by the redistillation of ordinary brands, and even of 'hard' spelter, which contains about 90-92 zincs, the remainder being mainly iron. The method chiefly adopted in this country was devised by Fricker, who distils the metal in vertical closed crucibles provided with connecting pipes leading into a brick condensing-chamber common to a number of pots, generally eight. The lead and other impurities are prevented from passing over with the zinc-vapor by covering the surface of the molten metal with a floating filter of crushed coke, or similar porous material. By this process large quantities of refined metal have been produced for cartridge-brass and other purposes. How far the demand for high-grade zinc will persist for ordinary commercial uses is uncertain. For most alloys containing a substantial percentage of zinc, as also for galvanizing, ordinary brands of spelter are sufficiently pure; hence consumers are not likely to pay the higher price demanded for 'purity' metal.* The latter will therefore have to compete with G.O.B., and producers may perhaps be forced to accept a price only greater in proportion to the higher unit of the purer product.

Zinc Oxide. Before leaving the subject of zinc metallurgy, reference may be made to the manufacture of zinc oxide in this country. Before the War practically the whole of our requirements were met from Continental and American sources; indeed, our secondary products were in some cases bought by German firms, exported to the Continent for treatment, and the zinc-oxide produce again sold to us. War conditions have since brought about the establishment of a domestic

*The galvanizer would prefer pure zinc if obtainable at a reasonable price, as a more durable product results from its use.

zinc-oxide industry; and, as in other cases, we now produce this material of a quality equal in all respects to that hitherto imported. Works capable of producing 50 tons or more per week are running regularly, and, given reasonable protection against unfair competition, there seems no reason why the whole of our requirements should not henceforward be met from domestic sources.

The oxide is manufactured by distillation of hard spelter, scrap, etc., with subsequent burning of the volatilized metal to oxide, which is collected in bag-house plant in the usual way. Technical details as to pipe arrangements, fan-capacities, etc., have been worked out, and the conditions necessary for the production of the highest quality product have been established. No doubt there will still be competition from American oxide, produced directly from ore, owing to the lower cost of the raw material employed. This oxide, though of inferior color, is suitable for many purposes, such as rubber filling; moreover, it possesses the advantage of high density. Oxide production from ores and residues though not yet established in this country is being investigated, and there is reason to anticipate that this may eventually prove successful.

In South Wales zinc-dust ("zinc blue") has recently been manufactured direct from metallic scrap and a product obtained which is far superior to that derived as a by-product from the retort process; the latter usually contains about 85% of active zinc, whereas the former carries not less than 95%. The demand for high-grade zinc-dust in the dyeing industry is large, and, owing to its superior reducing value, it should have a good outlet in gold-precipitation.

The prepared fume is screened in a flour-miller's bolting machine; owing to its granular character no difficulty is experienced in screening. The product though excessively fine is uniform in size of particle and free from dust; under the miscroscope each grain is seen as a brilliant metallic sphere. A word may be said as to the perfection of the bolting machine for screening fine powders; this has been developed to meet the stringent requirements of the corn-milling industry and if better known would no doubt find application in screening dry crushed ore.

A wider general knowledge of the practice of industries other than our own would, I believe, lead to the discovery of many appliances which could be adapted to our special needs. For example, the filter-press was well known to the potter before its value was recognized in ore treatment. He has, from our point of view, the worst possible type of clayey material to filter and in addition contamination by iron rust must be avoided; hence he adopts a press with wooden frames. We could perhaps reciprocate by introducing to him the vacuum-filter and pulp-thickeners.

Pottery. While on the subject of pottery an interesting application of gold may be referred to, though this perhaps comes rather within the province of chemical industry than metallurgy. It is not commonly recognized that the gold decoration of cheap pottery consumes a large amount of the metal in such a manner that it never returns to the market. The gold-line decoration on cheap cups and the 'solid' gold handles on cheap 'ornamental' vases is in fact gold of almost the highest degree of fineness employed in the arts. The compound as employed consists of an organic salt of gold in an oily medium, and as applied does not contain more than about 6-9% of metal. The desired decoration is painted on the otherwise finished ware, which is then heated to about 700°C., far below the melting-point of gold. Over 90% of the compound, consisting of the oils and medium, is thus burnt away, leaving the perfectly uniform coherent film of gold with which we are all familiar. The metallic components consist essentially of pure gold, but modified to the extent of about 1% with other metals, which brings about the brilliant metallic film; and it is interesting to remark that if absolutely pure gold be employed no such film would result, the effect being instead a dull earthy pink deposit. This affords another example of the influences of a small amount of a foreign metal on the mass, a feature so frequently met with in almost every branch of metallurgy. So coherent is the film, in spite of the loss of over 90% of the original compound, that it may be used as a satisfactory base for electro-deposition thereon of another metal, such as silver, for decoration or other purposes. Platinum behaves in a similar manner, and it is possible that for certain purposes porcelain dishes coated with gold or platinum by this means may be of service in the laboratory.

As another illustration of borrowing from other industries, the metallurgical furnace-builder may derive much assistance from the glass industry and *vice versa*. Oil-firing, now so commonly employed in smelting, is well known to the glass-maker, who may have experience in its use not generally known to the metallurgist. My object in the above remarks is to call attention to the advantages which must result from a freer interchange of knowledge and experience between our various industries. To this end one of our leading societies, the Society of Chemical Industry, has in normal times an annual program of visits to various works, giving members the opportunity of inspecting operations in which they are not directly interested.

Copper. For developments in the metallurgy of copper we naturally look to the United States. Thanks to the publicity given to progress in the States and to their excellent technical publications, we have been made familiar with recent advances and it thus becomes unnecessary to refer to them in detail. Among such, reverberatory practice (due to the ever-increasing amount of flotation concentrate to be smelted) may be mentioned. In this connection the increased throat-area, with correspondingly larger burners for oil or coal-dust firing resulting in largely increased output per furnace, should be noted. The El Paso 130-ft. furnaces burning oil have reached a daily capacity of over 960 tons with a consumption of 0.61 barrel of oil per ton. Leaching of oxidized copper ores by ammonia, so often suggested in the past, has come within the domain of practical metallurgy. For example, it is reported that the Calumet & Hecla Mining Co., in a plant treating 2,000 tons of tailing per day, is recovering copper at a total cost of 6.25 cents per pound, with a loss of only one pound of ammonia per ton of ore. Further developments have also taken place in acid-leaching plants in connection with which A. W. Halin's process deserves mention. He passes the acid solution through a number of ore-charges until the solution becomes neutral. It is then delivered to a tank containing fresh ore whereby the ferric iron is precipitated, whence, after acidification, the solution passes to the electrolyzing plant for precipitating the copper. The treatment of ore in heaps by leaching, following Rio Tinto practice, is also being extended in America.

In this country the industry cannot be said to be flourishing, though in spite of war conditions, and partly because of them, some notable achievements have been effected. One instance of overcoming a serious difficulty may be cited, as showing the adaptability and resourcefulness of our metallurgists. In this case the ores to be smelted demanded the addition of pyrite, hitherto imported from Spain. Owing to the requirements of the Governmnt for Spanish pyrite for acid-making this source of supply was cut off, threatening the closing down of the smelting operations. A new and hitherto neglected supply was, however, developed by the manager (one of our members) from the pyrite seams of the Welsh collieries, and it is satisfactory to record that this source now meets all the requirements of the works, not only for sulphur, but when calcined it is available as iron flux for smelting oxidized ores. The neglect to make use of this supply in the past is no doubt due to the reluctance of colliery proprietors to admit the existence of sulphur in their mines, as it might reflect on the quality of the coal. However, they now recognize that they have in pyrite an asset of value; moreover, it now pays to mine coal-seams rich in pyrite that hitherto have been left. The pyrite is recovered by hand-picking on belts. In the result the copper-works now secure ample supplies at a cost considerably below that previously paid for Spanish mineral; it is strange that this material has been overlooked by acid-makers in spite of the great demand created by the War.

As producers of copper we can, of course, never expect to compete with the United States, but, given a measure of State assistance, we ought to be in a position to secure for treatment a fair share of ores and matte from our own Dominions. For this purpose increased electrolytic refining capacity is certainly needed, but until some security for the industry be assured there is no inducement to capital to embark in such undertakings. The ever-growing demands of labor, with consequent increase in the price of raw materials, unless checked, must inevitably tend to drive the industry to countries where easier conditions prevail. The recent heavy fall in the price of the metal due to over-production, and the withdrawal of consumption for war purposes, calls for economy in every direction; it also points to the necessity for State action, failing which it is difficult to see how the industry can survive.

The Metallurgy of Gold, in so far as it relates to the recovery of the metal from its ores, shows general improvement, but nothing of first-rate importance except perhaps Crowe's method of precipitating cyanide solution under reduced pressure. He shows that the air dissolved in the solution, has, owing to the different co-efficients of absorption, a composition of 35% of oxygen and 65% of nitrogen, and consequently is a more active oxidizing agent than air of normal composition. He points out that in weak cyanide solutions, consequently with a minimum of hydrogen being generated, the oxidizing action of the dissolved oxygen largely neutralizes the reducing action and may even overcome it. In normal practice this is met by adding lump cyanide at the head of the precipitation box, with consequent increased consumption of both cyanide and zinc. By the adoption of the vacuum process this practice is unnecessary and extraction may be effected with weaker solutions resulting in savings in all departments, including the production of a purer bullion. The Portland Gold Mining Co. reports a saving of $30,000 per year in zinc and cyanide in a plant treating 2,000 tons of ore per day. It is interesting to note that G. T. Hansen claims similar advantages by heating the solutions to 170° F. before precipitation.

Concentration of gold ores by flotation is making progress, but the field for this process is somewhat restricted, owing to the general high efficiency of the older methods. At Cobalt, flotation has replaced gravity concentration, although at the Nipissing mine this process has been rejected, not on account of its inefficiency, but because of the difficulties in subsequent treatment of the concentrates. On complex gold-silver concentrate involving further treatment, the advantages of flotation compared with ordinary concentration followed by cyanide are not so manifest. The value of flotation as a means of increasing the world's output of gold lies rather in improved recovery of base metals, such as copper, with which gold is so commonly associated.

