General

This metal is the most important of the platinum group which includes platinum, palladium, iridium, rhodium, osmium, and ruthenium. These metals, although constituting two transitional groups, are very closely related to each other. In nature they sometimes all occur associated together in what is commonly known as platinum ore, and are on this account usually spoken of as the platinum group of metals.

Platinum is a white lustrous metal possessing a very high melting-point and high specific gravity. It is exceedingly malleable and ductile and may be welded at a red heat.

Some years ago its principal uses were in the manufacture of jewelry, scientific laboratory utensils and apparatus, incandescent lamps, certain electrical devices such as spark-coils, magnetos, etc., and in dentistry. Since 1914, however, a very large quantity of platinum has been employed in the contact method of manufacturing sulphuric acid for war purposes, and as the metal is not used up or destroyed in this process a large portion will be available for other uses when the over-production stage has been reached. Considerable quantities are used in the ignition apparatus of all types of internal-combustion engines, so indispensable in war time, and although the termination of hostilities has somewhat lessened this demand, quantities of the metal will continue to be used for this purpose.

The unprecedented demand for the metal during the period of the war, with an equally abnormal increase in its market value, was the cause of some concern to all of the belligerents and naturally gave rise to the adoption of stringent regulations regarding its purchase and use in the fine arts. We are unaware of the precise nature of the difficulties experienced by the Central Powers through the scarcity of platinum, but no doubt the Imperial German Government had secured fresh supplies of the metal subsequent to the Russian debacle and therefore it is not improbable that they possessed a sufficient quantity of the metal to meet their actual war requirements. The Allied Governments and the United States were at the disadvantage of being unable to gain access to the platinum fields in the Russian Urals, and therefore were forced to look elsewhere for supplies. Up to the time that the United States declared war the Allied Powers prohibited the exportation of platinum to that country without special guarantees, fearing that it would come into the hands of the enemy, and therefore a large quantity was held in England, France, and Russia which the manufacturers of certain war-munitions in the United States were unable to obtain.

Prior to the war the world's supply of platinum was derived almost entirely from the Ural mountains, in Russia, and when hostilities com-

menced in the fall of 1914 the Russian production was reduced almost one-third, due principally to the conscription of miners for the Russian army. This curtailment of the normal supply was further aggravated by the fact that a very large quantity was required by the munition industries of England, France, and the United States in the manufacture of sulphuric acid, and also for the ignition apparatus of all types of internal-combustion engines.

Colombia, in South America, is second only to Russia as an important source of platinum. In 1913 its production was 15,000 ounces and that of Russia 250,000 ounces. In 1917 Colombia produced 32,000 ounces and the Russian output fell to about 50,000 ounces (estimated).

In 1906 the price of refined platinum varied from $20 to $38 per troy ounce, but by 1914 had increased to an average of $45 per ounce. At the end of 1915 the price advanced to $85, averaged $84 in 1916, and by December, 1917, had reached a figure of over $100 per ounce. In March, 1918, the United States Government made an official fixed price of $105 per ounce of refined platinum and adopted stringent regulations governing its purchase and exportation. In August, 1918, the British Government advised the Imperial Munitions Board at Ottawa that it was prepared to pay the official United States price for Canadian platinum.

Prof. J. L. Howe of Washington and Lee University, has recently thoroughly revised the figures regarding the total world production of platinum, and the following table, based on his figures, has been published by the United States Geological Survey:(1)

Estimated Total Production of Crude Platinum in the World to January, 1917; in troy ounces.

Country	Minimum	Maximum
Russia	7,115,482	10,128,308
Colombia	700,000	735,000
Borneo	175,000	200,000
New South Wales and Tasmania	9,000	10,000
Canada	9,000	10,000
United States	10,000	12,000
	8,018,482	11,095,308

From these figures it is estimated that the total supply of platinum metals in the world in 1917 was probably more than 10,000,000 ounces, of which about 1,000,000 ounces of platinum and 400,000 ounces of other metals of the platinum group were in the United States.

The world's production of crude platinum for the years 1913-1917 is estimated by the United States Geological Survey as follows:(2)

(1) Mineral Resources of the United States, 1917, Part I, p. 13.
(2) Ibid. p. 14.

Estimated World's Production of Crude Platinum, 1913-17, in troy ounces.

Country	1913	1914	1915	1916	1917
Borneo and Sumatra	200	(a)	(a)	(a)	(a)
Canada	50	30	100	60	80
Colombia	15,000	17,500	18,000	25,000	32,000
New South Wales and Tasmania	1,500	1,248	303	222	(a)
Russia	250,000	241,200	124,000	63,900	50,000
United States	483	570	742	750	605
	267,233	260,548	143,145	89,932	82,685

Canada has up to the present been of very minor importance as a producer of this metal. From 1913 to 1918, inclusive, an average of about 1,800 ounces of metals of the platinum group is reported to have been recovered annually from the refining of Sudbury copper-nickel matte by the International Nickel Company in the United States, of which a little over one-third was platinum. Probably a somewhat larger quantity was recovered by the Mond Nickel Company at its refinery in England. In this connection it is interesting to note that the Mond Nickel Company is reported to be making a better recovery of platinum metals by its process of refining than the International Nickel Company has so far accomplished at its New Jersey works.

The report of the Royal Ontario Nickel Commission states that in 1916 the matte produced by the Canadian Copper Company was estimated to contain 5,640 ounces of platinum and 8,460 ounces of paladium, and that the recovery of these metals by the International Nickel Company in that year amounted to 1,093 ounces of platinum and palladium, together with 257 ounces of other metals of the platinum group. Recent research investigations conducted by the International Nickel Company have shown that it is possible to greatly improve its recovery of the platinum group metals and it is probable that these improved methods will be practised in the near future. The Mond Nickel Company did not furnish figures of platinum recoveries to the Royal Ontario Nickel Commission, but from assays made by that Commission it would appear that the Mond Nickel Company's matte contained more of the platinum-group metals than the matte of the Canadian Copper Company.

