Tasmania

DEPARTMENT OF MINES

GEOLOGICAL SURVEY BULLETIN

No. 18

Geological Reconnaissance

OF THE

Country Between Cape Sorell and Point Hibbs

BY

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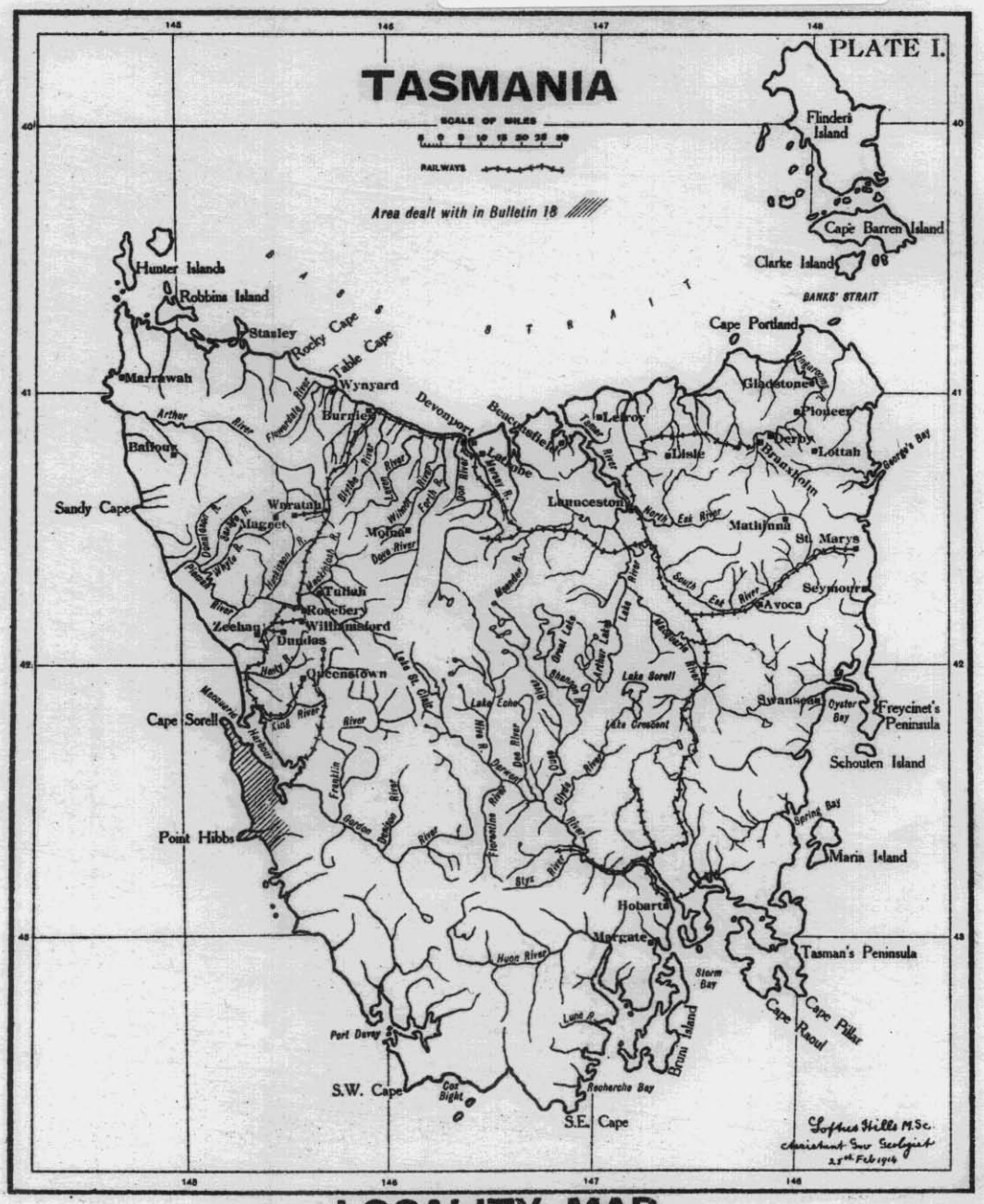

LOCALITY MAP

Photo Algraphed by John Vail Government Printer Hobart Tasmania

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INTRODUCTION.