With reference to the production of gold, and more particularly to the question of a bounty, this is a matter for settlement between the economist and the producer. It is a subject upon which so many varying opinions have been expressed by authorities that it is difficult to arrive at any decided conclusion. So far as our own direct interests are concerned, a bounty on gold would be an obvious benefit, as we have many members engaged in this industry, though the objections to this course are also weighty.

A committee of the Council of the Institution appointed to report on the position of the gold output of the British Empire made an exhaustive inquiry into the subject, and issued their report in March, 1918. This shows that a reduction of 20 per cent of the Empire's gold production is visibly imminent, and this at a time when the need for gold is ever more pressing.* There can be no two opinions as to the vital importance of not only maintaining but also increasing our gold supplies, and with the object of effecting this the committee recommend a 10 per cent bounty on the output of all struggling mines or alternatively a bounty of two shillings (48c) per ton of ore treated. Proposals on these lines, however, were not acceptable to the Government Gold Production Committee.

It seems self-evident that unless relief in some form be granted, the production of gold must necessarily fall by the stoppage of the lower-grade mines; apart from the influence this would have on the general economic position, as to which opinions vary, a serious injury would be done to gold mining as an industry. Lord Inchcape's committee, however, is not disturbed by the prospective stoppage of these mines, and does not consider such an eventuality to be of any great importance to national interests† Although there may be objections or difficulties in the granting of a direct bounty it would not appear impossible to concede some remission of taxation, and to this extent relieve the industry

*The accuracy of this forecast is shown by a recent question in the House of Commons in which the Chancellor of the Exchequer was asked if he was aware that there had been a drop in the gold production of the British Empire of 13½% in the year 1918, compared with 1915, and that the world's production showed a drop of 20% in the same period. The figures given were not questioned.

†Since these words were written the Chancellor of the Exchequer has stated: "There is nothing in the report of Lord Inchcape's committee to suggest that producers of gold are not entitled to obtain for their produce the best price available in the most favorable market, and I am now considering in what manner this can be secured."

of some of its unfair burden. We already have a precedent for such action; children are considered to constitute a valuable asset to the State, and in principle, though to a very slight extent, taxation relief is granted to the producer. Why, therefore, should not similar action be taken in regard to gold?

Lead. In the metallurgy of lead, also, recent advances seem to be in detail rather than in fundamental improvements. In the stress of recent years there has been small opportunity of developing new processes in industries that are well established on recognized lines, such efforts being rather devoted to specialties called for by the War. Mention, however, may be made to progress in hydro-metallurgy, as applied to oxidized lead ores. This has been limited to brine treatment with or without the addition of sulphuric acid to carbonate and sulphate ores. This process has been tested in America as well as in North Wales, where a small plant was working until the difficulties of obtaining supplies caused a temporary cessation of operations. In this case the material to be treated consisted of an extensive dump of blende and lead sulphate slimes. Vanner concentration yields a mixed product of no value until further separated. This is effected by agitating the concentrates with hot saturated brine at 70°C., whereby the lead sulphate is completely dissolved, with, of course, the equivalent formation of sodium sulphate. The presence of this salt in growing proportions interferes with the solubility of the lead sulphate, and must therefore be removed by the addition of the equivalent amount of calcium chloride. The lead solution is filtered from the blende-calcium sulphate residues, and precipitated with slaked lime, reforming a portion of calcium chloride; about 50 per cent of the chloride is regenerated, the balance of the chlorine being precipitated with the lead as oxy-chloride. The blende-calcium sulphate residues are then re-treated on a vanner, which effects perfect separation of the easily removed flocculent sulphate, leaving a saleable blend concentrate. The chief objection to the process lies in the chloride present in the lead precipitate involving volatilization loss in smelting, but this may be overcome by precipitating the lead by electrolysis, using soluble iron anodes. This process is limited in its usefulness by the relatively small quantity of material available and by its inapplicability to silver or gold contents. It may, however, develop in the direction of the treatment of low-grade sulphide ores, after a sulphating or chloridizing roast at a temperature low enough to prevent the volatilization of the lead chloride.

In the province of general metallurgy the increasing use of the Cottrell process deserves special mention. As an example of painstaking research in developing a practical process from a long-known but unused scientific fact it has few equals. We have to go back to 1870 to the work of Dr. Tyndall for the first disclosure of the phenomenon on which the process is based. This was further examined by Frankland, Lord Rayleigh, and Oliver Lodge; but for the useful application of the principles involved, we had to wait for Dr. Cottrell. He first applied the method to depositing sulphuric acid mist produced in the contact process, and is still being used for this purpose. It is satisfactory to report that the merits of the invention have been recognized in this country, the first plant to be erected here in 1917 being at one of the Government acid-plants. It is also in use here for the precipitation of fumes from metallurgical works, following established practice in America; its further extension in this country seems certain. The advantages of the process are far-reaching; not only are valuable products recovered, but agriculture in the neighborhood of the operations is saved from serious damage. We are glad to congratulate Dr. Cottrell on receiving the Perkin medal as a recognition of his valuable services to industry.

The Metal Industry. In considering the position of the metal-producing industry before the war, one cannot but be struck with the apathy of the Government in regard to a matter of such vital importance to our security. It is true that as soon as the seriousness of the position was realized, energetic steps were taken to meet the situation. That within such a comparatively short time the difficulties were overcome is a striking tribute to the ability and energy of the technical men in this country. Industries were created and developed in a period of months which had been the subject of many year's growth on the part of foreign producers; not only were we able to produce articles equal to those obtained from abroad, but in many cases higher standards of purity and efficiency were achieved. The production of high-grade tungsten already referred to is an example of this, while in other directions the manufacture of magnetos and optical glass has reached a state of perfection unsurpassed by makers possessing prolonged experience.

These facts demonstrate that our position in pre-war days was in no sense brought about by lack of technical knowledge or skill, though it has been usual to refer to our inferiority in this direction, as well as to lack of initiative and energy, as being the true cause. The experience of the war shows this view to be unfounded, and that given reasonable facilities and the absence of official and fiscal discouragement we can, so far as technical knowledge is concerned, place ourselves in the front rank as producers of all essential materials. This charge having been proved to be baseless, it is clear that in order to maintain our position as producers some protective steps must be adopted; failing this, there is every reason to suppose that our new or revived industries will relapse into their pre-war inefficiency. It is reported, for instance, that efforts are being made to re-introduce foreign glass into this country, which if successful (unless effected under conditions which will protect our own manufacturers) cannot but tend to harm, if not to destroy, an industry which, under war conditions, has succeeded in re-establishing itself.

I am, of course, referring here only to such industries as were either non-existent or were in a struggling state, and this condition obtained largely in the production of certain essential metals. This possibility has been officially recognized, and committees have been formed to examine into the problems and make recommendations. Lord Balfour of Burleigh's committee on commercial and industrial policy after the war has made an exhaustive inquiry into the subjects covered by the Terms of Reference. A study of the committee's final report reveals the complexity of the subject. The departmental committee's report on the iron and steel trades ascribes the relatively stationary condition of this industry in part to deficiency of our iron-ore resources, but primarily to greater efficiency of German and American methods.

A point is made of the individualism of the British character which prevents the manufacturer from "pooling his brains and capital to the greater ultimate ad-

vantage of the industry." This would appear to be a just charge. It is well known that with few exceptions large amalgamations are not looked upon with favor in this country, where moreover every effort is made to maintain secrecy in regard to working processes and operations generally. I cannot say from personal knowledge how far this applies to the steel trades, but it is very evident in other metal-producing industries. I am satisfied that nothing but benefit would result from removing the restrictions to open discussion which persist in this country. We should do well to open our works to the visits of technical men interested in the subject, as this would inevitably result in the exchange of experience and information to mutual advantage. The present attitude is certainly not dictated by the technical managers, who as a body would welcome such an interchange of knowledge, but are excluded from this benefit by the action of their employers.

W. R. Ingalls, in his admirable presidential address before the Mining & Metallurgical Society of America this year, says on this subject: "One of the cardinal principles of American engineering during the last 20 years has been the exchange of information and the promotion of publicity about everything—technical processes, business relations, corporate affairs. We have seen America forge ahead largely owing to the absorption of this idea, while Great Britain lagged behind. . . . She is wide awake now."

It is to be hoped that the awakening referred to has indeed taken place. Apparently this secrecy is not confined to our own special branch of industry. C. F. Cross, in 1916, on the occasion of the presentation to him of the medal of the Society of Chemical Industry, said: "He was particularly aware of the difficulties which they had encountered, especially that of being between the crossfires of the commercial or financial man whose watchword was secrecy and the scientific man whose disinterestedness, perfectly natural and spontaneous, led him always to wish to publish in order that he might communicate what he had found in his laboratory to his fellow scientific men. . . They . . . were always most anxious to take counsel with their brother chemists, and give them the benefit of anything that had impressed them, just as they looked to hear of any new discovery by others at the earliest possible moment."

This condition is reflected in our own Transactions (and to a less extent in our technical journals), which contain but little information on important undertakings in this country. In analyzing the papers published in the last ten volumes of our Transactions, I find that 35.8 per cent deal with mining in foreign countries and our dominions and colonies. Foreign, etc., metallurgy supplies 17.3 per cent; assaying and analysis 15.0 per cent; general 27.7 per cent, whereas British mining in these islands is confined to a solitary paper, and British metallurgy to six papers, or 3.5 per cent of the whole. It is true that some of the general papers find application here, but the record can only be considered as unasatisfactory in that it fails to present in any adequate manner important operations which we know are being conducted. I hope these remarks may have some effect in removing the veil of secrecy which overshadows our undertakings.

Reverting to the committee's report, the Departmental Committee (iron and steel) favors combination both in production and in realization of produce, but is also of opinion that protection in some form is required to give security to industry. Other departmental committees report on similar lines, ten such being in favor of a tariff, while three (representing the cotton, jute, and building industries) report against. The main committee is by no means unanimous on the point, but it should not be beyond the capacity of the Government to reconcile the conflicting views, and decide on the course most advantageous to the country as a whole. It would be out of place and indeed superfluous to discuss the well-worn arguments for and against tariffs, though it would probably be found that the majority of the members have very definite views on the question.