The British America Nickel Corporation, Limited, will employ the Hybinette process of electrolytic refining which is expected to make a more or less complete recovery of the precious metals in the matte.

Should the International Nickel Company succeed in recovering a high proportion of the precious metals, it is well within the range of possibility that the total production of platinum-group metals by the three companies will exceed 10,000 ounces annually.

Some years ago a considerable quantity of crude platinum was produced

from the Tulameen district in British Columbia. There are no data for the quantity produced previous to 1885, but since that date the platinum recovered has been estimated by C. Camsell at from 10,000 to 20,000 ounces,(1) and at one time this district was the principal producer of platinum in North America.

In view of the apparent serious shortage in the world's supply of this metal and more especially because of its importance as a war mineral, the Secretary drew the attention of the Deputy Minister of Mines to the advisability of making a careful examination of certain Canadian localities, particularly the Tulameen district in British Columbia, known to contain the metal.

About the middle of March, 1918, the Secretary proposed to the Deputy Minister of Mines that the Department should organize a field-party to prospect the bench and river gravels in certain areas in British Columbia. This proposal was seconded by C. Camsell of the Geological Survey and also by Wm. Fleet Robertson, Provincial Mineralogist of British Columbia and member of the Minerals Advisory Board to this Commission. No action was taken by the Department of Mines, but the Deputy Minister promised the assistance of the Geological Survey if the Commission would undertake the work.

In May, William Douglas, barrister, of Toronto, informed the Secretary that in the fall of 1917 he had operated a bucket-dredge on the Saskatchewan river a few miles east of Edmonton, for the purpose of recovering black sands containing gold, platinum, and iridium. Mr. Douglas stated that in fifteen days operation in November, 1917, he had recovered 3,000 pounds of black sands which assayed 6 ounces of platinum and 14 ounces of gold per ton. Subsequently Mr. Douglas interviewed the Chairman of the Imperial Munitions Board, who then requested the Secretary of this Commission to undertake an examination of the Douglas property on the Saskatchewan river. This the Secretary assented to, and made immediate arrangements to have W. L. Uglow of the Commission staff proceed to Fort Saskatchewan, Alberta, where the Douglas property is situated. A preliminary report from Dr. Uglow contained the information that both platinum and gold were found to occur in the gravel bars, but that no reliable estimate could be made of the value of the property without careful examination by means of core-drills. Accordingly, a 4-inch Empire drill, the property of the Department of Mines, was shipped to Dr. Uglow early in July and he commenced operations about the 10th of that month.

While Dr. Uglow waited for the drill to come forward from Ottawa he received instructions from the Secretary to make a quick trip up the Peace river for the purpose of investigating certain alleged platinum discoveries near the junction of the Finlay and Parsnip rivers with the Peace river. His report on the possibilities of securing platinum in the Peace River district was not optimistic.

(1) Geol. Surv. Can., Memoir 26, 1913.

On June 28 the Secretary received the following letter from the Chairman of the Imperial Munitions Board:

DEAR MR. MACKENZIE,

The Ministry advise, confidentially, that they consider the development of the platinum resources in Canada of great importance, and ask us to take such steps as may be necessary under urgent pressure to develop existing plants or ascertain what can be done elsewhere.

Under these circumstances can I ask you to arrange for increased activity in the investigations you are now carrying on in Saskatchewan? If it is possible for you to add two, or three, or four, additional parties with drills to your existing organization I will greatly appreciate the service being rendered.

Yours truly,

(*Sgd.*) J. W. FLAVELLE,

Chairman.

After receiving the above letter, the Secretary had several consultations with the Chairman and his Assistant and was impressed with the necessity for vigorous action in the exploration of the platinum resources of Western Canada. The Assistant to the Chairman stated that the matter of expenditure was of secondary importance, and in view of the urgent request to develop latent possibilities the Commission should place several parties equipped with drilling apparatus in the field at once. Subsequently, the Deputy Minister of Mines, who had consulted the Imperial Munitions Board on the subject, received the same impression. However, after discussing this matter with the Deputy Minister, the Secretary decided hat the wisest course to pursue would be to thoroughly equip one party and to explore only those portions of the country which were known beyond doubt to have produced platinum in the past.

In order to personally superintend the field-work, the Secretary left Ottawa on July 6 and proceeded directly to Edmonton, thence to Fort Saskatchewan where Dr. Uglow was drilling with the 4-inch Empire equipment.

Two extra 6-inch Empire drills which had been ordered from New York were unfortunately delayed in reaching Fort Saskatchewan until about August 12; and as the Fort Saskatchewan work was completed on August 15 the 6-inch drills were not used for this particular job.

The Secretary remained with Dr. Uglow at Fort Saskatchewan until July 24 and then left for Vancouver to meet the Deputy Minister of Mines and C. Camsell, Resident Geologist for the Geological Survey in British Columbia, for consultation regarding other localities deserving of attention. Both of these gentlemen were of the decided opinion that the Tulameen river was the most likely source of platinum in British Columbia, and as this locality could be reached by the Kettle Valley railway, there would be no trouble experienced in moving the necessary working equipment.

Before proceeding to Tulameen, Mr. Camsell and the Secretary interviewed the Honourable William Sloan, Minister of Mines, and William Fleet Robertson, Provincial Mineralogist for British Columbia, who were much

of 30,000 ounces of [illegible]inum would be made over the recovery perio[illegible] esides 30,000 ounces of gold. He [illegible]nated the initial cost of the dredging operations [illegible]$500,000 and the operating costs over the period at not more than $1,500,000.

The substance of Mr. Mackenzie's report was communicated to the Ministry of Munitions who have now replied expressing their great appreciation of the work done by Mr. Mackenzie and of the assistance afforded by the Mines Department of the Dominion Government, but stating that as the proposed development would not be likely to produce any platinum earlier than twelve months from date, they are not able to authorize the Board to undertake it on behalf of the British Government.