THE area dealt with in this bulletin is situated on the west coast of Tasmania, and lies to the south and west of Macquarie Harbour. The north-eastern boundary is formed by the southern shore of Macquarie Harbour, and its western limit is that portion of the seacoast extending from Cape Sorell on the north to the debouchure of the Spero River on the south. In shape, therefore, the area is roughly triangular, Cape Sorell being the apex.

Access to the region is possible from either Strahan or Kelly Basin, whence the crossing of Macquarie Harbour may be made by boats drawing up to 8 feet of water, this being the maximum depth at the jetty at Double Cove, which is the landing-place on the southern shore of the harbour. Strahan is 12 miles distant from Double Cove, and Kelly Basin is approximately the same distance.

From Double Cove a track has been cut in a general direction of south 40° west, and strikes the open seacoast in a distance of 7½ miles. At this point a depot has been established, and has been given the name of Albina. The track then turns southwards and follows the general trend of the coastline, and will be continued in this way until Port Davey is reached. This track was started under the supervision of Mr. Hartwell Conder, M.A., State Mining Engineer, in November, 1912, and at the time of the writer's visit had been extended as far as the Spero River, a distance of 27 miles from Double Cove. The object of cutting the track is to open up this region for prospecting, &c., and to provide a means of communication between the lighthouse at Cape Sorell, which is connected by cable with Strahan, and the whole of this wild, desolate coast, which is notorious as the scene of disastrous shipwrecks.

It is proposed to cut a track from Albina northwards to Cape Sorell, and thus complete the line of communication with Port Davey and other convenient points on the track. The track is being cut to a width of 6 feet, and is available for pack-horses. The first 7 miles has become very

boggy in many places, and needs cording at these points. The remainder of the track is good on the whole.

There is a hut and store, together with a stable, at Double Cove, whence the food supplies, &c., are transported by pack-horse to Albina, where another hut and store have been erected. At present a third depot is being established at the base of Point Hibbs, *i.e.*, in the neighbourhood of the 24-mile peg. There is a sheltered boat harbour behind the Pyramid Rock, and it is proposed to land several months' supplies at that point and store them at the Point Hibbs depot, thus obviating the 24-mile journey from Double Cove.

On this survey Double Cove was used as the starting-point. A traverse of the track from there to Albina had already been made by Mr. Conder as far as Albina, and this traverse was continued by the writer as far as the Spero River. In the complete absence of any accurate chart of the district this track was used as a reference-line, and all geological boundaries, as well as the coastline, have been plotted in relation thereto. It was found impossible, however, to penetrate the country to the eastwards of the track further than a maximum of about 2 miles, owing to the heavy impenetrable scrub. The country examined, therefore, really consists of a strip of varying width on the coastline and one either side of the track from Double Cove to Albina.

In reference to the absence of an accurate chart of the district, it must be mentioned that in those that are available the shores of Macquarie Harbour are carefully and practically correctly charted, but the main coastline from Cape Sorell southwards is very incorrectly mapped.

This is particularly so with regard to the county map "Montgomery No. 1," the coastline being incorrectly delineated. In the general map of Tasmania the bearing between Cape Sorell and Point Hibbs is approximately correct, but the intervening coast is less exact. The points which are mast pronounced in their inaccuracy are enumerated below.

In the first place, there is shown a stream called the Hibbs River, flowing westwards near three freshwater lagoons, and finding an outlet on the northern side of Point Hibbs, just south of the Pyramid Rock. As a matter of fact, the true position of the Hibbs River is $2\frac{1}{2}$ miles north of that shown in the map, and it passes near its outlet through a large freshwater lagoon, but there is only one such lagoon. The mouth of the Hibbs River

lies in a direction of north 23° east from the Pyramid Rock, and is distant therefrom about $2\frac{3}{4}$ miles.

The second most noticeable point is in the location of the Sloop Rock. This on the county chart is shown about 4 miles north-west from Albina, but there is no rock of any size at that point. The map of Tasmania shows the Sloop Rock in a corresponding position. There is, as a matter of fact, a rock situated about $1\frac{1}{4}$ mile in a direction south 38° west from Albina, but this is not the Sloop Rock, which is situated some considerable distance to the north. Its exact position, however, cannot be plotted from the results of this survey. It seems, however, that the rock opposite Albina has been mistaken for the real Sloop Rock, and, having been somewhat inaccurately charted, is shown on the maps where no rock actually exists.