Though the committee leans toward protection it expresses the fear that such might result in stereotyping inefficient methods, but in my view there is little ground to support this, I anticipate, on the other hand, that the feeling of security engendered by a suitable degree of protection would stimulate producers to adopt modern methods involving capital expenditure which under present conditions they decline to risk.

The committee is strongly of opinion that State control will be found detrimental to peace conditions, a conclusion with which most will agree, though recent action in regard to both coal mines and railways does not encourage the hope that this opinion will find favor. It is also eminently satisfactory that they agree with the resolution adopted by the Imperial War Conference as to the formation in London of the Imperial Mineral Resources Bureau. Much of the foundation work of the bureau has been accomplished, and there is good ground for anticipating that the hopes of its promoters will be realized.

It was my intention to discuss in some detail certain aspects of the problem of reconstruction in so far as our special interests are affected, but these have been so fully and carefully analyzed by W. R. Ingalls, in his address already referred to, that little remains to be said. I am in no sense detracting from the merits of his remarks when I say that he is addressing those who are already converted, but few have the knowledge and ability to put the case so succinctly and convincingly. It is earnestly to be hoped that it may come into the hands not only of Labor leaders, but of those in control of Government departments having relations with mining and metallurgical matters. Naturally he deals mainly with American affairs, but his arguments bear with equal force on conditions existing here. He makes reference to these, but in my view his opinions on our position are somewhat too sanguine. He will pardon me for giving one or two extracts. He quotes the view of an American visitor to this country, who says:

"England is knitting together for work. The directors of capital and organized labor were never more together. . . . England is studying efficiency and is preparing for overseas competition."

Mr. Ingalls himself says:

"We have seen how Great Britain practically lost important metallurgical industries . . . and we see her now keenly studying and introducing improvements that will . . . not unlikely put her ahead of us."

It will be admitted that there is some tendency in this direction, but the union and progress foreshadowed are still far from achievement. No doubt his reference to conditions in Europe are designed primarily to stimulate the efforts of his own countrymen. The ever-growing concessions of shorter hours at higher pay must be carefully watched in their effect if we are to

maintain our position against foreign competition. From this point of view it is almost a matter of satisfaction that similar claims are being put forward in America.

Mr. Ingalls in his masterly address shows the economic fallacy underlying such demands as have recently been pressed. I take the liberty of making two more quotations: the first, addressed to the American engineer, has equally forceful application to ourselves:

"First of all, what I see is that the engineer should saturate himself with sound economic doctrine. This is just as much the basis of his professional work as are the sciences of physics and chemistry."

The second will, I hope, reach the class to whom it aptly applies:

"The social reformer, who does not understand production, is a far less important person in the promotion of human welfare than the engineer who does."

The principles he lays down as to the general economic position apply with perhaps greater force to this country, since we are to so large an extent dependent on overseas countries for our supply of raw maerials.

It is beyond my capacity to forecast the future of metallurgy in this country. Our industry is suffering in common with many others from the lack of any clear indication of the fiscal policy of the future. The Minister of National Service and Reconstruction has certainly stated that all raw materials required for national industries would be admitted without restriction, but whether this applies only to the reconstruction period or is to be the final settled policy, seems uncertain. So far as his statement goes it indicates that ores, which are essentially raw materials, will be admitted freely, and to this extent the smelting industry would benefit; but if metal, such a spelter, which may be looked upon as raw material from the galvanizer's point of view, is also included in the list we may have a hard task to hold our own. In regard to this, however, there is ground for a hopeful outlook, as he also intimated that industries which it was essential to foster would receive a measure of protection in some form. I think it will be admitted the production of metal is among such industries.

Regarding the labor situation, we are, I think, justified in anticipating that the Industrial Conference will lead to greatly improved relations between Capital and Labor, though up to the present some of the more important groups have held aloof from the Conference. It is to be hoped that legislative effect will be given promptly to the proposals and that the National Industrial Council will be the means of promoting and maintaining industrial peace.

Though the future may be beset with difficulties it is not the time to take pessimistic views, but rather to use every effort to meet them and to accommodate ourselves to the new conditions brought about by the war. Shakespeare puts the following lines into the mouth of King Henry V when in a position of difficulty before Agincourt:

". . . . 'tis true we are in great danger;
The greater therefore should our courage be.

. . . . . .

There is some soul of goodness in things evil
Would men observingly distil it out.

It is in this spirit that we must go forward, striving if possible to extract the small essence of goodness which may, after all, be extractable from the vast slough left to the worl das a war legacy.

THE NORTHERN MANITOBA FIELD.

By R. C. WALLACE.

Prospecting is now general throughout the northern Manitoba belt and the prospectors have distributed themselves without partiality over a wide area. There has been a marked inclination to go further afield on the Hudson Bay Railway as far as the first crossing of the Nelson River and even further, a fact which in itself demonstrates that the railway is the incentive to development work and investigation of every kind in the north. The greatest interest, however, still centres around Athapapuskow Lake.

Since last fall there have been two discoveries on the western part of that area in the belt in which lie the Mandy and Flin Flon deposits at the North end of the North-East arm of Schist Lake.

The Davidson Copper Discovery.

A discovery was made by Pete Davidson of high grade chalcopyrite ore occurring in stringers at the surface but showing very promising indications of width at a depth of six feet. Prospecting is continuing at depth on this deposit in order to ascertain the extent of the ore body. The samples which have been brought down to The Pas show an intimate mixture of chalcopyrite and pyrite with values in copper considerably less than the best Mandy values, but undoubtedly sufficiently high to represent good profits provided the ore-body proves to be fairly large.

The discoverers of the Flin Flon property uncovered very high grade copper ore on the east side of the middle arm of Schist Lake and some few miles east of the Manx property. The values compare very favorably with the Mandy ore, but little development work has yet been done to ascertain the size of the body. Work continues on the chalcopyrite and pyrite showings in the epidotized greenstone on the East Arm of Athapapuskow Lake and thence eastwards through the first and second Cranberry Lakes to Copper Lake, where Peterson and Gordon are investigating a property which shows rather abundant galena in a quartz base and gives on assay good values in gold and silver.

Herb Lake.

In the original Herb Lake field development has been somewhat delayed by the inability of Makeever Bros. to operate the Rex mine under present conditions of labour and with the obligation for development which they are compelled to meet in their properties in Mexico. There is reasonable assurance, however, that the mine will be operated before the close of the summer and that the necessary underground development work will be first carried out to make it possible to feed the mill to capacity. There are other properties in the district which should not be held back because of this temporary delay in operation, and capital has been and is interested in the taking over of several of the best of the Herb Lake properties.

Prospecting is also going on on Wintering Lake, on the Pipe Lake belt, on the Burntwood River and at several points in the neighbourhood of the railway as far north as the Manitou Rapids. Samples that have recently come out from the railway belt show that there is scope for successful prospecting on more than one point in the neighbourhood of the railway, while the transportation facilities which are provided, form an additional incentive for prospecting in this district.

Flin Flon Negotiations.

Mr. Hammell has recently had a consultation with his partners in the Flin Flon property relative to the

basis of a deal which he hopes can now be negotiated with a very important mining corporation in the East. The declaration of peace and the steady and very satisfactory rise in the price of copper, which, there is every indication, will continue for some time, are factors which will assist Mr. Hammell greatly in negotiating a deal. The early operation of the Flin Flon property would be a factor of very great importance for the whole district, not only from the point of view of mining development, but in many other ways, and every assistance that can be given by both the Federal and Provincial Government will repay the authorities very handsomely in the increased actual wealth of the province and the country.

If it be found advisable to develop the power for the operation of the mine and district from the Churchill River, and if a narrow gauge light-railway system were maintained in operation (as it should be) after the power development and transmission line are completed, the famous Sturgeon fisheries of the Churchill River and the very valuable fisheries of Reindeer and South Indian Lake could be tapped and for the first time made accessible to the markets.

Transportation and Power.

The Dominion Government, through the C.N.R., has specifically promised to build a railway from The Pas to the smelter. The Provincial Government has recently passed an act enabling the Government to operate and transmit water power, and should undoubtedly assist, if the opportunity arises, by supplying the power necessary to operate both the property itself and the smaller mines which would require the use of power. In an undertaking of the magnitude that the operation of the Flin Flon demands, a share of the burden of the initial capital, in so far as that is possible, should be carried by the Governments concerned in the spheres, such as railways and water-powers, in which they are more directly concerned.

Display of Ore Samples.

A display of ore samples from the northern district was recently sent to the International Mining Convention at Nelson, B.C., where there were represented a very large number of collections from the Eastern British Columbia area and the Northern States. Arrangements were also made to have samples from the other Manitoba fields represented, but the unfortunate tie-up of the express service made it impossible to send samples to the Nelson Convention in time. For the Northern Manitoba collection, two first prizes were obtained and two special diplomas. No other collection obtained two first prizes and only very few special diplomas were awarded at the whole convention. To the Mandy ore came one of the first prizes and special diplomas. To the Northern Manitoba Mining Co. at Herb Lake, came the other first prize and special diploma. Other prizes were obtained for gold and nickel and there is no doubt that the convention was impressed with the fact that Manitoba stands no longer on its reputation as a wheat-producing province alone. Mr. H. MacLeod was in charge of the collection and reports that a great deal of interest was taken in the collection and that many who are interested will personally examine the field in the month of August. A paper by R. C. Wallace was read on "Mining Development in Northern Manitoba" and the local papers were supplied with material relative to the work in this area. One of the most fruitful methods of stimulating interest and development in all mining fields in the Province will undoubtedly be found in the display of good representative collections, fully labelled and with sufficient descriptive material, accurate in character, to convince all mining men and mining financial interests. With the co-operation of mining districts further south in the Province, this will be made a feature of all future mining conventions.

Special Correspondence

NORTHERN ONTARIO.