It is understood from the various communications received from the Ministry that the position with regard to platinum has somewhat altered since last summer. The appeal made in Great Britain apparently resulted in an unexpected quantity of platinum being offered which was already available in that country in various forms. There is now a prospect of the Russian exportation being resumed. While the Ministry still require a further supply, they apparently require it immediately and in comparatively small quantity, and the prospect of a large supply which will not begin to be available till twelve months from date does not attract them.

In conveying the thanks of the Ministry of Munitions to the Mines Department and also to the Munition Resources Commission, the Board wishes to express its own sense of the zealous help given by Mr. Mackenzie in this as in other matters, and its regret that the investigations which he has so ably carried out cannot be made the ground for the development of further operations in Canada as far as the British Ministry of Munitions is concerned.

They trust, however, that these investigations may not be altogether fruitless but may form the ground for development either by the Dominion or Provincial Government, if the prospects of success and the commercial demand for platinum appear likely to justify such development.

A similar letter has been sent to the Minister of Mines.

Yours faithfully,

(*Sgd*) J. W. FLAVELLE.

The Chairman of this Commission, Colonel Thos. Cantley, replied to the above letter as follows:

New Glasgow, N.S., Oct. 26, 1918.

SIR JOSEPH FLAVELLE,
Chairman, Imperial Munitions Board,
Ottawa, Ontario.

DEAR SIR,

I desire to acknowledge the receipt of your letter of October 22 last.

In view of Mr. Mackenzie's expression of confidence that the work so far done in the Tulameen district of British Columbia warrants further exploration with the possibilities of considerable quantities of platinum being secured, the necessary drilling should be undertaken with vigour at once. If this were done and such preliminary work results in proving platinum-bearing ground to the extent and value at present indicated, I can see no reason why dredging should not be put in operation by early spring, and a very considerable quantity of platinum won before midsummer next.

I regret that our efforts to aid the British Ministry in matters so far undertaken, have been rather disheartening. In the case of molybdenum, a great cry went up for an increase in production and conservation of this material, and an embargo was placed on the sale of it in Canada A good deal of prospecting and considerable development work was done, and the result so far as the purchase of this material by the authorities was concerned, was disappointing to practically all the operators who were induced to undertake the work.

Ministry correct in estimating twelve months before an production secured, but they are in ve error in assuming that an emergency supply can be secured in this country.

(*Sgd.*) GEO. C. MACKENZIE.

To the above telegram the Imperial Munitions Board replied as follows:

Ottawa, Oct. 9, 1918.

GEO. C. MACKENZIE,
510 Pacific Building,
Vancouver, B. C.

Your telegram 8th received. We have transmitted same by cable to London today exactly as received.

(*Sgd.*) FITZGERALD.

No further communication was received from the Imperial Munitions Board regarding this subject and therefore it was taken for granted that either the British Ministry of Munitions was needlessly alarmed over the platinum situation, or else the officials who requested the exploration in June, 1918, did not realize the nature of the work involved by the request they made, and the impossibility of securing a quick supply of platinum as the result of this work.

Before leaving the subject of the correspondence on the platinum work, attention should be drawn to the following letter addressed to the Honourable Martin Burrell, Minister of Mines, and to Colonel Thomas Cantley, Chairman of the Munition Resources Commission, both letters being the same.

Ottawa, Oct. 22, 1918.

COLONEL THOMAS CANTLEY,
Chairman, Munition Resources Commission,
Ottawa, Ontario.

SIR,

In June last, in view of the serious situation with regard to the supply of platinum required for war purposes, arising out of the stoppage of platinum exports from Russia, this Board was requested by the Ministry of Munitions to ask the Canadian Government to investigate, as a matter of urgent importance, certain reports which had reached the Ministry of important platinum discoveries in British Columbia.

By the courtesy of the Mines Department and the Munition Resources Commission, Mr. Geo. C. Mackenzie, of the staff of the Department of Mines, and Secretary to the Munition Resources Commission, who had already lent most valuable assistance to this Board in several other matters, was allowed to undertake the investigation in question.

Following on this, Mr. Mackenzie and his assistants carried out a thorough investigation at various points in Alberta and British Columbia. As a result of these investigations Mr. Mackenzie reported that he had discovered a promising source of supply on the Tulameen river in British Columbia. Preliminary tests and washings which he made in this locality indicated that a considerable quantity of platinum might be obtained by dredging operations. A little later Mr. Mackenzie put forward a definite scheme for developing this supply—firstly, by means of drilling operations to test the ground, then, if drilling gave favourable results, by installing dredging operations.

Mr. Mackenzie estimated that there were on the Tulameen river fifteen million cubic yards of gravel with a platinum and gold content available for dredging, and that by dredging this gravel at the rate of five hundred thousand cubic yards monthly a recovery

In the case of platinum, it was understood some few months ago that the situation was serious, if indeed not desperate, and again serious efforts were made to meet the situation as then understood, by the Munition Resources Commission, as well as by others, and now when a reasonable prospect has resulted which we think would warrant further exploitation the Ministry advise that the matter is not of sufficient importance to warrant further exploration.

I have, however, much pleasure in thanking you for the kindly expressions of appreciation for the zealous assistance and painstaking work given Mr. Mackenzie, for this and the other matters in which the assistance of the Commission was enlisted. I desire to further add that if the Commsssion can now or at any time in the future be of assistance within their sphere of influence, they will be very pleased to co-operate in the heartiest manner possible.

Yours respectfully,
(*Sgd.*) THOMAS CANTLEY,
Chairman.

In a communication to the Secretary on October 23, Mr. Edward FitzGerald of the Imperial Munitions Board explained the general situation in terms similar to those in Sir Joseph Flavelle's letter to Colonel Cantley.

The following reply was addressed by the Secretary to Mr. FitzGerald, which apparently terminated the correspondence:

Tulameen, B.C., Oct. 30, 1918.

EDWARD FITZGERALD,
Imperial Munitions Board,
Ottawa, Ontario.

DEAR MR. FITZGERALD,

I have your letter of October 23 with enclosed copy of communication from Sir Joseph Flavelle addressed to Colonel Cantley and the Honourable Martin Burrell on the subject of platinum.

