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METALLIC AND NON-METALLIC ORE-BODIES.

INTRODUCTION -

This brief report deals with some of the unworked and at present unworkable metallic and non-metallic deposits of Tasmania. It is prepared at the instance of the Development and Migration Commission for their particular information in order that the difficulties hampering development might be further investigated by their officers.

Such difficulties may be due to -

1. Complex nature of the ore,
2. Poor markets,
3. High cost of transport to market,
4. High cost of power,
5. High cost of proving the value of undeveloped ore-bodies,
6. or a combination of these and other causes.

In the preparation of two of these notes information has been obtained from Mr. Hartwell Conder of Strahan relating to the Oonah Mine and from Mr. R.B. Montgomery of Hobart relating to the Fraser River ilmenite deposits.

METALLIC ORE BODIES.

The following is a list of the metallic deposits not being worked at present owing to one or more of the causes enumerated:-

1. The Stannite ore-bodies of the Ooonah and Queen mines at Zeehan.

2. The copper-nickel pyrrhotite ore bodies of North Dundas, near Zeehan.

3. The pyrrhotite-cassiterite deposits of Renison Bell and Mt. Lindsay.

4. The magnetite and hematite ores of iron

5. The gold-bearing sands and slimes of the Tasmania mine, near Beaconsfield.

6. The ilmenite-cassiterite sands of King Island and elsewhere.

7. The barium deposits of Mt. Block and elsewhere.

8. The molybdenite deposits of Mt. Remus.

9. The alluvial tin ore deposits of the Ringarooma Deep Lead.

Notes and reports on 1 and 5 will be sent when the required information is at hand.

2. COPPER-NICKEL ORES OF NORTH DUNDAS -

These ores consist essentially of pentlandite, chalcopyrite and pyrrhotite and are contained in or closely associated with basic igneous rocks of gabbro and norite character.
The difficulties to be overcome are -

1. The finding of a suitable market. From 1914 to 1928 the Government held 600 tons of these ores and could not market them at a satisfactory price. ultimately the parcel was sold at 20/-per ton at the place of storage. The ore contained nickel in the proportion of 9% and copper of 5%.
Lately an enquiry has been received through the American Consulate from a New York firm.

2. The preparation of the material for market. Owing to the unstable condition of these sulphidic compounds spontaneous combustion is likely to result from long exposure to the oxidising action of humid air. One shipment caught fire at sea, and shippers subsequently refused to carry the ore. For that reason and in order to concentrate the valuable contents, the Department suggested smelting to matte before shipment. Heap roasting has been adopted as a preventative.

3. The cost of mining this ore to a depth of 120 feet is not excessive, but at that depth is met a channel of underground water of extraordinary flowage under pressure. At that level also the greater part of the sulphides have been replaced by secondary quartz. The Department suggests the use of electric pumps.

Note: Bulletin 36 giving details of these ore-bodies is appended.

3. THE PYRRHOTITE-CASSITERITE DEPOSITS.-

At Renison Bell and Mt. Lindsay are considerable bodies of tin ore in intimate association with pyrrhotite. The bulk of the tin ore is free, but a considerable portion is locked up in the pyrrhotite in a very fine (almost colloidal) condition. Tests in the laboratory show that very little of the occluded tin appears in the form of sulphide or stannite.

The processes of treatment at present consist of crushing to the grainsize of the free tin ore, separating the free tin ore, and concentrating the pyrrhotite-cassiterite mixture. The latter product is then roasted in a furnace preferably of the Hereschoff type, and pulverised before retreatment upon concentrating tables. In practice it is found that a loss of at least 30 per cent results from the treatment of this very fine tin ore.

It is suggested that the sulphur may be converted into sulphuric acid and that the iron oxide residue, after exposure to enhance its colour, may be bagged and sent to market as re d ochre.

The difficulties at Renison Bell are chiefly of treatment and the separation of by-products. At Lindsay these are added to by very high cost of transport. The cost of transport of tin ore from the mine to the railway at Renison Bell amounts to £1 per ton per mile (15) and of goods to Mt.Lindsay 30/- per ton per mile, moreover, light portable machinery only can be taken over the swing bridge at the Pieman River crossing.

Note: Reports are appended.

NON-METALLIC DEPOSITS.

