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Phosphate Deposits in Tasmania

BY

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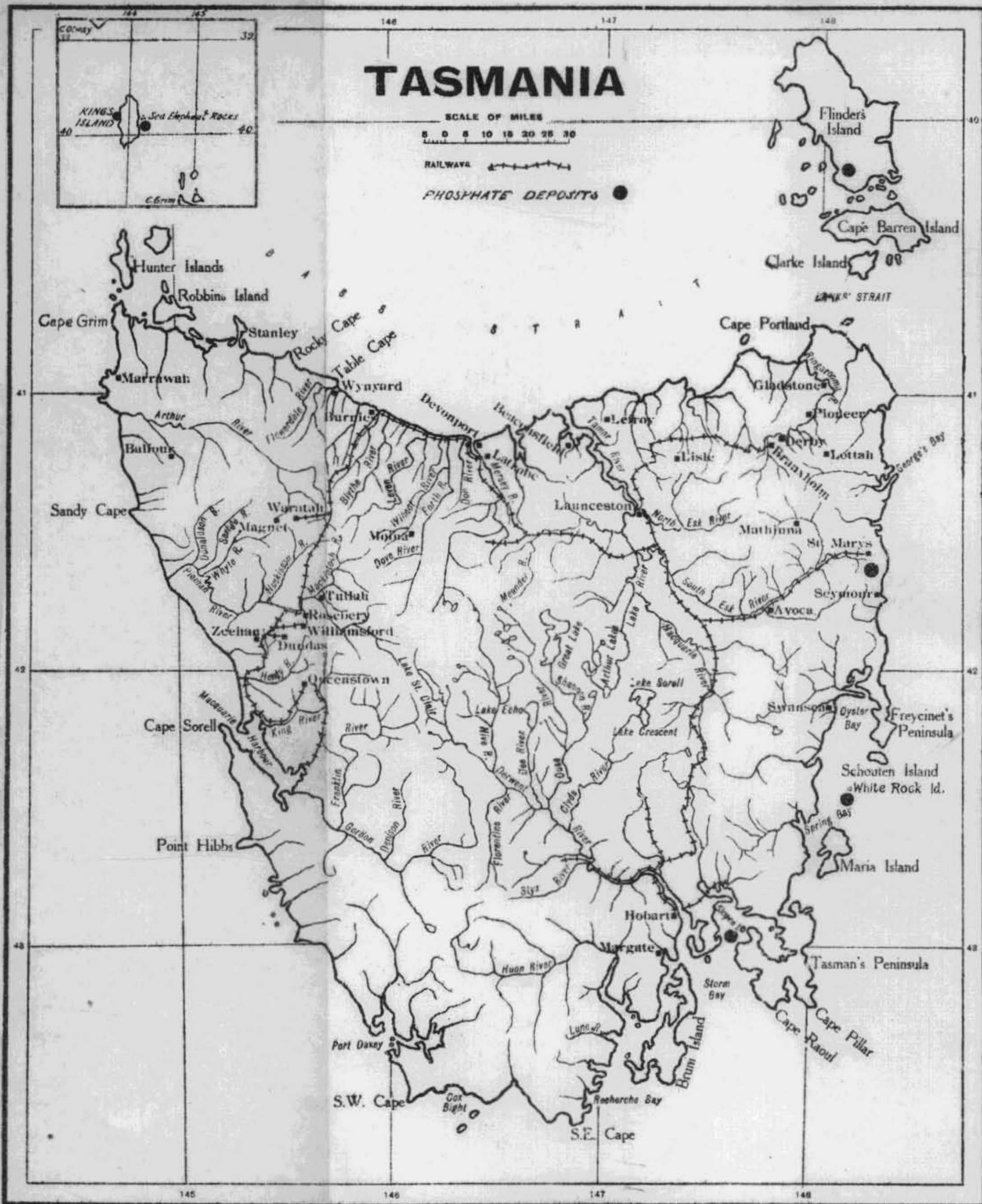

LOCALITY MAP

Photo Algraphed by John Vail Government Printer Hobart Tasmania.

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I.—Introduction.

THE necessity for phosphoric acid in modern agriculture rests on the fact that phosphorus is an essential element of plant food. Consequently, the farmer is anxious to replenish his exhausted soil with fresh supplies of this important substance. It is taken up by the plant in solution; the replenishment must therefore be in a soluble form. Tribasic phosphate of lime is the form in which the necessary phosphoric acid is obtainable. This is insoluble in its raw state in water. It is consequently ground and dried and mixed with sulphuric acid. The resultant superphosphate is soluble and available for plant food.

Owing to the consumption of sulphuric acid for war purposes, the manufacture of a soluble phosphate without making demands on the supplies of this acid is a special desideratum, Some methods have been devised to this end, but have not yet come into general use.

The importance of ascertaining what are the natural supplies of phosphate rock in Australia has been realised by the Commonwealth Advisory Council of Science and Industry, and the State Governments have been approached with a view of obtaining what information the geological services of the respective States may have available. The present report has been prepared in order to record briefly what is known respecting phosphate deposits in Tasmania.