It is regrettable that the Imperial Ministry of Munitions did not make themselves perfectly clear when they introduced the subject in June last. If at that time we had been instructed to provide an emergency supply of only a few hundred ounces of platinum, we would have undoubtedly adopted somewhat different measures because there is every reason to believe that we could have accumulated the required amount through the purchase of scrap.

At the present time the fact that we have a small platinum refinery in Vancouver has attracted quite a lot of scrap, but I am confident that if this refinery was well advertised throughout the whole of Canada, the returns would be sufficient to meet present requirements. If this suggestion meets with the approval of the Board, the Minister of Mines should be asked to advertise the Vancouver refinery in the Canadian press and to continue advertising until the required amount of platinum is obtained.

I am not optimistic over the chance discovery of a rich deposit that will yield quickly an emergency supply. We are investigating a reported occurrence on Jervis inlet, because the samples brought in by the owners of the property were exceedingly rich in platinum, but how these samples were taken or what they represent is impossible to estimate without careful examination. We could very easily secure samples of Tulameen black sand that would assay many ounces of platinum, but they would not be accurate representations of the average value per cubic yard of gravel. The layman and the ordinary prospector have absolutely no sense of the mathematics of sampling, with the consequence that 'many are called, but few are chosen.'

Would you please convey my thanks to Sir Joseph Flavelle for his appreciation of our

interested in the proposed work and promised every assistance. It was pointed out to the Minister that inasmuch as many of the old placer-mining leases on the Tulameen and Similkameen rivers were not in good standing, some provision might be desirable to hold ground for the Crown in the event of such ground being proved valuable. Mr. Sloan suggested that miners' leases could be taken out by agents of the Commission and any open ground, or ground not in good standing; could be staked for the Crown. This suggestion was forwarded to Ottawa for consideration but was not acted upon, supposedly for the reason that the Canadian Government did not wish to interfere with private interests.

Early in August, Mr. Camsell and the Secretary, accompanied by an expert panner, visited the Tulameen river for the purpose of making a preliminary survey of the possibilities of securing platinum. The result of a week devoted to a reconnaissance of the Tulameen and Similkameen rivers and Granite creek, a tributary of the Tulameen, was the decision that the Tulameen river between the town of Tulameen and the mouth of Slate creek, a distance of about 3 miles, should be carefully examined by means of placer drills. The following recommendation was telegraphed to the Imperial Munitions Board:

92HNE 199

Tulameen, B.C., Aug. 10, 1918.

EDWARD FITZGERALD,
Imperial Munitions Board,
Ottawa, Ont.

Have examined Tulameen river and consider this stream most likely source of platinum, much better than Fort Saskatchewan.

Miners operating have small production this fall which am taking steps secure.

Larger production next year contingent upon dredge placed in commission, but thorough drilling should be completed preliminary to dredge installation.

Gravel to be examined approximately fourteen million cubic yards and drilling in approved manner will cost seven thousand dollars per month and require six months to complete.

Propose using five drills, three we have and secure two more on coast, also to continue drilling through winter if first two months results encouraging.

Provided that Government objects to expenditure will the Board finance and shall I proceed.

Answer at Tulameen until August fifteenth then Vancouver.

(*Sgd.*) GEO. C. MACKENZIE.

On August 14 the following telegram was sent to the Imperial Munitions Board:

Tulameen, B.C., Aug. 14, 1918.

EDWARD FITZGERALD,
Imperial Munitions Board,
Ottawa, Ont.

Result of drilling Fort Saskatchewan property unsatisfactory and have ordered all equipment moved to Tulameen, British Columbia.

(*Sgd.*) GEO. C. MACKENZIE.

On August 16 the Secretary received the following message from Mr. FitzGerald:

Ottawa, Aug. 15, 1918.

G. C. MACKENZIE,
Tulameen, B.C.,

Referring to your telegrams tenth and fifteenth.

We note you will now concentrate your work on Tulameen river.

Regarding specific question asked in last sentence your telegram tenth, we think we could not give expression of opinion in advance of Canadian Government deciding what action they shall take in the matter.

(*Sgd.*) FITZGERALD.

Notwithstanding the fact that the Imperial Munitions Board had pressed for prompt and energetic action in examination of platinum resources, the Secretary received no further communication from them until September 15, when the following message came to hand:

Ottawa, Sept. 14, 1918.

GEO. C. MACKENZIE,
510 Pacific Building,
Vancouver, B.C.

We cabled contents your telegram August tenth to Ministry regarding continuance of drilling operations at Tulameen river.

Ministry cabled today as follows: Ministry wish to know if you can estimate probable cost of platinum obtainable from this source and how interests of Government will be protected if capital expenditure suggested is authorized.

Please telegraph your views.

(*Sgd.*) FITZGERALD.

In answer to the above telegram the following message was despatched in code:

Tulameen, Sept. 16, 1918.

EDWARD FITZGERALD,
Imperial Munitions Board,
Ottawa, Ont.

Your wire September fourteenth.

Have made washing test on 90 cubic yards gravel and recovered $31.84 gold and platinum of which practically half by weight is platinum.

This is equivalent to 35 cents per cubic yard actually recovered.

Our methods crude and did not save more than 60 per cent total metals in gravel.

Assume dredge operating costs at 10 cents per cubic yard which is three times best California practice.

Assume fifteen million cubic yards available. Assume dredge will recover 25 cents or ·002 ounces each of gold and platinum per cubic yard which is conservative.

This totals 30,000 ounces gold and 30,000 ounces platinum recovered from fifteen million cubic yards gravel.

Assume dredge cost five hundred thousand dollars for capacity of five hundred thousand cubic yards monthly. Total cost including operating two million.

Total returns gold six hundred thousand dollars and platinum over three million dollars taking gold at twenty and platinum at one hundred and five per ounce.

There can[illegible]no protection for drilling expenditure unless M[illegible]try intend to operate for recovery of metals.

British Columbia Minister of Mines assures that his Government will assist and protect to the limit of their jurisdiction.