In addition to this, the details of the coastline have apparently only been roughly sketched from seawards. It was not possible, however, during this survey to accurately chart the coastline, but in the map accompanying this bulletin it is sketched with a close approximation to accuracy. This applies to that portion extending from a point 4 miles north of Albina southwards to the Spero River. The portions both to the north and south of this are only roughly approximate.

II.—PHYSIOGRAPHY.

(1)—Topography.

(*a*)—*The Coastline.*

The seacoast which is washed by the waters of the Southern Ocean may be described as very rugged and desolate, and presents a most forbidding aspect. There is a complete absence of shelter for even small vessels, excepting just behind the Pyramid Rock, at what is known as the Boat Harbour.

Patches of sandy beach occur at intervals, but for the most part the shoreline is rocky, and in places decidedly precipitous. The erosive action of the rough seas has been directly responsible for the development of this serrated coast, the more resistant rocks now standing as bold headlands and cliffs, while those rocks which offer less resistance to erosion constitute either the less rugged shoreline or, having been completely worn down to water-level, are now covered by sand. The whole of the details of the coast are the result of this degradational erosion of the sea waves.

The geological features have had some considerable influence on the development of the present form of the coastline. This is especially marked in two particulars: (1) The coincidence of bold precipitous headlands with the occurrences of igneous rock, as the mica-syenite at Badger Farm and the diabase at Point Hibbs; and (2) the wholly characteristic honeycombed erosion of the limestone beds.

Along the whole coast there are outlying reefs and rocks. These represent portions of the rock series which have resisted the wave-erosion more effectively than their softer surroundings, and consequently remain to be ultimately completely removed by the destructive battering of the heavy seas.

(*b*)—*The Dissected Peneplain.*

The interpretation of the topography of this region is somewhat difficult when attempted from the results of observations made within the district itself, and it is only when the area is viewed from the neighbouring mountain ranges that the broad topographical structure is apparent. The writer had the opportunity during the progress of his previous field journey of thus viewing the

whole area from the summit of Mt. Sorell.(1) The only interpretation possible after such a general view is that we are here dealing with the remains of a peneplain which after suffering some considerable uplift has been greatly dissected by the resulting renewed activity of the streams. In fact, as pointed out by the writer in his bulletin on the Jukes-Darwin field,(2) this peneplain is a continuation of that which exists on the northern side of Macquarie Harbour, and has been called the Little Henty Peneplain.

From aneroid readings taken during this survey the general height of the peneplain is 600 to 700 feet above sea-level, sloping downwards towards the coast, that portion in the immediate vicinity of the coast having an elevation of, roughly, 400 feet. The country is covered with button-grass, and slopes gently downwards to the sea-coast, which at its highest does not rise more than 100 feet sheer from the sea, and generally considerably less. It is this portion which is traversed by the track from Albina to the Spero River.

The present cycle of erosion has only advanced far enough to produce steepsided valleys, and consequently the appearance presented is one of topographic youth.

As stated in previous publications of the Geological Survey, the uplift of the peneplaned surface took place in recent times. There is evidence in this area, however, that this uplift has either been intermittent or was succeeded by another smaller upward movement, for on the southern side of the base of Point Hibbs we find rounded boulders and shingle undoubtedly representing a raised strandline, at a heigh of almost 100 feet above sea-level. level.

The surface is everywhere covered with a thick layer of peaty soil, which supports either the button-grass of the plains or the somewhat stunted vegetation which forms the impenetrable barrier to exploration. The particularly notable feature is the almost complete absence of rock outcrops. This, combined with the difficulty of penetrating the scrub, makes geological investigations most difficult, and in addition will always greatly hamper prospecting operations.

Point Hibbs itself is a blunt-ended headland which at its highest point is not more than 200 feet above sea-level. It owes its existence to the occurrence of the mass of

(1) See Geol. Surv. Tas. Bull. No. 16, "The Jukes-Darwin Mining Field."
(2) Ditto.

igneous rock which constitutes the extreme end of the headland. This resistant rock has protected the softer limestones, &c., which occur behind it, from the erosive action of the waves.

(2)—Climate and Rainfall.