The following is a list of non-metallic deposits not being worked at present to the fullest extent owing to one or more of the causes enumerated:-

1. Trias-Jura Coals of Eastern and Midland Districts,
2. Kerogenites or Cannel Coals and Kerosene Shales of Preolenna,
3. Tasmanite Shales,
4. the manufacture of aluminous cement and the smelting of aluminium,
5. Magnesite and dolomite deposits of the Victory Mines, Arthur River.

1. TRIAS-JURA COALS -

The coals of this age consist of a series of eight seams in all, and are developed extensively in Midland, Eastern and South-Eastern Districts. They are of the sub-anthracite and non-caking humic varieties. The seams range in thickness from 2 to 12 feet.

Greatest development has taken place in Mt. Nicholas area where are situate the Cornwall, Jubilee and Mt. Nicholas Mines.

Production is limited to the local market owing to the high ash content of the coals and to the non-caking quality of the residual carbon and ash. Production in 1928 amounted to 128,5000 tons valued at £106,558.

These coals are used for household purposes, and, mixed in equal parts with Newcastle coal, are used extensively in locomotives.

They are suitable for steaming purposes in powdered form because of the generally high fusion point of the ash and the low sulphur content. In that form they are used at the Maria Island Cement Works and in smaller quantity at the Railton Cement Works. Owing to the high ash content, the development of an Inter-State trade appears impossible under existing economic conditions.

Improvements in machinery for the use of powdered coal in railway locomotives and marine boilers, however, may provide an outlet for a great increase in production. The recent arrival in New Zealand waters of the s.s. "Horarata", using powdered coal, is of particular interest as showing the latest trend in fuel development. Information relating to the application of combined pulverising and burning plants is desired for stationary and locomotive boilers and for use in rotary kilns and smelting furnaces. In Cornwall a system has been evelved for the use of powdered coals of high ash content in tin smelting.

2., KEROGENITES OR CANNEL COALS AND SHALES -

These belong to the lower coal measures and are found at Preolenna, Mt. Pelion, and at Mersey Valley.

In this statement the Preolenna coals and shales only will be dealt with, being the most important.

The Preolenna field covers 10,000 acres and contains five seams in all, two of which are not continuous. Steam and gas coals and the so-called kerosene shales are found

in seams varying from a few inches up to two feet and over. They are of exceptionally high calorific value, highly combustible, capable of withstanding the shock of heavy handling, and have a low ash content, but contains an excessive proportion (5 to 8 per cent) of sulphur, both intrinsic and extrinsic.

Because of the thinness of the seams the cost of mining is high. They can be opened through dip adits from Inglis River and Flowerdale River valleys.

Transport conditions are generally favourable, but haulage is necessary from all mine openings to the railway.

The high proportion os sulphur precludes its use as a fuel in steam engines unless mixed with a coal of very low sulphur content. Treatment in washing machines reduces the extrinsic sulphur (marcasite and pyrite combinations) considerably.

The coals, although highly combustible and containing a high proportion of sulphur, find a ready local market for household use at 15/- per ton.

Marketing -

The department has endeavoured to find another market for these coals. In time of shortage, owing to strikes affecting sea transport, the Gas Company at Launceston has drawn supplies from this field, and the Emu Bay Railway Company is now prepared to take regular supplies at the rate of 50 to 100 tons a week for use in locomotives.

The one scheme that seems feasible for the mining of these coals on a commercial scale is that of low temperature distillation for the production of oil. In this connection L. and N. (Tas.) Ltd., now interested in the tasmanite shale deposits of Latrobe, has made preliminary investigations.

Note: Details are given in the Coal Resources herewith.

3. TASMANITE OIL SHALE -

Deposits of this material have been opened at Latrobe, Railton, Nook, Beulah, Cheshunt, Quamby Bluff, Henrietta and Oonah. One seam only 4 to 5 feet thick is known. The seam is disrupted by minor and major faults and the areas are thus divided into a number of small mining fields. Economic conditions are generally favourable.

In addition to the proved areas others are known and are to be explored by drilling.

Parcels up to 50 tons were sent to England and America for testing on a commercial scale. No less than nine retorts have been tried, some of the internal heating, others of the external heating type. Smaller parcels were sent for experimental purposes to many science institutions in America and England. Very little information of value was obtained from those investigations. During the past five years great progress has been made by local engineering chemists and most of the problems of distilling seem to have been overcome. The chief difficulties may be enumerated as follows:-

1. Carbonisation or accumulation of carbon from burnt shale on the walls of the retort and on the internal machanism;

2. Intumescence of the material on heating and later coalescence and coagulation forming a mass impervious to heating gases;

3. Choking of condenser tubes with dust and burnt shale;

4. Emulsification of oil and water;

5. An excess of sulphur;

6. Disposal of the ash;

7. By products.

In discussing these problems the results obtained from the three latest retorts will be given.