Would suggest you ask Canadian Government to ascertain what protection could be secured through joint action Ottawa and Victoria.

We can stake and hold open ground for Crown as suggested my letter September third.

Ground now under lease can be secured by payment nominal royalty to owners who are willing to negotiate.

Bad weather is approaching and if work is to be undertaken I must make provision quickly. Therefore avoid delaying decision.

Platinum occurs here in commercial quantities present price and can be secured through expenditure of capital.

Will mail report next Saturday from Vancouver returning Tulameen twenty-fourth.

(*Sgd.*) GEO. C. MACKENZIE.

The Imperial Munitions Board acknowledged receipt of the above telegram and stated that they had forwarded a very large portion of the message to London, and had asked the British Ministry of Munitions for a reply.

On October 5, the following message was received from the Imperial Munitions Board:

Ottawa, Oct. 4, 1918.

GEO. C. MACKENZIE,
510 Pacific Building,
Vancouver, B.C.

We have cabled substance of your report to Ministry.

In reply they express great appreciation of your work and trouble in this matter and ask us to convey this appreciation to Mines Department.

They regret that they have to decide against proceeding with operations on lines you indicate.

The ground for this decision is that in view of the time required for exploration and for providing necessary equipment they do not anticipate that less than twelve months would elapse before appreciable quantity of platinum was secured.

This would not meet their purpose.

Apparently situation is purely an emergency one as they would like to hear if we find any source of quick supply.

(*Sgd.*) FITZGERALD.

On October 8, the Imperial Munitions Board furnished the Secretary with a copy of their cablegram B 8147, in which this proposition was laid before the British Ministry of Munitions. A copy of this cablegram follows hereunder:

Ottawa, Sept., 25, 1918.

REPRESENTATIVE,
Imperial Munitions Board,
London.

B 8147. M 5256 Regarding Platinum.

Expenditure of $7000 per month suggested by Mines Department is for drilling in district where indications are promising.

Mackenzie Mines Department who is on the spot reports the ground is either open and can be staked for Crown under British Columbia mining laws or where not open can be secured by payment of nominal royalty.

His opinion is that platinum occurs in commercial quantities at present prices and can be secured by expenditure of capital.

If drilling results confirm his present opinion he suggests follow with dredging operations.

He estimates that on present indications recovery would be two ounces platinum and two ounces gold per thousand cubic yards.

He estimates cost of dredging ten cents per yard and initial expenditure five hundred thousand dollars.

He estimates fifteen million cubic yards available for dredging which could be treated at rate of five hundred thousand yards monthly producing one thousand ounces of platinum monthly on above estimate.

You will recognize that estimate is merely based on small washings and requires to be checked by regular drilling.

In any case dredging is an uncertain operation and commercially speaking is generally a gamble.

The immediate question is whether Ministry requires platinum in considerable quantities sufficiently urgently to justify them spending between $10,000 and $50,000 in drilling a promising prospect.

If so it would be determined after drilling whether results justified installation of dredging operations.

Drilling is an exploring operation and will not itself produce platinum in substantial quantities.

Can you get this question decided at once as Mackenzie reports that in view of seasonal conditions work must be begun at once if drilling is to be done this year.

We should be glad therefore if you would send immediate reply.

(*Sgd.*) IMPERIAL MUNITIONS BOARD.

It is to be noted that in the sixth paragraph from the bottom of the above cable the Imperial Munitions Board made the following statement:

> In any case dredging is an uncertain operation and commercially speaking is generally a gamble.

The above statement is so inconsistent with the facts of dredging operations throughout the world, when these operations have been preceded by careful drilling, that the Secretary immediately sent the following telegram to the Imperial Munitions Board:

Vancouver, B.C., Oct. 8, 1918.

EDWARD FITZGERALD,
Imperial Munitions Board,
Ottawa, Ont.

Have received your telegram October fourth and regret decision of Ministry regarding Tulameen but will not stop operations until Canadian Government issue instructions.

Regarding your cable B-8147, September twenty-fifth, to Ministry, you state therein that *in any case dredging is an uncertain operation and commercially speaking is generally a gamble.*

This assertion is not true providing that dredging is preceded by careful drilling.

Camsell and myself consider your cable misleading in this particular and suggest you correct the erroneous impression which you have undoubtedly conveyed.

field-work? I feel confident that if the Canadian Government will continue the work, platinum in considerable amounts will be proved to exist in the Tulameen and adjacent streams.

Yours very truly,

(*Sgd.*) GEO. C. MACKENZIE.

Secretary.

Drilling operations were commenced with the 6-inch Empire equipment at Tulameen during the first week in September and were continued until December 2, when, owing to heavy snow storms, the work was stopped.

After the Imperial Munitions Board advised that the British Government was no longer interested in the drilling of the Tulameen river, the Secretary laid the whole matter before the Honourable Martin Burrell, who was then in Vancouver, and pointed out to him the desirability of continuing the attempt to prove the value of the ground, because all the equipment being on hand it would be unwise to stop operations until the Canadian Government had an opportunity of reaching some decision in the matter. Mr. Burrell agreed to this proposal and after returning to Ottawa instructed the Secretary to continue drilling operations until December 15, 1918.

In addition to the exploring of placer ground by means of core drills, the Commission engaged Mr. Wm. Thomlinson of New Denver, B.C., to examine, sample, and report upon certain occurrences of ores and minerals in British Columbia that were alleged to contain platinum. It was manifestly impossible to examine every occurrence brought to the attention of the Commission, as this would have entailed more work than time permitted and was beyond the capacity of the assay-laboratory facilities placed at the disposal of the Commission by the Department of Mines.