This region differs in a very marked degree as regards its climate and rainfall from the remainder of the West Coast of Tasmania. Some inkling of this may be obtained by a comparison of the rainfall at Cape Sorell with that at Strahan and Zeehan. It must be remembered that Strahan is at sea-level, and only distant from Cape Sorell about 8 miles, while Zeehan is approximately 700 feet above sea-level, thus corresponding with the general elevation of the region we are now dealing with. The following is a list of the rainfall figures for the three places mentioned for nine months of the year 1913:—

	Feb.	Mar.	Apr.	May.	July.	Aug.	Sept.	Oct.	Nov.
Cape Sorell...	2·17	4·26	2·96	3 71	5·18	7·06	5·34	3 02	3 83
Strahan	2·94	6 35	3·42	3·14	8,87	11·44	7·92	5·41	8 66
Zeehan.....	4 52	7·35	3·90	7·82	13·02	13·42	12 38	6·95	14·07

It will be seen, therefore, that the rainfall at Cape Sorell is distinctly lower than that at Strahan, and very much less than that at Zeehan. The Cape Sorell rainfall may be taken as that which is characteristic of the whole of the region with which this bulletin deals. The aggregate rainfall for the year 1913 at Cape Sorell was 46.51 inches, as compared with 104·17 inches at Zeehan.

The same comparison holds good with regard to the general climate, the area under examination possessing a much milder climate than that which obtains north of Macquarie Harbour.

The streams which drain this area are not large. When the fact is taken into consideration that the width of the region varies from a few chains at Cape Sorell to a gradually increasing width southwards, this is not surprising, as the catchment area supplies two drainage systems, namely, towards Macquarie Harbour and also into the Southern Ocean. The streams increase in size to the southwards until the Spero River is reached, whihc is quite a considerable stream. In fact, this latter river drains the southern portion of the western slopes of the D'Aguilar Range. The streams south of the Spero are all of considerable size, as these drain a large area of the inland country.

However, although of inconsiderable size, the creeks between Albina and the Spero are sufficient to ensure a good supply of water throughout the whole of the year. There is no possibility of utilising water for power purposes in this district.

There are many freshwater lagoons near the seacoast which have been caused by the damming back of the drainage water by the incursions of the sand-dunes. There is one such lagoon about a mile north of Albina, another at the 16-mile peg, and a third (the largest) near the mouth of the Hibbs River.

III.—GENERAL GEOLOGY.

(1)—Sedimentary Rocks.

(*a*) *Pre-Cambrian.*

There is an abundant development of rocks of this age in the area under examination, and they constitute the predominating rock series throughout the whole district. They are seen outcropping on the seacoast from Cape Sorell to the mouth of the Hibbs River, and occur inland as far as the country was penetrated. They are seen outcropping on the track from Double Cove to Albina at intervals, and extend right to Albina, whence they are practically continuous to the Hibbs River. They recur south of the Spero River, and then continue southwards, but were only followed on this journey 4 miles south of that point. Apparently they continue southwards to Port Davey, where their occurrence has been recorded.

The series as developed in this region consists of beds of claystones, argillites, slates, dolomites, quartzites, and sericitic schists—all intensely folded and metamorphosed. The strike of this series varies greatly from place to place, this being due to the intense folding and crumpling that has taken place. Variations were observed from a due north-and-south to a due east-and-west strike, the dip also varying widely both in direction and amount. It is therefore rather difficult to decide the general trend of the whole system, but the conclusion which the writer has arrived at is that the general strike is apparently north and south, with a deviation either to the west or east of this with a prevailing tendency towards east of north. The dip, of course, will vary with the folding.

It is thus seen that the generally prevailing strike is such as to cause the successive beds to be intersected by the coastline approximately at right-angles, since the trend of the latter is decidedly west of north.

At Albina occur vertical beds of black slates striking north 5° east. Traced to the northwards the beds give place to calcareous claystones, and finally to magnesium limestones or dolomites. These latter have been partly silicified, and now consist of siliceous nodules set in calcareous groundmass. These siliceous nodules are brought into prominence by weathering, and give a characteristic knobby appearance to the rock. The siliceous excrescences

measure up to 1 inch in diameter. In places the limestone has been completely converted into black jasperoid. The dolomite beds recur a short distance south of Albina, and are here seen to be striking north 50° east, and are practically vertical, and show signs of excessive crushing. They here consist of greyish-white crystalline dolomite, seamed with veins of well-crystallized dolomite, and in some beds, veins of pure calcite. There is an abundant development of these dolomite beds from this point southwards to Birthday Bay, and are much affected by folding and crumpling. It is impossible to say definitely whether the two occurrences of calcareous beds north and south of Albina are separate beds or whether the southern outcrops are the continuations of those seen to the north, but the writer is inclined to regard them as at two distinct horizons in the series separated by beds of slates and quartzites.