Internal heating type -

(a) Bronder Retort

External heating type -

(a) Schultz Retort

(b) Long Retort

The Bronder Retort is of the vertical type fed at the top and heated by means of gas burners below. The large size retort was designed to treat 240 tons per day - the actual capacity was 49 tons.

The operators found that -

1. owing to the presence of air, carbonisation set in;

2. the heavy charge made it necessary to over heat the shale in order to effect distillation. This resulted in a "burnt" oil containing an inordinate proportion of unsaturated hydro-carbons in the distillate and a partly fluxed congealed mass that would not pass through the discharge grates. Improvements wereeeffected by reducing the charge to half and by coarser crushing in order to provide large air spaces between the pieces of material in the retort.

3. Drawing off the gases at the top of the retort only, necessitated such a strong fan draught that dust was drawn into the condenser tubes and choked them. Arrangements were made to draw off the gases at lower pressure from two levels in the charge.

4. Wet feed resulted in the condensing of a large volume of water with the heavy (sp. gr. 0.95. to 0.97) crude oil resulting in the forming of an emulsion that could not be broken down with the appliances at hand.

5. The oil contains an excess of sulphur (up to 3 per cent) in many combinations, which give to it an offensive odour.

6. Although the ash contains little fertilising value it apparently has a good mechanical effect on heavy soils and its sulphur compounds acts as insecticides.

There appears to be market for this material.

7. By-products of the oil were not investigated by this Company. The separation of phenol, pyridine and creosote may add greatly to its ultimate value.

Summarising the results of the experiments with this internal heating type of retort, the opinion may be expressed that, although the principle of internal heating may be sound, its application on a commercial scale has not been established, and that, although retorts of that type have a much greater capacity, the running down of one unit would have a serious effect on the rate of output of the whole.

External Heating Type -

(a) Schultz Retort.

This retort is modelled on the Rolle plan, which includes an internal mechanism for keeping the material in motion during the process of distillation. After a short run the retort, mechanism, and condensers became choked with dust and carbon.

(b) Long Retort.

The inventor of this retort came into the field knowing all the difficulties that beset the others. He thereupon worked to overcome the major difficulties before attempting experiment on a large scale. The result is a great advance in our knowledge of retorting as applied to oil shales of this kind.

Long overcame carbonisation by introducing into the coarsely crushed charge carbon monoxide gas from a producer plant, the carbon monoxide taking into combination the oxygen of the air that found its way into the retort.

He found that by low temperature distillation coalescence did not result, and that by drawing off the volatile oils at three levels the dust nuisance could be avoided. Moreover, by pre-heating the charge almost to the temperature of distillation before feeding the retort little or no emulsion would be formed.

Long so designed his retort as to provide standard inter-changeable parts and in groups of four. Each retort designed to treat 10 tons of shale per day of 24 hours and each is so placed as to allow of stoppage and attention to repair without affecting the operation of the others in the group.

A trial run of three weeks was made under the control of Messrs. Avery and Anderson, Chemists, of Melbourne. They report a satisfactory performance, quite up to the claims of the inventor.

Summarising the results of the experiments with the external heating type, it is found that internal mechanism is to be avoided, that better control can be maintained with the external than with the internal heating type, and that the external is more economic and produces a better grade of oil.

As regards mining this shale, the seam is of suitable thickness for economical mining and the presence of a mudstone band in the middle provides for an easy preliminary

cut. The seam lies between beds of hard mudstone which forms a strong roof and a hard floor. Although the shale is very tough it can be bored with ease by the use of jack-hammer drills. Cutting machines are useless owing to the presence of numerous boulders and pebbles of hard quartzite.

The tough shale is broken in the mill by diamond tooth rollers.

In the interests of the industry it is essential that the Commonwealth Bounty be retained until the companies become firmly established.

LINES OF INVESTIGATION -

It is suggested that the proportion of the by-products pyridine, phenol, etc, be determined in order to ascertain whether their separation would prove of advantage and that a process for the reduction in the proportion of sulphur would add greatly to the market value of the oil.

In the process of distillation this Department has found that limestone has a catalytic action on the conversion of the wax into oil, and a mechanical action in providing a better passage for the gases and in adding to the mobility of the shale in the retort. Moreover, its presence would add to the value of the ash as a soil improver.