Mr. Thomlinson's instructions, therefore, were to confine his investigations to localities within easy reach of rail and steamboat transportation and exercise reasonable judgment in the sampling of occurrences, with regard to their possible commercial value in the immediate future. Mr. Thomlinson's work which is described in his reports entailed a great deal of travelling and required familiarity with the country. The fact that the Commission had undertaken this work of sampling and assaying absolutely free of charge, meant that Mr. Thomlinson's services were constantly in demand by prospectors and others who believed that they were in possession of claims which contained minerals carrying an appreciable quantity of platinum. It will, therefore, be recognized that in carrying out his instructions Mr. Thomlinson had to exercise some nicety of judgment in order to avoid useless work, and at the same time avoid overlapping the activities of others who have investigated some of these localities in the past. With due appreciation of these conditions, Mr. Thomlinson spent over three months in the field and completed his work with tact and resourcefulness in a manner highly appreciated by the Commission.

Many of the samples submitted by Mr. Thomlinson consisted of specimens of rock and ore in place, containing small proportions of platinum in a manner difficult of determination and in quantities rendering doubtful

the commercial value of these deposits. For instance, the copper ores of the Franklin camp in the Grand Forks mining division were found to contain some platinum, apparently in association with chalcopyrite, possibly as sperrylite, the arsenide of platinum, and in order to recover this platinum, the copper ore would of necessity require to be smelted, bessemerized, and subsequently refined electrolytically. Therefore, it may be assumed that unless the Franklin Camp ores contain sufficient copper to warrant their exploitation for that metal alone, there is small likelihood of these ores being worked for platinum itself. On the other hand, black sands from placer operations and from the mechanical concentration of certain platinum-bearing rocks which contain the metal in the native state may possibly be treated by a special process of amalgamation, explained farther on in a report by Mr. W. B. Timm.

In order to provide facilities for the assaying of all field samples of platinum-bearing ores and sands collected by officials of the Commission, the Mines Branch, Department of Mines, undertook the equipment of a special laboratory at the Dominion Assay Office in Vancouver and transferred Mr. H. K. Anderson of the Mines Branch staff in Ottawa, to the Assay Office in Vancouver for the sole purpose of taking charge of this work. The securing of correct results in assays for platinum is not without certain difficulties and there are few chemists in this country who have had either the opportunity or training necessary for precision assaying of the platinum group metals. The Commission desires to make special acknowledgment of Mr. Anderson's services in this respect, knowing that his work was accomplished with great care and accuracy.

The Department of Mines established a small platinum refinery at the Dominion of Canada Assay Office, in September, 1918, which received up to the end of December 124·58 ounces of crude and scrap platinum, of which amount only 38·81 ounces were crude. The operation of this little refinery did, however, encourage prospectors to send their deposits to Vancouver, instead of, as formerly, to the Eastern United States. The Commission recommends that in order to encourage platinum production in British Columbia the operation of the Vancouver refinery be continued and arrangements be made to accept and valuate deposits for sale at the current market price.

Platinum Resources of the Tulameen District, British Columbia.

By GEO. C. MACKENZIE

The Tulameen district lies in the Similkameen mining division, in the southern part of the Province of British Columbia, and is reached from Vancouver via Ruby Creek Junction and the Kettle Valley railway. Leaving Vancouver in the morning at 8.30 it is possible to reach Tulameen the same day at 4.30 in the afternoon.

The Tulameen river is a small mountain tributary of the Similkameen river, and in the early days was worked energetically for placer gold. A considerable quantity of platinum has been secured from the Tulameen in the past, but as the price of this material at the time of these early mining operations was only from $5 to $10 per ounce not much attention was given to its recovery.

Placer sluicing with hand labour was the only method of mining in the early days, and while several attempts at drift tunnelling in the bench gravels were made, these ventures were on the whole unsuccessful, chiefly because of lack of equipment on the part of the operators.

Only the richest portion of the river that would pay to work by hand labour was attacked, and when the Cariboo gold rush came in the early sixties the Tulameen district was practically deserted for the more attractive fields in the north. However, small operators, both Chinamen and white miners, returned to the Tulameen from time to time and have always taken out more or less gold and platinum, making wages with every attempt.

All these operations were confined to the upper portions of the river where the gravels were not deep and to the deeper cañons where a plentiful supply of water under sufficient head gave opportunities for working the stream to bed-rock wherever pay gravel was found.

The ground in the Tulameen valley between the mouth of Slate creek, which enters the Tulameen 3 miles above the town of that name, and a point some twenty miles down-stream where the Tulameen joins the Similkameen river, has never been worked, owing to the fact that the gravels are heavy and very deep.

One or two attempts have been made to ascertain the depth and value of these gravels by boring with power-drilling outfits, but these attempts were not carried out systematically nor with persistence, and all that has been accomplished is two or three holes which are reported to have struck pay-gravel at various points on the Tulameen between the town of Princeton and Slate creek.

Both Camsell[1] and Kemp[2] have described exhaustively the occurrence of platinum in this district, and there is no need of further amplification. Both of these investigators determined the fact that platinum, associated with chromite and magnetite, originated with the pyroxenite rocks of the district. It is interesting to note in this connection that we were shown several small nuggets of platinum encrusted with chromite which the uninitiated might readily mistake for pure chromite or magnetite. When these small encrusted nuggets were immersed in dilute nitric acid for a short time the coating of chromite was dissolved away leaving the kernel of platinum.

During our investigation in the field there were no large nuggets of platinum discovered, but we were shown a very fine collection of nuggets,

(1) Geol. Surv. Can., Memoir 26, 1913.
(2) U. S. Geol. Surv., Bulletin 193, 1902.

the property of Mrs. Cook, of Coalmont. The largest of these nuggets was about the size of a large kernel of corn, and the smallest about the size of a grain of wheat. These nuggets have been on exhibition at various times and as they form a unique collection should be acquired for the museum of the Department of Mines in Ottawa.

The upper portion of the Tulameen river lying above the mouth of Slate creek has a more or less cañon-like character, the banks being very steep and precipitous, and this portion of the river is being worked at the present time by prospectors for the recovery of the precious metals. Some of these prospectors are working the high benches from 50 to 100 feet above the creek bottom, whilst others are attempting to recover the gold and platinum from pot-holes in the river-bed (Plate XXXVI); but the sum total of their operations is rather small, and the production of precious metals almost negligible, making little better than wages for the operators.