About 3 miles north of Albina there occur beds of quartz conglomerate intercalated between the schists and quartzites. The constituent pebbles of these conglomerates are angular to subangular, the absence of well-rounded pebbles being rather marked; in fact, it is a breccia rather than a conglomerate.

As stated above, the whole of the series show abundant evidences of intense folding, crumpling, and puckering. This is especially well seen on the beach to the south of the Birthday, where the folding and crumpling is seen under almost ideal conditions. In this locality the prevailing strike seems to be a little west of north, but the dip varies without limit, this being a necessary accompaniment of the intense folding that has taken place.

(*b*) *Silurian.*

This series of rocks occurs south of the Hibbs River, and can be seen outcropping on the seacoast along the northern shore of Point Hibbs until they form what is probably a faulted junction with the Permo-Carboniferous beds described below. They recur on the southern side of Point Hibbs, and can be traced on the beach until they are seen to be intruded by the series of basic rocks north of the Spero River. They are characterised by the occurrence of beds of limestone, which in places are highly fossiliferous. There may be some doubt that the whole of these limestones are of Silurian age, but the general appearance gives that impression. Representative samples of fossils were submitted to Mr. R. Etheridge, Curator of

the Australian Museum, Sydney, who expresses the opinion that they are probably Silurian, but need further detailed examination before a definite pronouncement can be made. They may, therefore, be provisionally classed as Silurian, and this conclusion is confirmed by the observation that the associated sediments have an appearance of too great antiquity to be classed as Permo-Carboniferous, as well as being distinctly unconformable with the undoubted Permo-Carboniferous conglomerate beds.

The strike of the series varies from place to place from nearly due north and south, with a dip of 55° to the east, to north-east—south-west, with a dip of 25° to 35° to the south-east.

The associated sediments consist of quartzites, claystones, calcareous claystones, sandstones, and quartz conglomerate. The limestones have suffered the erosion which is characteristic of that rock, and caves and arches are of common occurrence. This limestone is very pure, and differs from that associated with the Pre-Cambrian quartzites, &c., in that dolomite is absent, and that the silicification which has taken place in the Pre-Cambrian limestones does not seem to have occurred.

(*c*) *Permo-Carboniferous.*

There is a development of rocks of this age in only one portion of the field visited by the writer. This is on Point Hibbs, east of the outcrop of diabase at its western extremity. The particular portion of the system here represented is that of the basal mudstone conglomerate. The boulders in this conglomerate are up to 1 foot in diameter, and consist, *inter alia*, of blocks of Devonian granite of many varieties, granite-porphyry and greisen being present as well as the normal granite. These beds are replete with fossil remains which provide indisputable evidence of their Permo-Carboniferous age. In fact, in places the beds assume the character of a calcareous conglomerate, the shells being so very numerous.

The strike is north 20° west, an dthey are vertical or dip at a very high angle to south 70° west. This is an absolutely exceptional feature as regards the Permo-Carboniferous system in Tasmania, no similar structure having yet been recorded therein. The origin of this vertical disposition of the beds may be ascribed to the tilting of originally horizontally Permo-Carboniferous strata at the periphery of the upward irruption of Mesozoic diabase.

These Permo-Carboniferous beds are seen on the northern side of Point Hibbs over a width of about 20 chains. They recur on the southern side of the point, and there have the same characteristics.

(*d*) *Recent.*

Along the seacoast there occur occasional patches of drift-sand in addition to the sand-dunes. These are subaerial accumulations of recent age, and do not extend more than a few chains inland. They are nowhere very extensive, their greatest development being in the neighbourhood of the 8 and 9 mile pegs. As mentioned above, there occurs at the base of Point Hibbs an accumulation of waterworn boulders at some appreciable height above sea-level. These also are of quite recent age.

(2)—Igneous Rocks.