Boston Creek District—Government Blamed for Lack of Roads.

The failure of the Ontario Government to assist in the development of the Boston Creek mining district is uppermost in the thoughts of those citizens of Northern Ontario who possess a genuine sense of fair treatment to those concerns, backed by capital from abroad, which have chosen this district as the most attractive place in which to apply their efforts at mine development.

Early last spring, the Ontario Government, through Hon. G. Howard Ferguson, stated that a road was to be built for the accommodation of the mines in that district. The summer is now well advanced yet not a shovel of dirt has been turned. Instead, privately financed companies find it necessary to maintain their own roads, not only for their own benefit, but for the benefit of the entire camp.

In the Miller-Independence section of the district a lot of money has been spent, with very successful results. The Independence has alone spent about $300,000, and will expend perhaps another $100,000 before the end of this year, by which time it is expected to be treating ore at the rate of about 75 tons daily. This company is financed from the United States, chiefly from Dayton, Ohio. The Company has built its own road and has maintained it, and the Ontario Government, despite the fact that a large number of other property owners use this road, has not seen fit to even lend assistance in its upkeep.

In addition to the rich ore-bodies proven to exist in the Miller Independence section of the Boston Creek district, the area farther east, in the townships of Catherine and Skead, is attracting more and more attention. The mining companies operating in the Skead area are seeking a road to the Boston Creek station by way of the Miller-Independence mine. The distance from Skead to the Independence is about thirteen miles, and would necessitate the construction of a bridge across the Blanche River. They are asking the government to build the bridge and to advance two-thirds of the cost of building the thirteen miles of road. These companies would pay one-third of the cost. The road would pass through one of the most promising prospective mining areas in the north.

Within the next three months many carloads of materials will have to be transported over the road from Boston Creek station to the Miller-Independence mine, a distance of about three and one-half miles. Coal alone will average about one carload each week. Carloads of lumber, cement, machinery and supplies must be taken in before bad weather sets in. As a consequence, this company is obliged to prepare and maintain a road, not only for its own use, but for all the other mines in the district.

The development of the whole Boston Creek district is being retarded by the neglect of the Government to redeem its promise to provide road facilities. So far, the Ontario Government has not spent one dollar to assist highway transportation in this important and promising district. Boston Creek miners are energetically protesting against the unfair treatment they are receiving.

Gowganda to Cobalt by Motor.

That the inevitable connecting of the various districts of Northern Ontario by motor roads is coming about slowly but surely is demonstrated in the fact that an automobile was driven this week from the Gowganda camp, by way of Elk Lake, to Cobalt. The distance is not great, being perhaps not more than one hundred miles along the route of the road. But, the incident attracts attention due to it being the first time the through trip has been made.

The road from Gowganda to Elk Lake, when the present work of macadamizing it is completed, will be a good one, but at the present time it is but a rough waggon road through the bush, some thirty miles in length. Over the first few miles east from Elk Lake it was found necessary to travel over comparatively rough roads, paralleling the Elk Lake branch of the T. & N. O. Ry. There roads were found to improve on approaching closer to the main line of the T. & N. O. Ry., where fair roads are maintained through the farming districts and over which the trip was completed to New Liskeard, and finally to Cobalt over the macadam road passing through Haileybury.

It is learned that Henry Cecil is endeavoring to negotiate a deal for the disposal of the Hohenaur claim in the Kirkland Lake district. Promising progress was reported to have been made this week in Toronto.

It was also intimated that C. E. Wettlaufer, of Buffalo, might become involved. Also, that an endeavor might be made to consolidate the Hohenaur with two or three adjoining properties, including the Hunter-Kirkland.

A fair measure of encouragement and success is understood to be attending operation at the La Rose Consolidated. Recent unofficial reports, however, have exaggerated the situation, it is understood.

The Crown Reserve Mining Company has arranged to have a small amount of exploration work done on mining claims acquired a few months ago in the Larder Lake gold district. The company is also planning a small amount of exploration work on claims recently secured in the Gillies Limit.

McKinley-Darragh's Statement.

The financial position of the McKinley-Darragh, as shown in the statement just sent out, is concrete evidence of the success being met with this year. As of June 23rd the statement shows cash in bank $259,371; ore in transit and at the smelter $134,000; ore at mine ready to ship $57,700, making a total of $469,071. This compares with a total of $346,861, as of March 22nd.

During the second week in May the excellent physical condition of the McKinley-Darragh was pointed out in these columns. It was shown that net earnings were far in excess of dividend requirements of 3 per cet. quarterly or 12 per cent. annually. The official statement just submitted to shareholders corroborates the advance information printed in this paper about two months ago.

It is a further interesting fact that the present high production is being achieved with a force of men considerably less in number than the average employed throughout 1918. During recent months, working forces have been reduced to about 180 men, a reduction of about twenty per cent. A number of changes have been made and a high degree of efficiency is obtaining.

The dividend of 3 per cent. paid this month amounted to $67,428 and makes a total of 9 per cent. or $202,284 distributed so far this year. That the present rate of dividends will continue for years would appear to be certain. First, is the fact that the $469,071 now on hand is sufficient to care for dividend requirements beyond the first quarter of 1921 without drawing from profits made from operations in the meantime. However, at the present rate of output, not only will this surplus of about 20 per cent. be left intact for use at some later date, but current earnings may add to the surplus in addition to covering the 12 per cent. annual dividends.

Present Price of Silver Increasing Cobalt Returns.

Readers have been shown recently in these columns that the output of silver from the silver mines of this district will have reached the total of $306,056,976 fine ounces by the end of the current year, and that the total value will approximate $184,641,387. This shows that the quotations for silver since 1904 have averaged approximately 60 cents per ounce. It further shows that had silver averaged $1.10 per ounce as in the month of June this year, the entire output since 1904 would have a value of approximately $336,662,673.60, as compared with $184,641,387 actually received. In a word, provided silver quotations are to rule as high as an average of $1.10 an ounce, then Cobalt lost approximately $152,021,286.60 by having been discovered and mined during a period of the lowest silver quotations in history.

However, the mines of Cobalt are not worked out, and the camp as a whole will be a heavy producer of silver for a good many years. The mining companies operating in this field produced $12,135,816 in 1915, with silver averaging a little under 50 cents an ounce. With silver considerably more than double the 1915 average, the added value more than makes up for the lower output in point of ounces, and 1919 promises to be a more prosperous year than was either 1614, 1915 or 1916.

Had the situation been reversed, it is probably true that the majority of the mines in this district would at present be closed down. That is, haw silver averaegd above $1 an ounce during the early years of mining in Cobalt, and dropped to around 50 cents an ounce at the present time, the camp would not be the big thriving industrial centre that it is to-day. It is fortunate therefore, that the rise in quotations for silver has taken place at a time when most needed, and that the lowest average occurred just at a time when the camp was in its prime and in excellent physical condition to stand the strain.

Therefore, although low silver values in the early years of the current century denied the mining companies scores of millions of dollars, yet the fact that good fortune now smiles radiantly upon the silver producing companies, serves to offset the unfavorable silver market in the early days.

NORTHERN ONTARIO (Continued)

Low Fatality Rate in Northern Ontario Mines.

Previous reference has been made in these columns regarding to the fact that there was no fatal accidents during 1918 in connection with the silver mining industry of Ontario. This year the record is not quite so favorable, two men having already been killed.

When it is considered that close to three thousand men are employed at the silver mines of this province this record compares favorably with the best in the world. For instance, in the United States it is stated that an average of three out of every thousand employed at mining meet accidental death each year.

Clifton-Porcupine Mine.

Satisfactory progress and excellent results obtaining at the Clifton-Porcupine mine bids fair to add still farther to the extent of the profitable gold mining area of Porcupine. It is learned that at the first level where drifting operations are under way the vein is the full width of the drift and carries considerable quantities of visible gold. At the present point of operation the ore is stated to be high grade.

The mining plant is working smoothly and will be sufficiently powerful to meet requirements until the completion of the new and larger electrically driven plant, a part of which equipment has already arrived and a part of which is in course of transportation. With the completion of the new modern plant it will be pressed immediately into service. The present temporary plant will then have served its purpose and no delay will have been incurred during the period of installing the new equipment.

General Mining Notes.

In addition to the usual amount of ore from underground, the Mining Corporation is treating about 300 tons of tailings from previous operations. For the time being the tailings are being drawn from a large stock pile at the west side of the railway, but the work of pumping from the bed of Cobalt lake will begin very shortly.

Up to the present the new oil flotation equipment has not been used due to the fact that cyanidation is being found satisfactory. The material being treated is first ground to forty mesh.

Alfred R. Whitman is stated to have been engaged as consulting geologist for the Boston-McCrea property at Boston Creek. Mr. Whitman made his first visit to the property last week, and will make a re-study of the property accordingly as the occasion appears to demand.

The reported discovery of high grad eore at a depth of 575 feet on the Temiskaming mine is stated to have been incorrect. In view of the policy of the company being decidedly reticient in so far as information as to development work is concerned, the report gained a good deal of headway in a short time.

Milling operations are being carried on by the Pittsburg-Lorrain Syndicate, in South Lorrain with a fair degree of success. Some difficulty has recently been experienced in securing a supply of water, which has caused only temporary inconvenience. The mine and the mill of the Wettlaufer mine are under lease to the Pittsburg-Lorrain.

The action taken by the Tough-Oakes Gold Mines against its former president, C. A. Foster, involving some $1,896, no matter what the outcome of the affair, does not appear to constitute any reason for shareholders of the Tough-Oakes Company to become alarmed lest it should be the forerunner of more serious litigation that would again serve to draw the company into a position where the operation of the mine should suffer.

As far as can be seen at the present time, any future litigation appears likely to be confined to the minor phases incidental to the complete winding up of all differences which at one time existed.

The company is adequately financed to carry on operations in a big way, and following the clearing up of labor difficulties, the mill will be pressed into service, and the company shall then be permitted to enjoy the prosperity which has been held in abeyance, both due to the war in Europe and due to litigation.