This information has been given to the companies operating at Latrobe, but they have not yet made use of it, being more concerned with the larger problems before them. The carbon also of the shale appears to exert a catalytic action.

Note: The Oil Shales of Tasmania is sent herewith.

4. THE MANUFACTURE OF ALUMINOUS CEMENT AND THE SMELTING OF ALUMINIUM-

are matters that have come up for consideration by this Department.

One of the ingredients (limestone) of aluminous cement is available in very large quantity, but the other (bauxite) it is proposed to bring from Dalmatia. It is proposed to use the La Farge electric process, the Australian rights of which, it is understood, is held by a Launceston group. A thorough investigation of Australian resources of bauxite is desired.

A year or two ago the representative of an English company came to Tasmania to secure rights over Lands on the bank of Tamar River for a site for an aluminium smelting works and to arrange terms with the Hydro- Electric Department for 13,000 horse-power. This company expressed their intention of erecting works in Tasmania if the Federal Government would agree to the imposition of a 10 per cent duty on aluminium ingots, which are now admitted free. The Minister for Customs (the late Mr. Pratten) could not give them any encouragement to continue negotiations with the Government to that end.

5. MAGESITE AND DOLOMITE DEPOSITS OF THE VICTORY MINE, NEAR TAKONE, ARTHUR RIVER. -

Large bodies of magnesite and dolomite, derivatives of pyroxenites by natural secondary processes, lie on the south

bank of Arthur River six to seven miles beyond the terminus of Preolenna Railway.

It is understood that an offer of £1 per ton at Burnie for 15,000 tons per annum has been received by those interested. The rail cost to Burnie amounts to 3/11 per ton.

Difficulties are -

(a) the necessity of tramway connection with the railway, and

(b) a thorough preliminary exploration of the ore-bodies. If the bodies prove to be very large and of a uniformly high grade and a market such as that mentioned be available tramway connection seems warranted.

The Department has carried out a preliminary investigation, the results of which appear in the appended report.

By: W. Reid.

MAGNETITE AND HEMATITE ORES OF IRON.

A. Magnetite ore-bodies of exceptional quality are found in commercial quantities at -

1. Tenth Legion Mine, near Mt. Agnew, six to seven miles from Zeehan. These ore-bodies at the time of the official investigation in1919 were estimated to contain2,900,000 tons; but the estimate of G. and C. Hoskins Ltd. of Lithgow since their developments during the past nine years, is placed at 14,000,000 tons. (It is the intention of the Department to make another investigation soon in order to ascertain whether the reserve has appreciated to that extent as a result of the development work performed in the meantime.) Open-cutting and mining methods of excavation. A two-foot gauge steel-rail tramway from Zeehan railway station terminates within two miles of the mines, and surveys have been made for a standard gauge (3'6") railway to connect with the Zeehan-to-Strahan line.

2. Rio Tinto Mine, 20 miles by road west of Waratah. These are very extensive lenticular bodies, 100 to 200 feet wide, extending at intervals over a distance of 3 miles. They are rich and clean at surface, but gradually become contaminated with pyrite from a depth of 100 feet. They have been cut through to a depth of 400 feet by Savage River and tributaries. Matrix: basic igneous schists.

Magnet Range on the east forms a great barrier to lines of transport, and the natural outlet through Pieman River is hampered by a difficult entrance to that port and very broken intervening country. Their exploitation does not appear practicable at present. The reserve is calculated at 16,000,000 tons.

3. Hampshire, six miles east of Hampshire siding on the Emu Bay Railway, which is 20 miles from Burnie. Transport cost on Emu Bay Railway would be high owing to heavy adverse grades. The quality of this ore is excellent. It is contained in garnetised limestone in association with granite and intrusive bodies of amphibolite. The dimensions of these bodies, which crop out at intervals over a distance of a mile, have not been determined.

4. Beaconsfield (Mt. Scott and Mt. Vulcan). Bodies of magnetite, its alteration product limonite, in association with chromite, are found six miles west of Beaconsfield. These bodies are being explored by the Department at the present time in order to ascertain their size and value. Many years ago chrome-iron was smelted here.

The result of the drilling so far performed shows that the bodies are not very extensive. The chromium content is not high, but full details are not yet available.

The Tenth Legion and Rio Tinto areas have been held under lease by G.& C. Hoskins Ltd. for 9 years. This Company has complied with the expenditure clauses of the Act and has performed a very valuable work in developing the ore-bodies, but no intimation has been givenas to their proposals for exploitation.