Below the mouth of Slate creek, and for 3 miles down-stream to the town of Tulameen, the character of the river is decidedly different. The river valley broadens to an average width of 900 feet, and the gravel lies in large bars and low-lying benches at depths that vary from 20 to over 100 feet. This is the area that should be prospected by means of core drills. The total quantity of gravel has been roughly estimated at 15,000,000 cubic yards, most of which consists of heavy coarse pebbles with many boulders the size of a football. Large boulders weighing many tons are occasionally encountered, but are by no means numerous and should not present any serious difficulties in dredging operations. (Plates XXXVI and XXXVII.)

The Kettle River railway touches the Tulameen river at the town of Tulameen, 3½ miles below Slate creek, and follows the river for a distance of approximately 20 miles to the town of Princeton. The question of transportation is therefore solved. The river valley between the town of Tulameen and Slate creek is not heavily timbered, although there is some quantity of poplar and jack pine with an occasional spruce of a good size and more rarely fir and red and white pine.

The river between Slate creek and the town of Tulameen drops 116 feet in a series of rapids interspaced with quiet stretches, and has an average rate of flow of about five miles per hour. The stream is not deep—probably the deepest holes directly below the numerous small rapids are not more than 15 feet. The average depth of the river at low water is about 1½ feet. Like all mountain streams, it is very turbulent in the spring of the year, but this condition should not seriously affect dredging operations if due precautions are taken.

In company with Mr. Charles Camsell of the Canadian Geological Survey, and an expert panner, the writer arrived at Tulameen during the first week in August and spent the following ten days in a preliminary examination of the gravels in the Tulameen and Similkameen rivers.

Samples taken during this preliminary work were sent to the Dominion

Assay Office, Vancouver, and the assay results are shown in the following table:

ASSAY RESULTS

Preliminary Investigation of Tulameen and Similkameen Rivers, Tulameen District, British Columbia

Sample No.	Location	Description	Gold per ton	Platinum per ton
			Oz.	Oz.
1	Tulameen river, at mouth of Bear Creek.	Combined black sand from two pans of medium-size gravel.	67·36	50·56
2	Tulameen river, at mouth of Slate creek.	Combined black sand from five pans of medium-size gravel.	1·52	17·51
3	Same as No. 2.	Combined black sand from three pans of medium-size gravel.	29·27	38·40
4	Same as No. 2.	Pebbles of magnetite.	0·02	Trace
5	Same as No. 2.	Pebbles of chromite.	nil.	Trace
6	Similkameen river, two miles above Princeton on south bank of river.	Combined black sand from two pans of sandstone bed-rock.	5·91	5·86
7	Same as No. 6.	One pan of river gravel at edge of bed-rock.	15·84	6·93
8	Same as No. 6.	Combined black sand from two pans of sandstone bed-rock.	3·47	0·33
9	Same as No. 6.	Sandstone bed-rock, without panning.	0·02	Trace

Note: These assay results show the presence of gold and platinum, but do not indicate the value of the ground per cubic yard.

On August 9 the party motored from Tulameen to Princeton, and as the road follows the hillside immediately above the valley of the Tulameen river we had a good opportunity to inspect the character of this ground.

A considerable portion of the valley consists of low, flat, gravel bars containing a large quantity of gravel which, if it proved to be valuable, could be dredged.

At Princeton we called upon the managers of the Bank of Montreal and the Canadian Bank of Commerce, and secured from them statements, given below, of the deposits of platinum which they have received during the past few years. Both banks have, until quite recently, been in the habit of shipping their platinum to refineries in the Eastern United States. The managers promised to hold any that comes in and forward it to the Dominion Assay Office in Vancouver.

Crude Platinum purchased by the Bank of Montreal, Princeton, B.C.

Date.	Depositor	Weight		Value
1916		Oz.	Dwt.	
Mar. 31	Thompson, C. W.	2	5	$ 135.38
April 18	Schubert, J. A.	3	4	166.17
May 26	Cook, F. P.	2	1	102.49
June 13	Schubert, J. A.	4	9	168.99
July 13	Schubert, J. A.	2	15	114.54
	Cantril, A. N.		11	21.22
Sept. 14	Schubert, J. A.	4	7	272.43
Oct. 30	Schubert, J. A.	2	9	152.51
Nov. 28	Thompson, Chas. W.		17	45.72
1917				
June 30	Wing Kong	1	15	123.85
July 9	Howse Co., A. E.	4	1	291.95
26	Schubert, J. A.		15	47.77
31	Schubert, J. A.	3	5	236.22
Aug. 18	Yin, c/o Wing Kong	4	8	318.31
Sept. 4	Wing Kong	8	2	566.84
5	Lung Kee	2	3	148.65
5	Schubert, J. A.	1	4	81.74
Oct. 10	McTavish, I.		4	13.10
15	Schubert, J. A.	3	7	224.01
23	Thompson, Chas. W.	1		66.77
Nov. 20	Thompson, Jos.	1	3	71.37
1918				
Feb. 20	Schubert, J. A.	2	10	160.11
Mar. 22	McTavish, I.	1		61.69
	Totals	57 oz	15 dwt	$ 3591.83

Crude Platinum purchased by the Canadian Bank of Commerce, Princeton, B.C

Year.	Oz.
1915	8·685
1916	2·365
1917	12·527
1918 (to Aug. 9)	5·250
	28·827

Returning to Tulameen, the party made camp at the mouth of Slate creek and decided to undertake sluicing on a small scale for the purpose of experimental tests.

Making use of an old ditch near the mouth of Slate creek, we coupled up some three hundred feet of sluice-boxes and washed 90 cubic yards of medium-size gravel (Plate XXXVII). Bed-rock was stripped and cleaned over an area of 20 square feet at the upper end of the sluice, but no bed-

rock was reached at its lower end. The operations were carried out in two tests. In the first test 27 cubic yards of gravel was washed from the upper end of the sluice and the ground cleaned to bed-rock. In the second test 63 cubic yards of gravel was washed but bed-rock was not reached. The black sand caught in the sluice-boxes was cleaned by means of rockers and forwarded to the Dominion Assay Office at Vancouver for recovery of both gold and the platinum group of metals.