(*a*) *Devonian Acid Rocks.*

There occurs in this region a series of igneous rocks which may be regarded as offshoots from a granitic reservoir. These rocks are seen at several localities. Mr. Waller resported the occurrence, in the bed of a creek to the north-east of the surveyed mineral sections at the Birthday, of a rock which may be termed an augite-mica-syenite. The most pronounced development, however, occurs on the seacoast opposite the 13 and 14 mile pegs. It here forms a bold headland, and extends inland for about half a mile. This occurrence is in the form of a "boss," measuring roughly 1 mile in length by half a mile in width, which has been intruded into the Pre-Cambrian series. The rock consists of an allotriomorphic granular aggregate of orthoclase and biotite. Quartz is absent. Augite is occasionally seen. Apatite is present in appreciable amount. The texture varies from a fine-grained rock to one which is coarsely crystalline. In places it assumes a pegmatitic aspect. Patches occur which consist almost wholly of felspar, while at other times mica is the predominant constituent. The petrological designation would be mica-syenite.

A similar rock occurs south of the Hibbs River, and is here intrusive in the form of dykes, up to 10 feet across, into Silurian sediments. South of Point Hibbs it is again seen in close proximity to the basic rocks mentioned below. South of the Spero River it occurs in the form of numerous narrow dykes intruded into the Pre-Cambrian rocks.

This rock has a porphyritic structure, and consists of orthoclase felspar with a little plagioclase, together with abundant biotite and occasional augite. The biotite occurs as porphyritic crystals in the groundmass of felspar. The structure is lamprophyric, and the rock may be called a minette or mica-lamprophyre. South of the Spero River the dykes are characterised by the numerous inclusion of angular fragments of quartzite which have become occluded in the igneous mass after having been torn from the walls of the fissure by the movement of the pasty mass within it.

As regards the age of these related rocks, it is quite certain that they must be classed as a variety of our Devonian granitic irruptives, for they are clearly intrusive into the Silurian sediments. They are certainly not members of the porphyroid suite, which is Pre-Silurian in age.

(*b*) *Devonian Basic Rocks.*

There are two widely separated occurrences of basic rocks in this region. One is situated at Asbestos Point, on the shore of Macquarie Harbour, and the other occurs about 2 miles north of the Spero River.

The rock-type at Asbestos Point is almost wholly serpentine, which is in places seamed with veins of chrysotile asbestos. The serpentine belt is here about 2 chains wide, and strikes roughly north and south. Bands or bars of unserpentinised rock, such as bronzite rock, occur within the serpentine, as well as approximately spherical masses up to a foot in diameter of partly serpentinised rock (saussurite-gabbro, &c.).

The occurrence north of the Spero consists of a belt of basic and ultra-basic rocks of various types, and can be seen outcropping on the sea beach, and extend inland for an undetermined distance. There are many varieties of these basic rocks here which seem to grade by insensible gradations into each other. Gabbro, saussurite-gabbro, bronzite rock, and serpentine are all present. The serpentine, however, is in relatively small amount.

These basic and ultra-basic rock types are certainly of Devonian age, as they intrude the Silurian strata at the base of Point Hibbs. They represent the basic facies of the Devonian igneous intrusives.

(*c*) *Diabase.*

This rock constitutes the western portion of Point Hibbs, half of the headland, in fact, consisting of it. The west-

ern face of the headland is composed of an almost vertical cliff-face of diabase, the superior resistant character of which is responsible for the existence of this prominent headland. The rock is the normal diabase of Mesozoic age so common in Tasmania. The texture is generally medium-grained, but some coarse patches occur.

(*d*) *Basalt.*

The only occurrence of this rock observed by the writer was a small boulder on the beach above high-tide mark opposite the 20-mile peg. This certainly indicates the presence of basalt somewhere in the neighbourhood, and there may exist extensive patches of basalt in the hinterland. Mr. Conder reports the occurrence of several boulders of a rock resembling basalt on a ridge in the vicinity of the track about 4 miles from Double Cove.

IV.—ECONOMIC GEOLOGY.

(1)—The Asbestos Deposits.

The deposits of asbestos occur in a belt of serpentine which outcrops on the southern shore of Macquarie Harbour, at what is known as the Asbestos Point. This is situated due west of Settlement Island, and about 1 mile therefrom.

The existence of asbestos in this locality has been known for some years, and an asbestos reward was granted to H. Grice on 1st July, 1900, the section-number being 4767-93M. The reward was in force for five years, and the section became vacant in 1905. Practically no work was done on the section during the currency of this lease.