The work of pumping out the underground workings of the Marigold property, formerly a part of the Lucky Cross mine, is under way, presumably preparatory to the commencement of mining operations. This step is taken as an indication that work will be started regardless of the present labor strike in that district.

The Adanac has made a shipment of concentrates together with some high grade ore, the whole amounting to between 50,000 and 60,000 pounds. Although detailed figures are not available, yet it is understood the returns from the shipment will serve to place more money in the treasury than the amount with which the current year was begun.

Further exploration work is being carried on, the most promising of which is the driving of a raise from the underlying diabase up into the Keewatin directly above. The vein being explored is about eight inches in width, and contains heavy cobalt mineralization. It is situated on the northern part of the property.

Diamond drilling was commenced this week on the Gold Reef property, situated in the north-western part of the township of Whitney, in the Porcupine district. Some years ago some speculator ore was found on the Gold Reef, the ore occurring in narrow pay-streaks.

MINING PERSONALS.

T. R. Jones, manager of the Buffalo Mines, is in Cobalt, on his regular monthly business visit to the mine.

M. P. McDonald, mining engineer, is making an examination of mining property in the Larder Lake district.

Max Morgenstern, shareholder in the Temiskaming, is paying a visit to the mine this week.

A. R. Whitman, mining geologist, has returned to New York after spending a few days on business in the Northern Ontario field.

Lieut.-Col. Johnston, of the Tough-Oakes Gold Mines, has returned north after an absence of a week or so on business at Eastern points.

BOOK REVIEW

Recent Publication of the United States Bureau of Mines. Abstracts of Current Decisions on Mines & Mining. Reported from September to December, 1918, by J. W. Thompson. Bulletin No. 179.

This useful digest of legal findings on matters relating to mines and mining is the latest volume of a series of great value. The subject index, which is carefully compiled, arranges the contents in a manner that makes reference easy for the non-legal reader, and in addition there is a Table of Cases, which gives the information as to origin of the abstract for legal readers.

An interesting reference is contained in the Chapter on Eminent Domain in connection with the application of one operator to use the tunnel belonging to another operator. It is laid down that the power of the Legislature of Utah in making mining a public use is conceded, and the purpose of the statute should not be hindered by any narrow or technical objections. The importance of encouraging the mining industry of the States must be kept in view, and as this "was the object, intent and purpose of the Legislature in passing the Act, and its wisdom, policy and expediency were thereby determined, a reasonable, fair, just, broad and liberal view should be taken by the court in the interpretation of the Statute."

There is a tendency to break away from the old rigid rules on the subject of "public use," and to enlarge the definition of the term so as to make it synonymous with "public welfare," and the test of "public welfare" instead of the old doctrine of "public use" is being gradually extended with the promise of its becoming the prevailing doctrine in most jurisdictions.

The owner of a mine sought by appropriation proceedings to condemn a joint use of a mining tunnel, the use to be in connection with that of the owner of a tunnel, and where the tunnel was not used to its full capacity by the owner. Proof that the condemner owned a mine and that the cost of the construction of a separate tunnel would be too great to justify this, and if the condemner cannot reach his mineral deposits through the existing tunnel, he will be prevented from removing his mineral deposits. There is prima facie evidence that it is necessary for the condemner to have a joint use of the tunnel in order to develop and mine the ores in his mining claim.

The burden of proof that the use required is a "public use" was laid upon the condemner. As to compensation, it was held that some just method, based upon all the known facts, is all the law contemplates, and is all that can be required in such a case.

This series of decisions seems to afford an important set of precedents in the application of the doctrine of "Eminent Domain" to mining operations. The principle appears to be that minerals constitute a public property, or perhaps, a more correct expression would be that the development of mineral is necessary for the public welfare, and that any condition of ownership which prevents such development, is against public welfare, and is open to correction and remedy by the power inherent in the state as the representative of the people.

Samuel Underhill, superintendent of the Queen Mine, Sheep Creek, died at Spokane, Wash., recently. He had been employed on McCune property in the interior of British Columbia for about thirty years.

MINE EXPLOSION FROM STRIKING MATCH NOT HAZARD ARISING OUT OF EMPLOYMENT.

In the First Division of the Court of Session, at Edinburgh, judgment has been given in an appeal in an arbitration under the Workmen's Compensation Act, between the Woodilee Coal & Coke Company, Limited, Lenzie, and Mrs. A. Robertson, whose husband was a miner in the appellants' employment, and was injured by an explosion in the Meiklehill Colliery. He died as the result of his injuries. The explosion occurred on his striking a match to light his pipe, after finishing his piece, at the customary knock-off in the middle of the shift. The possession and use of matches in the pit were prohibited by the Coal Mines Act, 1911, and these prohibitions were known to Robertson. Sheriff-Substitute Kippen at Dumbarton found that the explosion was an accident arising out of and in the course of the employment, and in law that the appellants were liable to pay £300 of compensation to the widow.

The First Division reversed that finding, holding that the deceased added a new peril to his employment by striking a match against prohibitions. What he did was for his own purpose, and was innocent enough but did not arise out of his employment.

Special Correspondence

The Silver Bell Mine, situated on the south fork of Kaslo Creek, and the Silver Bear group of mineral claims, which adjoin each other, are to be consolidated. The Silver Bear group has recently been acquired by the owners of the Silver Bell mine and it is understood that the development of the two properties is to be proceeded with this season.

There is said to be a renewal of interest in mining along the Upper Kootenay Lake, which is evinced in development work on a number of properties which have been comparatively inactive. The Blue Bell mine at Riondel, the operation of which has been interfered with by the flooding of the mine workings, is being pumped dry and probably will be in a position to resume mining and milling operations at an early date. This, of course, is contingent on lead marketing conditions improving. In the meantime it is likely that shipments of carbonate will be resumed. The carbonate ore which is of a rather low grade, but the mining costs of which are not heavy, formed a considerable portion of the tonnage sent out from the Ainsworth mining division last year. With the slump in lead prices following the signing of the armistice these shipments were discontinued. The Curle Manganese properties, near Kaslo, is to be operated again this summer, a small shipment of this class of ore having been asked for by the Consolidated Mining and Smelting Company. The Cork Province Mill on the south fork of Kaslo Creek is running on a one-shift basis. The Index Mine is being developed by Spokane capital. A two-ton motor-truck was imported recently for use in connection with this property. This is the first motor truck used in the south Fork section.

Taylor Engineering Co's Titles.

On Saturday, July 5, Land Registrar Smith raised objections in supreme court chambers to registering the title of the Taylor Engineering Company in the Dolly Varden mineral claims because of his construction of the Land Registry Act. These objections were over-ruled by Mr. Justice Murphy, who pointed out that the legislature had passed a special act stating that in the event of two conditions being proven it conveyed the rights in question to the Taylor Engineering Company and whatever the consequences, the registrar must comply with the act. He then ordered the title registered.

W. M. Archibald, field engineer for the Consolidated Mining & Smelting Co. of Canada, reports that the plant destroyed by fire recently at the Old Sport Group of Mineral Claims, West Coast of Vancouver Island, has been replaced and that development work again is in full swing. Two diamond drills are at work on the surface. The showing so far, it is stated, are very encouraging, the most satisfactory result being the uncovering of a number of high-grade shots of ore. These, in addition to the large body of low-grade ore which there is no doubt is abailable, makes the proposition a good one. Mr. Archibald, however, is doubtful whether any extensive work will be done in the direction of opening the property on a large scale until conditions generally are more stable. In making this observation he refers to the question of labor as well as that of the cost of supplies. However, when the problems which large industries now are facing are more or less settled there is no doubt that the Old Sport Group will be made a shipping mine, second to few in importance in this Province.

M. E. Purcell, of the engineering staff of the Consolidated Mining & Smelting Co. of Canada, recently inspected some iron properties on Iron Mountain, near Merritt, B.C. He appeared satisfied with what he had seen and stated that it was his intention to make a more exhaustive examination at a later date.

Interest in the mining properties of the northern section of British Columbia, to which the town of Stewart is the gateway, continues keen. Charles Caldwell, the operator of the Kootenays, who recently acquired interests in Portland Canal, predicts that the Stewart-Salmon River Railway will be under construction this year. He states that a company has been formed, that the necessary capital will be provided, and that tenders for the contract will be invited in the course of a few weeks.

Meanwhile the development work on various properties which have gained considerable renown recently proceeds and, if reports from usually credible quarters are to be believed, the showings are such as to justify optimistic prophesies. The Premier Mine, for instance, is said to have encountered high-grade silver ore in one of the lower tunnels.

S. I. Silverman, of New York, is expected at Stewart during the summer and P. Welch, the Canadian Railroad Contractor, who is a heavy owner of mining property on the Salmon River, is visiting the district.

A compressor plant has been installed at the Maple Leaf Mine, Franklin Camp, near Grand Forks, B.C. This has been done to facilitate development work and in the opinion of P. B. Freeland, Resident Government Mining Engineer, is an encouraging indication of the determiatio of some of the owners of this camp to prove their properties.

Sir Donald Mann, who with Sir William Mackenzie, is the builder of the Canadian Northern Railways in Canada, now absorbed by the Canadian National Railway System, passed through Vancouver, B.C., a few days ago on his way to examine the Big Missouri Property, Portland Canal, as well as to inspect other holdings in which he is interested in the Portland Canal District. In a statement made before going North he stated that the Big Missouri was not a mine but was a good prospect. He was not in a position to say anything more about it, but if it looked good he would send an engineer from New York to inspect and report upon it. Sir Donald said that it was not his present intention to arrange for the operation of the railway which was constructed some years ago in the Portland Canal Country.

The development of large copper deposits on the Ecstall River by the Granby Consolidated Mining & Smelting Co., is being carried on energetically and with good results, according to word from that camp. While the ore is said to contain considerable sulphur this will not interfere with its economical utilization, it being pointed out that smelting processes have been so improved that while this may have been a serious disadvantage in the past it now offers little difficulty in respect of treatment. Work of an exploratory character has been under way on the Ecstall Property for two years, and it is stated that the showings developed indicate that there is a bigger mine in the making there than now exists at Anyox in the well-known Hidden Creek Mine. It is reported in this connection that there is a strong probability that the smeltery at Grand Forks, which was recently closed down by the Granby Company, will be removed to Ecstall River. There has been no authoritative statement, however, to this effect.