The results of these tests are given in the following tables and show the actual values of the precious metals recovered:

Result of Washing Test on Tulameen River opposite Slate Creek

TEST NO. 1. Washed 27 cubic yards of gravel.

	Weight	Value	Value per cu. yd.
	Oz.	$	c.
Gold recovered	0·078	1.56	5·8
Platinum recovered	0·061	6.40	23·7
	0·139	7.96	29·5

TEST NO. 2. Washed 63 cubic yards of gravel.

	Weight	Value	Value per cu. yd.
	Oz.	$	c.
Gold recovered	0·2224	4.45	7·06
Platinum recovered	0·1859	19.51	30·96
	0·4083	23.96	38·02

TOTAL RESULTS. From 90 cubic yards of gravel (Combined results of Tests Nos. 1 and 2).

	Weight	Value	Value per cu. yd.
	Oz.	$	c.
Gold recovered	0·3001	6.01	6·67
Platinum recovered	0·2469	25.91	28·78
	0·5473	31.92	35·45

It should be noted that our appliances and methods were necessarily crude, and it is doubtful if the saving of the precious metals exceeded 60 per cent of the original content of the gravel.

Both gold and platinum were found to be in small rounded and flat grains. Some of these when examined under a strong magnifying glass showed sharp edges, indicating that they had not travelled far from their source. None of them could be called nuggets as they usually weighed less than one milligram.

After completion of the washing tests described in the preceding paragraphs it was decided that the results obtained justified more extensive examination of the ground. Dr. Uglow was therefore instructed to commence a survey of the Tulameen river between Slate creek and the town of Tulameen. While this survey was in progress the Empire-drill equipment was in transit from Fort Saskatchewan, Alberta.

Drilling with the Empire hand-equipment was commenced in September, and after the completion of 3 holes, the deepest being 62 feet, it was decided to install a power-drill of the Keystone type, as the gravels were too heavy and tight to allow of much speed being made with the Empire equipment.

The chief advantage of the Empire hand-drill is its mobility. It will take down so that the largest piece to be transported does not weigh more than 250 lb., and, providing that the gravels to be examined are not heavy and do not contain too many boulders, considerable progress can be made with this equipment. The manufacturers claim that the essential feature of the Empire is the rotation of the casing during the entire drilling operation. A platform is mounted on the top of the casing upon which four labourers stand and alternately lift and drop the drill rods to which are attached the drilling tools. Providing the ground is not very tight and does not consist of heavy gravel, the rotation of the casing by means of horse-power together with the weight of the equipment and the men on the platform will sink the casing as drilling proceeds, and the core of sand and gravel accumulated in the inside of the casing is pumped out as fast as it forms. (Plate XXXVIII.)

A power-drill of the Keystone type works in a somewhat different manner. The casing is driven into the ground for every foot made and as a general rule progress is made by alternately driving for one or more feet and then pumping the core accumulated from the previous driving. When exceptionally large boulders are encountered, drilling below the casing is resorted to and is generally permissible. The Keystone casing is larger and heavier than the Empire, and is driven by means of two steel driving-blocks bolted to the drilling-stem, the total weight of which is approximately 800 lb. In driving, some fifty to sixty blows are struck per minute with a fall of approximately 14 inches, and it is an exceptionally large boulder that cannot be drilled through, broken up, or pushed to one side by this heavy and continuous pounding. (Plate XXXVIII.)

When starting with the Empire drill it was quickly demonstrated that the ordinary Empire method of working would not make progress in heavy gravel, and it was therefore decided to erect a tripod over the drill platform

and with an ordinary pile-driver trip employ a 500-pound driving-block of fir in order to drive the casing in the same manner as a Keystone casing is driven. With this equipment, and using a horse to lift the driving-block, from two to four blows were struck per minute and considerably better progress was made than by allowing the casing to sink simply by rotation. Notwithstanding this additional equipment the Empire could not keep pace with the Keystone, and the power-drill was eventually used exclusively.

Drilling was continued until December 2, when a heavy fall of snow held up operations, and as no provision had been made to continue during the winter months, the work was stopped and the outfit stored in Vancouver.

From the comparatively small amount of work accomplished it is difficult to arrive at definite conclusions regarding the value of the Tulameen gravels, but it can be stated that results, incomplete as they are, warrant further investigation.

Eleven holes were put down, the deepest being 72½ feet and the shallowest 11 feet, with a total of 516 feet drilled. Six holes were put down to bed-rock, the others being stopped at depths at which the values did not warrant further drilling. Bed-rock was found to consist of a rather hard, green, quartz schist, which on panning yielded no black sand but abundance of fresh iron pyrites. Both gold and platinum were found to occur in small scales and pellets with an occasional gold 'colour' approximately ½ milligram in weight. Platinum in the ore samples could not be distinguished from drill-steel cuttings, and therefore no log could be made of its occurrence during drilling operations. Gold 'colours,' however, were logged in the customary manner.

Core samples, consisting of the total quantity of black sand from each hole, were forwarded to the Dominion Assay Office, Vancouver, and in every case the whole sample was melted down for assay. This entailed a great deal of work, but was considered necessary because of the difficulty in accurately cutting down to assay-ton samples. No attempt was made to amalgamate gold in the field because in the recovery of both gold and platinum by large-scale operations ordinary methods of amalgamation would not apply.

Complete data and results from the drilling operations are given in the accompanying table. If this table be studied in conjunction with the map of the Tulameen river prepared by Dr. Uglow (Plate XXXIX) it will be noted that only a very small portion of the ground has been covered. Consequently, nothing definite can be stated regarding the value of the ground for dredging operations on a large scale.

A definite conclusion can be reached only by completing the drilling of the ground. This, of course, would involve the expenditure of considerably more money, but all the necessary equipment is still on hand.

Acknowledgments are due to Dr. W. L. Uglow and Mr. Wm. Thomlinson, who superintended the camp and all drilling operations.