Quite recently, however, attention has been paid to the deposits by Mr. J. R. Ross, who has done some trenching work on the outcrops, and a company is now being formed to investigate the extent of the asbestos-bearing zone.

The work attempted so far has consisted in the cutting of three trenches, each about 12 feet in length and 6 feet deep. In each of these trenches there are shown ramifying veins of chrysotile asbestos varying in width from 1 inch down to a mere paper-like film. The width over which the asbestos veins are seen to occur is approximately 120 feet, but it must be understood that the whole of this width does not carry asbestos veins, as there are patches of barren serpentine between the rich portions.

The trenches put in have served to show the quality of the asbestos below the immediate effect of the surface agencies. It is thus seen that the quality of the fibre is first-class. It has the silky sheen which characterises the finer varieties of chrysotile asbestos, and varies in colour from pale greenish-yellow to a golden brown. The single fibres are white in colour. The fibres are orientated at right angles to the direction of greatest length of the vein. In fact, the whole of the fibre exposed is of very good quality, and from that point of view could command a high market price.

The problem, however, with which the owners are faced is in regard to the question whether the length and quantity of the fibre in the rock mined would be sufficient to more than pay the cost of mining and treatment. This problem is admittedly a difficult one to solve, and certainly cannot be definitely settled until further exploratory work has been carried out on the sections.

There need be no doubt, however, that the length and quality of the fibre will be altogther satisfactory, as these both compare favourably with that obtaining in the Canadian asbestos deposits, which are the most important source of the asbestos supply of the world. The bulk of the asbestos quarried in Canada is between a quarter and half an inch in length,(3) so that the average of this deposit compares favourably with what is worked elsewhere at a profit.

The next important question to decide is whether the total amount of fibre in the rock mined would be sufficient to warrant expenditure on plant, &c. It is really impossible to decide this at present, as not enough work has been done in opening up the deposit. For the guidance of those interested the following information(4) is given:—

(1) *Percentage of Milling Material in Total Rock Mined.*—The practice in different mines varies, for whereas some resort to hand-picking with the production of crude fibre (which is further dressed by hand) and barren rock, others mill the whole of the product with no production of crudes or barren material. Accordingly, the percentage of fibre in the rock milled will vary in different mills. On an average, however, the milling rock constitutes from 30 to 60 per cent. of the whole rock mined.

(2) *Percentage of Fibre in the Milling Rock.*—There is also a great variation in this factor, but on the average an extraction of from 6 to 10 per cent. of fibre from the rock milled is obtained.

(3) *Grades.*—The hand-picked crude is graded into two qualities: No. 1 measuring about 1 inch, and No. 2 measuring from half an inch to an inch in length.

The milling fibre is generally divided into three grades, as follow:—First grade (spinning fibre), second grade, and third grade (paper stock).

(4) *Prices.*—The following figures will give some idea of the value of the several products:—

No. 1 crude asbestos = £55 per ton of 2000 lb.
No. 2 crude asbestos = £32 per ton of 2000 lb.
No. 3 mill fibre = £20 per ton of 2000 lb.
No. 4 mill fibre = £6 per ton of 2000 lb.
No. 5 mill fibre = £2 per ton of 2000 lb.

(3) See "Chrysotile Asbestos," by Fritz Cirkel, M.E., Department of Mines, Canada, p. 49.

(4) Taken from "Chrysotile Asbestos," cited above, pp. 152, *et. seq.*, to which the reader is referred for full details of the asbestos industry.

(5) *Cost of Equipment.*—For the extraction of the shorter fibre a mill is an essential, and in this matter it may be mentioned that the technology of asbestos-extraction has reached a high state of perfection. Fritz Cirkel gives the complete cost of a mill fitted with two cyclone units having a capacity of 240 tons in 24 hours as in the neighbourhood of £10,000. This is the cost in Quebec, Canada.

(6) *Cost of Production.*—Of course the total cost of production will vary within rather wide limits, according to the scale on which the operations are carried out, the cost of labour, and the quality of the material mined, and consequently no hard and fast figures can be given; but as a general indication of the total production costs the following cases are cited, both being under Canadian conditions:—In one case where no "crude" is produced, the total cost of production, exclusive of administrative expenses, is approximately £3 per ton of fibre. The extraction is given as 8 per cent. Where the production of "crude" enters into the mining costs the total cost of production of both crude and mill fibre combined is from £4 to £5 10s. per ton, which is also exclusive of administrative charges. It must, of course, be clearly understood that in both these cases the production is on a very large scale, which, of course, considerably reduces the average cost.