The Queen, Nugget, Bonanza and Ore Hill Mines, situated in the Sheep Creek District, are being opened up and from the information available the showing generally are reassuring. Activity in this section, however, is not confined to these properties. Development is proceeding on a number of prospects and there has been a considerable influx of miners. An illustration of the extent of the recent improvement in conditions in this section is found in the reopening, after a period of two years idleness, of "The Half-Way House." This is situated on Sheep Creek, and is reported to be well patronized.

PRINCE OF WALES TO VISIT THE NORTH COUNTRY.

The Prince of Wales is to visit Cobalt on September 2nd, and will be escorted through one of the leading silver mines of the camp.

The owners of the Cane Silver Mines, situated in the township of Cane, in the Elk Lake district, have failed to conclude the proposed deal with Buffalo interests. The deal appeared to have fair chances of being consummated, but a last minute hitch occurred.

The Cane Silver Mines consists of about 120 acres on which a number of narrow veins containing patches of native silver have been found. The formation is diabase, and in no case has silver been found to continu eto more than a few feet below the surface.

Silver was first found on the property in the spring of 1913, and the claims have been explored in a small way intermittently during the last six years.

THE DERBYSHIRE (ENGLAND) OIL BORINGS.

The flow of oil at the Hardstoft bore has not appreciably increased, and it has been decided to instal a pump. A similar experience is expected at the other bores, and while the finding of oil is not by any means unimportant, no indications of a "gusher" of oil in quantity has yet been observed.

The question of a royalty on oil is being largely discussed in England. The Government is being urged to announce a reservation of oil to the Crown. The question of royalty on a flowing substance is rather a new one in England, and it raises a number of considerations of source, direction of travel, and support to adjoining properties which are not in question in connection with solid substances, such as for example, coal and ironstone.

ALBERTA COAL STATISTICS.

Some interesting figures have been compiled by John T. Stirling, chief inspector of mines for the Province of Alberta. They show the coal output for the province during 1918 and indicate its relation to Canada's total production. During that year, he points out, the consumption in coal was approximately 37,237,065 tons, of which 22,057,065 tons were imported from the United States, and of which total 2,559,041 tons were imported into Western Canada. In 1918 there were produced in the Province of Alberta 6,148,620 tons of coal, 100,470 tons of briquettes, 32,858 tons of coke, and 9,898 tons of shale for the manufacture of bricks. There were 7.687 tons of bricks sold. During the period in question 317 coal mines were in operation in Alberta, as well as two copper and two shale mines. Seventy new mines were opened, while nine old mines were reopened. Off-setting this to some extent there were 71 mines abandoned. To operate these mines an average of 2.633 persons were employed above ground and 6,144 below ground.

The Canadian Miners' Buying Directory.

Acetylene Gas:
Canada Carbide Company, Ltd.

Air Hoists:
Canadian Ingersoll-Rand Co. Ltd. Montreal, Que.

Amalgamators:
Northern Canada Supply Co.
Mine and Smelter Supply Co.

Antimony:
Canada Metal Co., Ltd.

Assayers and Chemists:
Milton L. Hersey Co., Ltd.
Campbell & Deyell, Cobalt.
Ledoux & Co., 99 John St., New York.
Thos. Heys & Son.
C. L. Constant Co.

Assayers' and Chemists' Supplies:
C. L. Berger & Sons, 37 William St., Boston, Mass.
Lymans, Ltd., Montreal, Que.
Stanley W. F. & Co., Ltd.
Mine & Smelter Supply Co.

Brakeshoes:
Can. Brakeshoe Co., Ltd.

Babbit Metals:
Canada Metal Co., Ltd.
Hoyt Metal Co.

Balances—Heusser:
Mine & Smelter Supply Co.

Balls:
Canadian Foundries and Forgings, Ltd.
Canadian Steel Foundries, Ltd.
Hull Iron & Steel Foundries Ltd.

Ball Mills:
Mine & Smelter Supply Co.
Fraser & Chalmers of Canada, Ltd.

Belting—Leather, Rubber and Cotton:
Northern Canada Supply Co
Jones & Glasco.

Blasting Batteries and Supplies:
Canadian Ingersoll-Rand Co., Ltd., Montreal, Que.
Northern Canada Supply Co.
Canadian Explosives, Ltd.

Blowers:
MacGovern & Co., Inc.
Northern Canada Supply Co.
Fraser & Chalmers of Canada, Ltd.

Boilers:
Northern Canada Supply Co.
Canadian Ingersoll-Rand Co., Ltd., Montreal, Que.
Marsh Engineering Works.
MacGovern & Co., Inc.
R. T. Gilman & Co.
Fraser & Chalmers of Canada, Ltd.
The John Inglis Company.

Boxes, Cable Junction:
Standard Underground Cable Co. of Canada, Ltd.
Northern Electric Co., Ltd.,

Buckets:
Canadian Ingersoll Rand Co., Sherbrooke, Que.
Hendrick Mfg. Co.
M. Beatty & Sons, Ltd.
Marsh Engineering Works. .....
Northern Canada Supply Co.
Fraser & Chalmers of Canada, Ltd.

Cable—Aerial and Underground:
Northern Canada Supply Co.
Standard Underground Cable Co. of Canada, Ltd.

Cableways:
M. Beatty & Sons, Ltd.
Fraser & Chalmers of Canada, Ltd.

Cages:
Canadian Ingersoll Rand Co., Sherbrooke, Que.
Northern Canada Supply Co.
Fraser & Chalmers of Canada, Ltd.

Cables—Wire:
Standard Underground Cable Co. of Canada, Ltd.
Canada Wire & Cable Co., Ltd.
Northern Electric Co., Ltd.,

Car Dumps:
Sullivan Machinery Co.
R. T. Gilman & Co.

Carbide:
Canada Carbide Company, Ltd.

Cars:
Canadian Foundries & Forgings, Ltd.
Canadian Ingersoll Rand Co., Sherbrooke, Que.
MacKinnon Steel Co., Ltd.
Northern Canada Supply Co.
Marsh Engineering Works.
Mine & Smelter Supply Co.
Fraser & Chalmers of Canada, Ltd.

Car Wheels and Axles:
Canadian Car Foundry Co., Ltd.
Marsh Engineering Works. Ltd.

Castings (Iron & Steel):
Canadian Steel Foundries, Ltd.

Cement Machinery:
Northern Canada Supply Co
Hadfields Ltd.
Fraser & Chalmers of Canada, Ltd.

Chains:
Jones & Glasco.
Northern Canada Supply Co.

Chemical Apparatus:
Mine & Smelter Supply Co.

Chemists:
Canadian Laboratories.
Campbell & Deyell.
Thos. Heyes & Sons.
Milton Hersey Co.
Ledoux & Co.

Classifiers:
niMe & Smelter Supply Co.

Coal:
Dominion Coal Co.
Nova Scotia Steel & Coal Co

Coal Cutters:
Sullivan Machinery Co.
Can. Ingersoll-Rand Co., Ltd., Montreal, Que.

Coal Mining Explosives:
Canadian Explosives, Ltd.

Coal Mining Machinery:
Canadian Ingersoll-Rand Co., Ltd., Montreal, Que.
Sullivan Machinery Co.
Marsh Engineering Works.
Hadfields, Ltd.
Fraser & Chalmers of Canada, Ltd.

Coal Pick Machines:
Sullivan Machinery Co.

Compressors—Air:
Smart-Turner Machine Co.
Canadian Ingersoll-Rand Co., Ltd., Montreal, Que.
Northern Canada Supply Co.
MacGovern & Co., Inc.
R. T. Gilman & Co.
Fraser & Chalmers of Canada, Ltd.

Concrete Mixers:
Northern Canada Supply Co.
Gould, Shapley & Muir Co., Ltd.
MacGovern & Co., Inc.

Condensers:
Smart-Turner Machine Co.
Northern Canada Supply Co.
MacGovern & Co., Inc.
Fraser & Chalmers of Canada, Ltd.

Concentrating Tables:
Mine & Smelter Co.

Converters:
Northern Canada Supply Co.
MacGovern & Co., Inc.

Conveyor—Trough—Belt:
Hendrick Mfg. Co.

Cranes:
Smart-Turner Machine Co.
M. Beatty & Sons, Ltd.

Crane Ropes:
Allan, Whyte & Co.

Crucibles:
Mine & Smelter Supply Co.

Crushers:
Canadian Steel Foundries, Ltd.
Lymans, Ltd.
Mussens, Limited.
Mine & Smelter Supply Co.
Hadfields Ltd.
Fraser & Chalmers of Canada, Ltd.

Derricks:
Smart-Turner Machine Co.
M. Beatty & Sons, Ltd.
Marsh Engineering Works.
R. T. Gilman & Co.

Diamond Drill Contractors:
Diamond Drill Contracting Co.
E. J. Longyear Company.
Smith & Travers.
Sullivan Machinery Co.

Dredger Pins:
Canadian Steel Foundries, Ltd.
Hadfields Ltd.

Dredging Machinery:
Canadian Steel Foundries, Ltd.
M. Beatty & Sons.
Hadfields Ltd.

Dredging Ropes:
Allan, Whyte & Co.
R. T. Gilman & Co.

Drills, Air and Hammer: ... ...
Canadian Ingersoll-Rand Co., Ltd., Montreal, Que.
Sullivan Machinery Co.
Northern Canada Supply Co.
Canadian Rock Drill Co.

Drills—Core:
Canadian Ingersoll-Rand Co., Ltd., Montreal, Que.
E. J. Longyear Company.
Standard Diamond Drill Co.
Sullivan Machinery Co.

Drills—Diamond:
Sullivan Machinery Co.
Northern Canada Supply Co.
E. J. Longyear Company.

Drill Steel—Mining:
Hadfields Ltd.

Drill Steel Sharpeners:
Canadian Ingersoll-Rand Co., Ltd., Montreal, Que.
Northern Canada Supply Co.
Sullivan Machinery Co.
Canadian Rock Drill Co.