(It may be of interest to you to learn that a clause is to be inserted in the Regulations under the Mining Act giving power to forfeit any mining rights if productive work be not undertaken within a reasonable time.)

The Hampshire area is held under lease by L.J. Smith of Ulverstone, who has not been able to deal with it.

B. Hematite ore-bodies are found in the northern part of the country the more important being at Deal Range and Blythe. These bodies are iron oxide replacements of conglomerates and sandstones of Silurian age. In some parts replacement has been complete, and the ore is rich; in other parts incomplete and the ore is associated with silica.

1. Dial Range - over 40,000 tones of hematite has been shipped from this area where the several bodies have been opened in deep cuts. Selective mining is necessary to obtain high grade ore, although in parts the material can be broken and shipped in bulk.

2. Blythe River - these deposits have been examined at different times by officers of the Department and by other geologists and mining engineers. The latest investigation (performed by McIntosh Reid) shows that the estimates formed by other officials are not justifiable. The ore-bodies are certainly very extensive, but except at a few places, are too siliceous to be of any actual value as ores of iron. Consideration of the foregoing brief account will convey the idea that the magnetite iron ores are the more valuable, and that the sampling of those bodies only can be regarded as reliable. Contained in basic igneous rocks or in garnetised limestone uncombined silica is found in very small proportion.

The difficulties confronting us are due to-

1. Lack of suitable lines of transport

2. The richest deposits are held under lease by the one Company, who apparently do not intend to work them for some time.

SUGGESTED LINES OF INVESTIGATION -

Electric smelting in Tasmania does not appear altogether impracticable? Can consideration be given to the economics of this question?

The actual reason for the long delay in the mining and shipment of magnetite from Mt. Agnew to the Port Kembla Works of G.&C. Hoskins Ltd. is not known to us. It may be that the Company has ample reserves in New South Wales, in which event we cannot look for an early start in Tasmania. We do not wish to appear unreasonable, but think that after nine years, the time has arrived for the starting of production on a commercial scale.

(Note: Attached are reports in details)

6. Ilmenite and other titanium ores are found in commercially large alluvial deposits at many places in Tasmania and its dependency, King Island. The chief difficulties to be overcome in their exploitation are-

Separation from associated heavy minerals:

cost of transport;

preparation in marketable form;

extension of the markets.

In dealing with this subject notes on the ilmenite-cassiterite sands of Fraser River, King Island, will be given as an example.

Composition of the deposit -

ilmenite about 60 per cent (varying between 30% and 90%)
quartz sand 30% (approx.)
zircon " 10%

The tin ore content ranges from nil to 60 lbs. per cubic yard. The latest systematic prospecting with the use of a drill gives an average content of 4-1/3 lb. tin oxide per cubic yard over a length of 30 chains and a width of 1 chain. (Weight of a cubic yard - about 2 tons).

The problems here are:-

To discover a profitable method of separation of each valuable mineral (tin ore, gold and ilmenite); and to find a market for ilmenite or a profitable process for bringing that ore into marketable condition.

WET METHODS OF CONCENTRATION OF TIN ORE-

Owing to the high specific gravity of the associated ilmenite (4.5 to 5) and of zircon (4.2 to 4.86) sands, effective separation and concentration depend upon classification of the sand either by sieving to even sizes or by grinding the whole mass to a fine powder before passing it over a concentrating table. By the latter process the ilmenite is brought to such a physical condition that a separationof the tinore and its concentration to 65% tin grade can be effected without serious difficulty; but whether the ilmenite can be separated from the gangue in a later operation is questionable.

DRY CONCENTRATION BY MAGNETIC SEPARATION OF THE LIMENITE-

It is found that ilmenite separates easily from the Quartz and Zircon sands, with a titanic oxide content of 47 per cent. (It is worthy of note here that the best assay for titanic oxide was obtained from ilmenite concentrated on a Wilfley table.)

Dry concentration reduces the bulk of sand 60 per cent, the residue being Quartz, Zircon, etc. It seems that grinding or sizing of the residue is necessary before a satisfactory separation of tin ore can be effected by processes of wet concentration.

MARKETING -

Frequent inquiries have been received for ilmenite during the past two or three years from paint manufacturers and from company promoters. One mainland paint manufacturer has been supplied with crude ilmenite sand for experimental purposes. That firm was unable to effect a clean separation from the Zircon.