II. Mineralogy.

Natural phosphates are derivatives of tri-basic phosphoric acid (orthophosphoric acid) H_3PO_4. The phosphatic ingredient of phosphate rock is tri-basic phosphate of lime ($Ca_3P_2O_8$). This figures in trade lists under the name of bone phosphate. The value of the crude rock is

dependent on its content of phosphoric anhydride (P_2O_5). The latter is usually referred to as phosphoric acid.

The division of phosphoric-acid-bearing rock into phosphorites and phosphates is very loosely followed. The pneumatolytic apatite rock, which is the source of mineral phosphates, is called phosphorite; but the term has been extended also to the more compact varieties of any phosphate rocks, reserving the name phosphates for the earthy varieties of lime phosphate. Pure apatite contains about 90 per cent. phosphate of lime, and is the sole mineral source of this substance.

Apatite, when it occurs as fresh-looking crystals, is brilliant, colourless, to greenish or bluish. The colour, however, is variable, yellow, red, or brown shades occurring. It crystallises in the hexagonal system. The crystals become earthy and dull in the course of weathering. Pure fluorapatite contains 42·3 per cent. phosphoric anhydride and chlorapatite 40·9 per cent.

The chemical compound known as organic phosphate of lime or rock phosphate is considered to be the result of the infiltration of phosphoric and carbonic acid-bearing waters into calcareous beds and the replacement of carbon dioxide by phosphoric anhydride. When perfectly pure, lime phosphate contains 45·81 per cent. phosphoric anhydride (P_2O_5).

III. Mineral Phosphates.

(Phosphorites.)

Veins and disseminations of apatite (phosphate of lime) are met with in some countries in basic and other eruptives. Veins in scapolite rock are well known occurrences in Norway. Scapolite has not been reported in Tasmania, excepting as a scapolite-felspar vein in serpentine at Anderson's Creek.

The nature of apatite veins is pegmatitic, and the genesis of the mineral is connected with pneumatolytic processes.

The apatite mines of Canada and Scandinavia were at one time appreciable sources of phosphate supply, but their importance has diminished since the development of organic phosphate deposits in other parts of the world (United States, Tunis, Algeria, France, and Belgium).

In Tasmania no apatite veins are known. This is somewhat surprising, in view of the favourable conditions for their genesis. The mineral exists as a microscopic constituent of gabbro-amphibolite at Rocky River (Pre-Cambrian), of stanniferous granite at Crystal Hill, near Lottah, of metamorphic schist in the serpentine area of Anderson's Creek, in basalt at Table Cape, and in other eruptive rocks.

There are very considerable developments of serpentine and gabbro rock in different parts of the island, several of which are in positions favourable for pneumatolytic action (Bald Hill, Heazlewood, Meredith Range, Dundas, Trial Harbour, &c.). These rocks form the outer margins of granite masses. and might be expected to yield the lime-phosphate mineral, but examination of numerous rock samples has not revealed the presence of apatite in other than microscopic quantities. It may be, however, that further search will disclose apatite veins. Prospectors would do well to look out for these.

IV.—Organic Phosphates.

These embrace guano deposits and the leachings from them, and the deposits in calcareous sedimentary rocks.

Wavellite, met with in the cleavages of slate, is a phosphate of alumina, and is a precipitate from solutions carrying phosphoric acid, which was previously disseminated in the sediments. It is used exclusively in the preparation of phosphorus.

On the hill slope east of the Den spur, near Lefroy, a few boulders of slate rock occur having a brecciated appearance, and containing (rather abundantly in places) spherules of greenish-white wavellite. Where broken across, these spherules show small discoid sections with a radiating structure, implanted on the surface of the slate. Although only these boulders are visible on the surface, there would appear to be a meridional line of this country, as the same mineral has been found further north. The improved appearance of the crops in the paddocks where the boulders are seen is noticeable.

Our ordinary limestones, such as we find in our Silurian and Permo-Carboniferous sediments, usually contain a small percentage of phosphoric acid, but not sufficient from an economic point of view.

For instance, an analysis of the dark-grey or bluish Silurian limestone at Mr. Blenkhorn's quarry at Railton, made by Mr. H. J. Colbourn (the Government Agricultural Chemist), shows the following results:—

	Per Cent.
Lime carbonate	75·10
Combined water	0·55
Phosphoric anhydride (phosphate of lime 2·2 per cent.)	1·02
Magnesia	0·54
Protoxide of iron	2·88
Sulphuric anhydride	4·66
Alumina	3·05
Silica	12·20
	100·00

Mr. Colbourn remarks on this limestone as follows—

"As an agricultural lime it must possess a high value, from the fact that it contains, apart from the lime, several important crop constituents in appreciable quantity, notably 1 per cent. of phosphoric anhydride, which is equal to rather more than 2 per cent. (2·2) of tricalcic phosphate of lime."