Drills—Electric:
Northern Electric Co., Ltd.,

Drills—High Speed and Carbon:
Hadfields Ltd.

Dynamite:
Canadian Explosives.
Northern Canada Supply Co.

Ejectors:
Canadian Ingersoll-Rand Co., Ltd., Montreal, Que.
Northern Canada Supply Co.

Elevators:
M. Beatty & Sons.
Northern Canada Supply Co.
Hadfields Ltd.
Fraser & Chalmers of Canada, Ltd.

Engineering Instruments:
C. L. Berger & Sons.

Engines—Automatic:
Smart-Turner Machine Co.
Fraser & Chalmers of Canada, Ltd.

Engines—Gas and Gasoline:
Alex. Fleck.
Smart-Turner Machine Co.
Gould, Shapley & Muir Co., Ltd.
MacGovern & Co., Inc.

Engines—Haulage:
Canadian Ingersoll-Rand Co., Ltd., Montreal, Que.
Marsh Engineering Works.
Fraser & Chalmers of Canada, Ltd.

Engines—Marine:
Smart-Turner Machine Co.
MacGovern & Co., Inc.

Engines—Steam:
Smart-Turner Machine Co.
M. Beatty & Sons.
R. T. Gilman & Co.
MacGovern & Co., Inc.
Fraser & Chalmers of Canada, Ltd.

Flood Lamps:
Northern Electric Co., Ltd.,

Forges:
Northern Canada Supply Co., Ltd.

Forging:
M. Beatty & Sons.
Canadian Foundries and Forgings, Ltd.
Smart-Turner Machine Co.
Hadfields Ltd.
Fraser & Chalmers of Canada, Ltd.

Frogs:
Canadian Steel Foundries, Ltd.

Furnaces—Assay:
Lymans, Ltd.
Mine & Smelter Supply Co.

Fuse:
Canadian Explosives.
Northern Canada Supply Co.

Gears, Machine Cut:
Canadian Steel Foundries, Ltd.
The Hamilton Gear & Machine Co.
Fraser & Chalmers of Canada, Ltd.

Canadian Miners' Buying Directory.—(Continued from page 29.)

Gears:
Canadian Steel Foundries, Ltd.
Smart-Turner Machine Co.
Northern Canada Supply Co.
The Hamilton Gear & Machine Co.
Fraser & Chalmers of Canada, Ltd.

Hammer Rock Drills:
Mussens, Limited.

Hangers&Cable:
Standard Undeground Cable Co. of Canada, Ltd.

High Speed Steel:
Hadfields Ltd.

High Speed Steel Twist Drills:
Northern Canada Supply Co.

Hoists—Air, Electric and Steam:
Can. Ingersoll-Rand Co., Ltd., Montreal, Que.
Jones & Glassco.
M. Beatty & Sons.
Marsh Engineering Works.
Northern Canada Supply Co.
Mine and Smelter Supply Co.
Fraser & Chalmers of Canada, Ltd.

Hoisting Engines:
Mussens. Limited.
Can. Ingersoll-Rand Co., Ltd.
M. Beatty & Sons.
Marsh Engineering Works.
Fraser & Chalmers Engineering Works.
Fraser & Chalmers of Canada, Ltd.

Hose:
Northern Canada Supply Co.

Hydraulic Machinery:
Hadfields Ltd.
MacGovern & Co., Inc.
Fraser & Chalmers of Canada, Ltd.

Ingot Copper:
Canada Metal Co., Ltd.
Hoyt Metal Co.

Insulating Compounds:
Standard Underground Cable Co. of Canada, Ltd.

Jacks:
Can. Brakeshoe Co., Ltd.
Northern Canada Supply Co.

Laboratory Machinery:
Mine & Smelter Supply Co.

Lamps, Miners:
Canada Carbide Company, Ltd.
Dewar Mfg. Co., Inc.
Northern Electric Co., Ltd.,

Locomotives (Steam, Compressed Air and Storage Steam:
H. K. Porter Company.
R. T. Gilman & Co.
Fraser & Chalmers of Canada, Ltd.

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

Manganese Steel:
Canadian Steel Foundries, Ltd.
Hadfields Ltd.
Fraser & Chalmers of Canada, Ltd.

Metal Merchants:
Henry Bath & Son.
Geo. G. Blackwell, Sons, & Co.
Consolidated Mining and Smelting Co. of Canada.
Canada Metal Co.
C. L. Constant Co.
Everitt & Co.

Mining Requisites:
Canadian Steel Foundries, Ltd.
Hadfields Ltd.
Fraser & Chalmers of Canada, Ltd.

Monel Metal:
International Nickel Co.

Motors:
R. T. Gilman & Co.

Nickel:
International Nickel Co.

Ore Sacks:
Northern Canada Supply Co.

Ore Testing Works:
Ledoux & Co.
Can. Laboratories.
Milton Hersey Co., Ltd.
Campbell & Deyell.
Hoyt Metal Co.

Ores and Metals—Buyers and Sellers of:
C. L. Constant Co.
Geo. G. Blackwell.
Consolidated Mining and Smelting Co. of Canada.
Orford Copper Co.
Canada Metal Co.
Hoyt Metal Co.
Everitt & Co.

Perforated Metals:
Northern Canada Supply Co.
Hendrick Mfg. Co.

Pig Tin:
Canada Metal Co., Ltd.
Hoyt Metal Co.

Pig Lead:
Canada Metal Co., Ltd.
Hoyt Metal Co.

Pipes:
Canada Metal Co., Ltd.
Consolidated M. & S. Co.
Northern Canada Supply Co.
Smart-Turner Machine Co.

Pipe—Wood Stave:
Pacific Coast Pipe Co., Ltd.
Mine and Smelter Supply Co.

Piston Rock Drills:
Mussens, Limited.

Plate Work:
John Inglis Co., Ltd.

Pneumatic Tools:
Can. Ingersoll-Rand Co., Ltd.
Jones & Glassco.

Prospecting Mills and Machinery:
E. J. Longyear Company.
Standard Diamond Drill Co.
Mine & Smelter Supply Co.
Fraser & Chalmers of Canada, Ltd.

Pulleys, Shafting and Hangings:
Northern Canada Supply Co.

Pulverizers—Laboratory:
Mine & Smelter Supply Co.

Pumps—Boiler Feed:
Smart-Turner Machine Co.
Northern Canada Supply Co.
Canadian Ingersoll-Rand Co., Ltd.
Fraser & Chalmers of Canada, Ltd.

Pumps—Centrifugal:
Mussens, Limited.
Smart-Turner Machine Co.
M. Beatty & Sons.
Canadian Ingersoll-Rand Co., Ltd.
Mine & Smelter Supply Co.
Fraser & Chalmers of Canada, Ltd.

Pumps—Electric:

Pumps—Sand and Slime:
Mine & Smelter Supply Co.

Pumps—Pneumatic:
Smart-Turner Machine Co.
Sullivan Machinery Co.

Pumps—Steam:
Canadian Ingersoll-Rand Co., Ltd.
Mussens, Limited.
Northern Canada Supply Co.
Smart-Turner Machine Co.
R. T. Gilman & Co.
Fraser & Chalmers of Canada, Ltd.

Pumps—Turbine:
Smart-Turner Machine Co.
Canadian Ingersoll-Rand Co., Ltd.
Fraser & Chalmers Engineering Works.
Fraser & Chalmers of Canada, Ltd.

Pumps—Vacuum:
Smart-Turner Machine Co.

Quarrying Machinery:
Sullivan Machinery Co.
Canadian Ingersoll-Rand Co., Ltd.
Hadfields Ltd.

Rails:
Hadfields, Ltd.
R. T. Gilman & Co.

Roofing:
Northern Canada Supply Co.

Rope—Manilla and Jute:
Jones & Glassco.
Northern Canada Supply Co.
Allan, Whyte & Co.

Rope—Wire:
Allan, Whyte & Co.
Northern Canada Supply Co.

Rolls—Crushing:
Canadian Steel Foundries, Ltd.
Hadfields Ltd.

Samplers:
Fraser & Chalmers of Canada, Ltd.
C. L. Constant Co.
Ledoux & Co.
Milton Hersey Co.
Thos. Heyes & Son.
Mine & Smelter Supply Co.
Fraser & Chalmers of Canada, Ltd.

Screens:
Northern Canada Supply Co.
Hendrick Mfg. Co.
Hadfields Ltd.

Screens—Cross Pateent Flanged Lip:
Hendrick Mfg. Co.

Separators:
Smart-Turner Machine Co.

Sheet Lead:
Canada Metal Co., Ltd.

Sheets—Genuine Manganese Bronze:
Hendrick Mfg. Co.

Shoes and Dies:
Canadian Foundries and Forgings, Ltd.

Shovels—Steam:
Canadian Steel Foundries, Ltd.
M. Beatty & Sons.
R. T. Gilman & Co.

Smoke Stacks:
Hendrick Mfg. Co.
MacKinnon Steel Co., Ltd.
Marsh Engineering Works.

Special Machinery:
John Inglis Co., Ltd.

Spring Coil & Clips Electrico:
Canadian Steel Foundries, Ltd.

Steel Barrels:
Smart-Turner Machine Co.
Fraser & Chalmers of Canada, Ltd.

Steel Castings:
Canadian Brakeshoe Co., Ltd.
Canadian Steel Foundries, Ltd.
Hadfields Ltd.

Steel Drills:
Northern Canada Supply Co.
Can. Ingersoll-Rand Co., Ltd.

Steel Drums:
Smart-Turner Machine Co.

Steel—Tool:
N. S. Steel & Coal Co.
Hadfields Ltd.

Stone Breakers:
Hadfields Ltd.
Fraser & Chalmers of Canada, Ltd.

Surveying Instruments:
C. L. Berger.

Switches & Switch Stand:
Canadian Steel Foundries, Ltd.

Tables—Concentrating:
Mine & Smelter Supply Co.
Fraser & Chalmers of Canada, Ltd.