Another firm (Sydney) appears to have examined the problem of ilmenite reduction fairly thoroughly, but has not been able to launch out because it would be necessary: to buy the patent rights attaching to the process of reducing ilmenite to titanium white; to import a chemist having actual experience of the work, and to install a large plant.

After close investigation it was found that production on a commercial scale would be in excess of Australian requirements for paint. When this firm learnt that a high grade ilmenite could be obtained from Tasmania at much lower price than their supplies, the manager suggested the reduction of the ilmenite on the spot to a

more marketable form. A smelting process was indicated, but no details were offered regarding the method of treatment nor of the required qualities of the product. (This firm stated that they would be willing to invest in the work of producing titanium ores from the deposits under reasonable conditions. This is mentioned as indicating a growing demand for titanium oxide for the production of high quality paint.)

I opine that a survey of existing markets for titanium ore, the development of an Australian market and the promotion of industries to those ends are matters of considerable importance to Australia. A more extended market may be obtained by preparing titanium oxide for special cements which are now coming into more general use.

The potential reserves in King Island and in Tasmania are of such magnitude that thorough investigation of the problems are warranted. Such problems are -

1. The elimination of the associated Zircon,
2. The separation of tin ore,
3. the reduction of the ilmenite compound on the spot in order to concentrate the titanium component and thereby greatly increase the value. (The Department is continuing research to this end.)
4. The provision of a large market.

Appended are reports in detail on some of the more important deposits.

7. THE BARIUM DEPOSITS OF MT. BLOCK AND ELSEWHERE -

In the accompanying report accounts are given of all the known important deposits except Mt. Block, which, on the authority of prospectors, is of extraordinary size. A futile attempt, owing to heavy fall of snow was made by an officer of the Department last winter to reach Mt. Block.

Difficulties attendant to the development of this branch of the mining industry are -

cost of transport over land,
" " " " sea,
a weak market and
a suitable method of preparation for market.

Take the Mt. Block body as a subject of discussion. It lies seven miles east of the Emu Bay Railway at the Cue River Crossing. The route is ill-defined and through rough country. Tramway construction would be costly, and transport by rail to Burnie and by ship to Melbourne would be so great as to leave no margin of profit. The only scheme that seems likely to prove successful is that of its manufacture into marketable products such as titanox and lithopone at Burnie.

The Department of Mines has produced colloidal barium sulphate at Launceston laboratories by the process of melting with common salt. The process depends upon the property of salt in a molten condition of retaining barium sulphate and not retaining any other substance such as ores of iron and lead.

Note: Reports are appended.

8. MOLYBDENITE AT MT. REMUS -

It is doubtful whether this undeveloped deposit is worthy of inclusion in the list, but a place is made because this appears a promising body in a new field. The veins are small, but very persistent along the strike.

Mt. Remus lies between the settlements of Lorinna and Tullah and is accessible only by way of a steeply graded track from Lorinna. At present the deposits are of no economic value because of high cost of transport.

Report attached.

9. THE RINGAROOMA DEEP LEAD.

The Ringarooma Lead of Tertiary Age lies in some part under deep cover of basalt and in some parts under cover of quaternary and recent alluvium. The sub-basaltic tin ore deposits of Briseis Mine lie in a tributary of the old lead which before the basalt eruption received the drainage on the north side of the Blue Tier and other granite ranges. The heavy minerals in the waste of this granite and its veins of tin ore were concentrated in the bed of the Tertiary Ringarooma River now 100 to 200 feet below the surface.

It is desired to explore this lead by drilling, and that proposition is now under the consideration of the Government.

The chief difficulty, supposing that the results of drilling prove tin ore-bearing beds of equal value to those of Briseis, is to devise a scheme for the exploitation of the deposits. At present, the depth limit of the largest tin-ore dredges in use ranges from 80 to 100 feet. It may be possible to draw up a plan of working to that depth in a series of deep benches.

No information is available regarding the tin ore content of these deposits.

Whether the later (Quaternary to Recent) cover-beds contain tin ore in profitable proportion at any place requires a more thorough investigation for an answer. Drilling, moreover, would prove of the greatest advantage to such operating companies as the Briseis, Pioneer, Moorina and Arba.

As regards the development of the tin-mining industry in north-eastern district, this work seems to offer the greatest promise.

A report in detail on the upper section of the lead is appended. The Government Geologist is about to extend his survey over the lower section in order to define its course towards the sea.