Limestones of Permo-Carboniferous age occur in nearly all parts of the island, but do not contain sufficient phosphoric acid to make the beds of commercial value.

Some limestone of this age, highly fossiliferous, situate 4 miles south from St. Marys, assayed by Mr. W. H. Baker, yielded the following:—

	Per Cent.
Phosphoric acid	5·12
Silica	22·01
Carbonate of lime	40·80
Oxide of lime	3·82
Oxide of magnesium	0·31
Oxide of aluminium	5·97
Oxide of iron	2·03
Organic matter	13·88
Water given off at 100° C.	6·11
	100·05

The most likely sources of supply are, perhaps, the shell limestones of the Straits Islands, where they happen to be

on the present shore-line, and the rocky islets on the coast, irrespective of whether they consist of limestone beds or not. As a matter of fact, the rock on most of them is granite. They are visited by numerous sea birds, and receive deposits of bird guano. This guano decomposes partially, and its P_2O_5, combining with lime from the shells of molluscs, forms some of the tri-calcium phosphate which is found in the crustal portion of the underlying rock. The undecomposed portion of the excreta hardens, and, with its lime phosphate, probably forms the loose lumps on the surface. Slopen Island is an exception, for it is reported by Mr. R. M. Johnston, I.S.O., to be composed of diabase, Permo-Carboniferous mudstones, and Mesozoic sediments. The calcareous content of the mudstones would supply the lime for the necessary combination.

Samples have been received from Sea Elephant Rocks (off the east coast of King Island), from White Rock Island between Freycinet Peninsula and Maria Island, from Slopen Island in Frederick Henry Bay, and from some islands in the Furneaux Group.

Results of assays have been:—

	Per Cent.	
Sea Elephant rocks (granite)	11·00	phosphoric anhydride
White Rock Island	13·80	,,
Ditto (sand)...	3·10	,,
Slopen Island (Permo-Carb.)	13·56	,,

The factor for converting P_2O_5 into tri-calcium phosphate (phosphate of lime, $Ca_3P_2O_8$) is 2·183, consequently the above assay figures would represent the following percentages of lime phosphate:—

	Per Cent.
Sea Elephant rocks	24·01
White Rock Island...	30·12
Ditto	6·76
Slopen Island	29·60

In manufacturing superphosphates the percentage of phosphate of lime is reduced by 50 per cent., or, to put it in another way, double the above percentages would be necessary for the production of a superphosphate containing the same proportions of lime phosphate. The proportions are insufficient to enable the material from these islands to compete with supplies reaching the manufacturers of superphosphates from other sources.

The extent of these deposits is not exactly known, but from all appearances is very restricted both horizontally and vertically. Some of the rocks have been visited only infrequently by fishermen, and information with respect to them is limited.

Information supplied by Mr. H. M. Rivett-Carnac, who has a wide knowledge of King Island, derived from long residence there, is to the effect that anywhere on the west coast of that island north of Currie layers of re-deposited lime may be found containing phosphoric acid up to 10 per cent. He considers the Pyramid Rock, between King Island and Hunter Island, a likely spot for guano. Mr. Rivett-Carnac also states that on Flinders Island, south of White Mark, limestone occurs with a content of from 2 per cent. to 5 per cent. phosphoric acid.

V.—Conclusion.

From the preceding it will be gathered that the prospects of finding economic deposits of phosphate rock in the State cannot be described as very encouraging. The most promising localities are the small islands off the coast, more particularly the east coast. Numerous sea-birds frequent these rocky islets, and are responsible for deposits of guano of moderate extent. Their numbers, however, cannot be so large as in warmer climes, and from all reports it seems doubtful whether deposits of any magnitude will be found.

The lime phosphate seems to be due to infiltrations from this guano, as well as to its consolidation, but, as far as can be learned, the phenomena are on a small scale.

The conditions justify the collection of information but do not warrant any great expenditure at present in surveying these islets. As a preliminary step the fishermen who sail the surrounding waters might be induced to bring in samples and supply some initial information as to the extent of the deposits and their nature, and the accessibility of the islands, before any official attempt at examination is made.

It will be well to continue on the alert for possibilities, even if immediate results cannot be foreseen. There are some Tertiary limestones on the Flinders Group which are slightly phosphatic, and the west coast, near Temma, may possibly prove to be phosphatic. Residents in these remote localities might be asked to make observations and send in samples for assay. Prospectors may make a rough

test of the rock in the field by taking with them a little nitric acid and molybdate of ammonium (powdered). A spot on the sample should be wetted with the acid, and a grain or two of ammonium molybdate dropped on it. If the molybdate powder turns a yellow colour, the presence of phosphorus is indicated.

Finally, a Government bonus, on a less extensive scale than the bounties under "The Commonwealth Bounties Act, 1912," for the discovery of a deposit of commercial value, might have the effect of stimulating local search for phosphates, both of organic and mineral origin.

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Geological Survey Office,
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