Tanks (Wooden):
Gould, Shapley & Muir Co., Ltd.
Pacific Coast Pipe Co., Ltd.

Tanks—Steel:
Canadian Ingersoll Rand Co., Sherbrooke, Que.
Marsh Engineering Works.
MacKinnon Steel Co.
Fraser & Chalmers of Canada, Ltd.

Tanks—Cyanide, Etc.:
Hendrick Mfg. Co.
Pacific Coast Pipe Co., Ltd.
MacKinnon Steel Co.
Fraser & Chalmers of Canada, Ltd.

Tanks (water) and Steel Towers:
Gould, Shapley & Muir Co., Ltd.
MacKinnon Steel Co.

Tramway Points and Crossings:
Canadian Steel Foundries, Ltd.
Hadfields Ltd.

Transits:
C. L. Berger & Sons.

Transformers:
R. T. Gilman & Co.
Northern Electric Co., Ltd.,

Tubs:
Hadfields Ltd.

Welding Rod and Flux:
Prest-O-Lite Co. of Canada, Ltd.
Imperial Brass Mfg. Co.

Welding and Cutting, Oxy-Acetylene:
Prest-O-Lite Co. of Canada, Ltd.
Imperial Brass Mfg. Co.

Wheels and Axles:
Canadian Steel Foundries, Ltd.
Hadfields Ltd.

Winding Engines—Steam and Electric:
Can. Ingersoll-Rand Co., Ltd.
Marsh Engineering Works.
Fraser & Chalmers of Canada, Ltd.

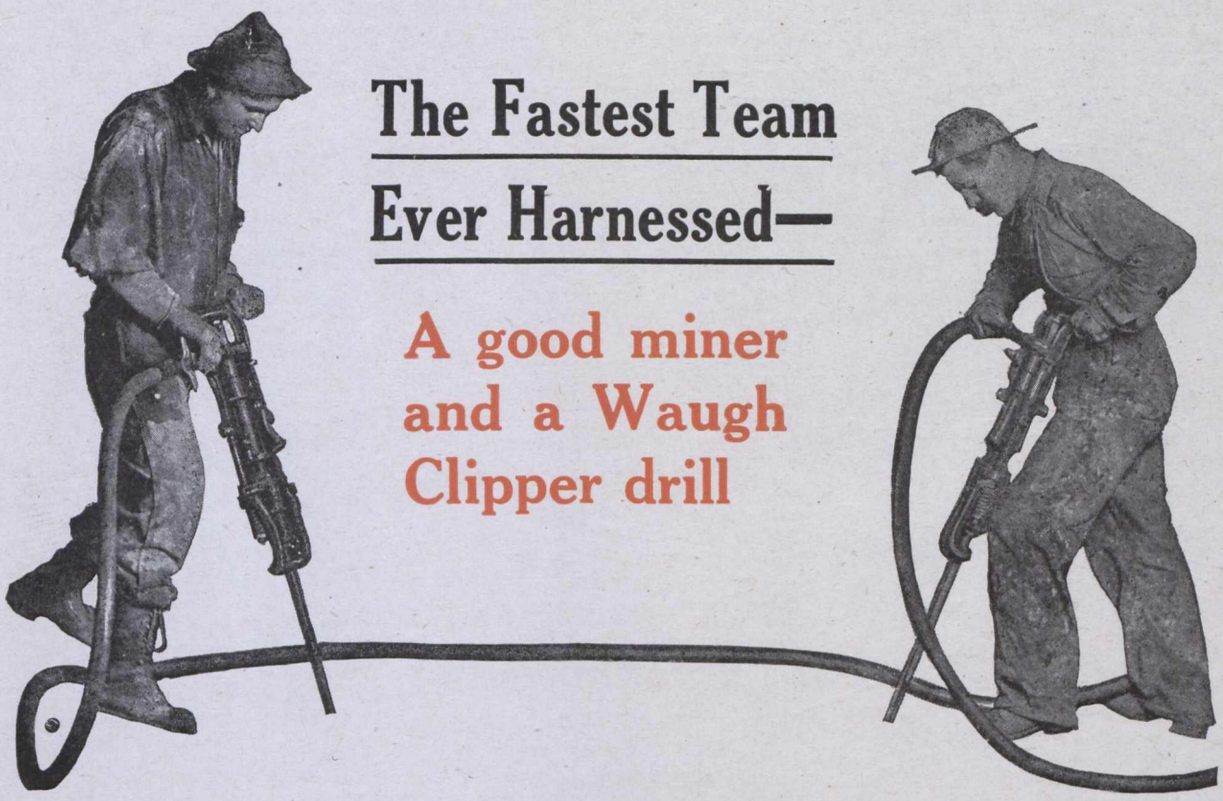
Wire:
Canada Wire & Cable Co., Ltd.

Wire Cloth:
Northern Canada Supply Co.
Greening, B., Wire Co.

Wire (Bare and Insulated):
Standard Underground Cable Co., of Canada, Ltd.
Northern Electric Co., Ltd.,

Zinc Spelter:
Canada Metal Co., Ltd.
Hoyt Metal Co.

ALPHABETICAL INDEX TO ADVERTISERS



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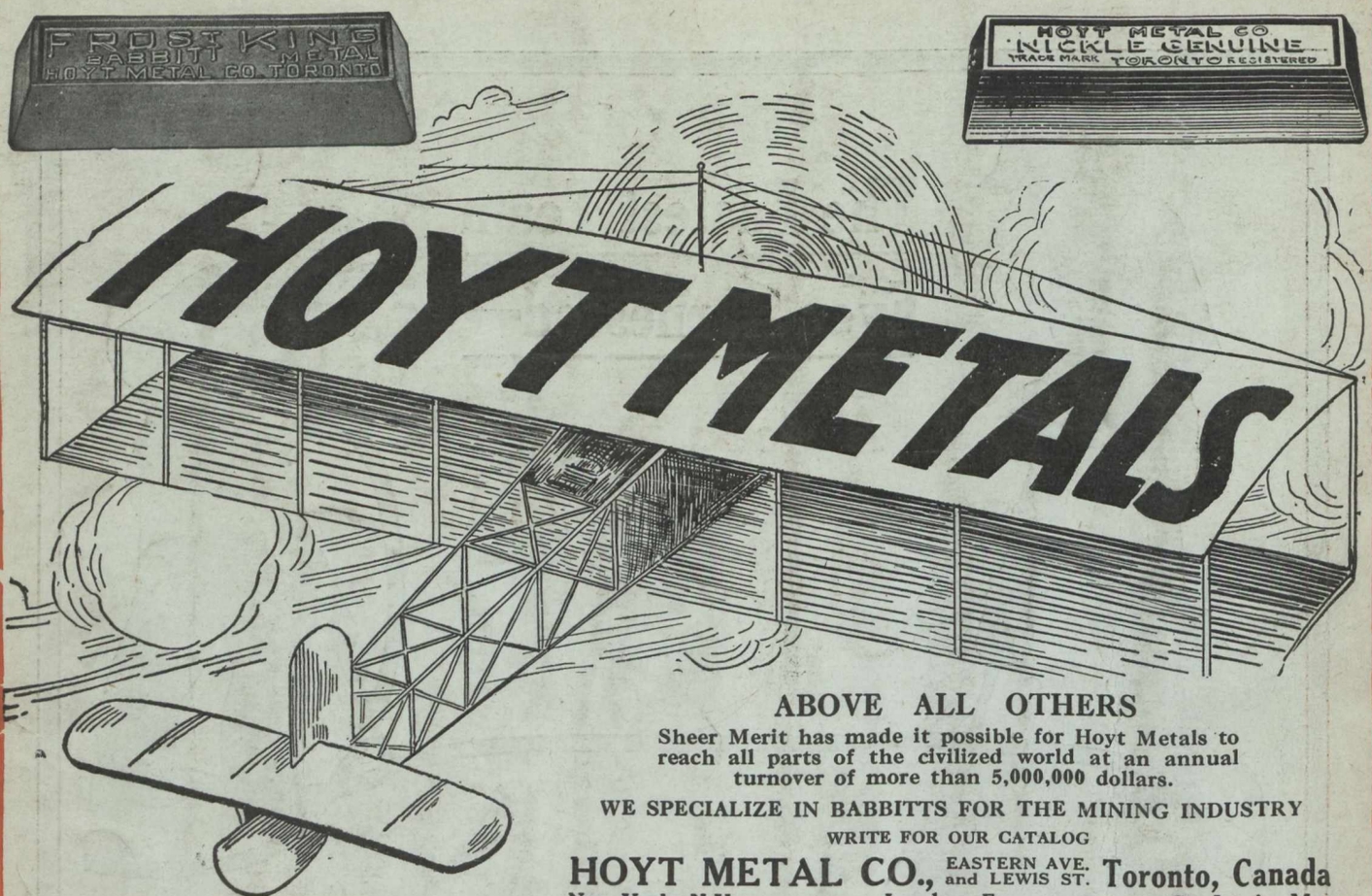

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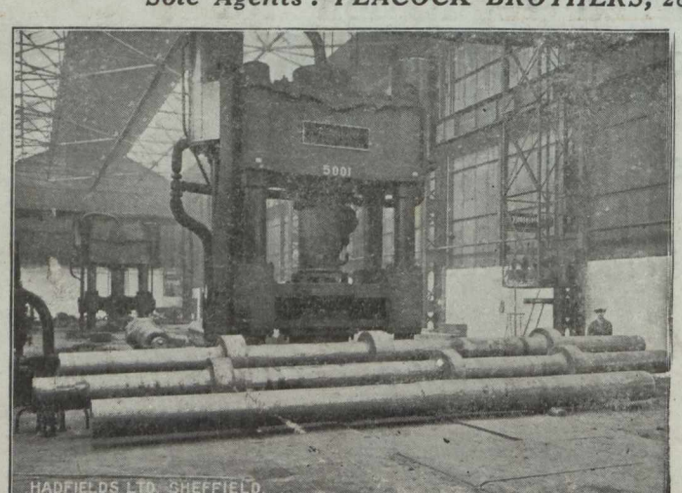

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