It must be further especially noted that the universal method of mining asbestos is by the open-cut or quarry system. Now, the occurrence on Macquarie Harbour is seen at present outcropping on the foreshore at an elevation of not more than, say, 10 feet above sea-level. Inland the country rises rather rapidly, and as the serpentine belt extends in a southerly direction, it is probable that the asbestos zone will also occur in this higher land. Search for this southern continuation of the asbestos deposits is desirable and even necessary, for any attempt to work the deposits on the seashore by open-cut workings will be greatly hampered by water-troubles.

The writer, therefore, would strongly urge the desirability of thus exploring the southern continuation of the serpentine belt for asbestos veins, and the opening up by further prospecting work of the known asbestos zone to ascertain in a more decisive manner the probable amount of the fibre that is present. Certainly the present indications are such as to warrant the expenditure of some capital in thus investigating the occurrence.

(2) The Asphaltum Fragments.

Along practically the whole of the seacoast of this region there are found fragments of a black bituminous substance. These fragments vary in size from about 3 feet long by 2 feet square down to small fragments a few inches in diameter. The shape varies, some of the lumps being roughly cubical with rounded edges, but the greater number being quite flat. One piece, for example, measured about 3 feet by 2 feet, with a thickness of about 2 inches.

The bitumen or asphaltum is jet black in colour. Some fragments are hard and brittle, while other blocks, although hard on the outside, are soft and plastic in the centre. A fresh fracture gives the odour of gasoline or kerosene. Those fragments which have been exposed to the sun develop a series of cracks on the surface. Sometimes, also, there occur waterworn pebbles of the brittle varieties. When subjected to the heat of the sun the substance becomes plastic, and conforms in shape to the surface on which it rests. It is very pure, being quite free from extraneous matter such as sand, &c. It will just float on seawater.

The most plentiful occurrence seems to be on that portion of the beach opposite the 8 and 9 mile pegs, although fragments occur all along the coast.

This asphaltum is, in fact, identical with that found on the shores of Kangaroo Island and Eyre's Peninsula, and described by Mr. L. K. Ward, B.A., B.E., Government Geologist of South Australia.[5] It has also been found on the shore near Recherche, in Southern Tasmania, and in fact, the source has been searched for in land from that point, but with no success up to the present. Mr. Ward, in the bulletin above referred to, has discussed the origin of these blocks, and expresses his opinion that the present position is due to the action of ocean currents bringing them from an unknown source, which may or may not be submarine.

As regards the investigation of the origin of the masses of asphaltum which occur on the seacoast of this region, without taking into consideration their occurrence in other parts of Australia, there are three possibilities which suggest themselves:—

(1) Are they derived from beds of asphaltum in the Tertiary deposits of Macquarie Harbour?

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[5] See Geol. Surv. S. Aust. Bull. No. 2, pp. 13–15.

(2) Do they occur in beds of Permo-Carboniferous age, the submarine outcrops of which may probably occur at no considerable distance from the shore?

(3) Are they simply fragments from a cargo of such material on a wreck situated somewhere to the west of the coast?

In connection with the first question, it is important to note that deposits of Tertiary age containing seams of lignite and brown coal are plentiful on the northern shore of Macquarie Harbour. It has therefore been suggested that this asphaltum has been shed from a bed in these deposits and carried out to the open sea, and subsequently cast up on the beach. This possibility is, however, thrown out of consideration by the fact that no fragments whatever of the asphaltum have been found in Macquarie Harbour, as would assuredly happen if such deposits did exist in the vicinity.

The evidence which suggests the second contingency is supplied by the occurrence on Point Hibbs of vertical beds of Permo-Carboniferous mudstones striking north 20° west. The northern extension of these beds along their line of strike would bring them about a mile west of the beach where the fragments are most numerous. It may be possible that these Permo-Carboniferous beds contain in this locality a seam or seams of asphaltum, but this is purely conjectural.

As regards the third possibility, it may be stated that although it is the first impression that one gets on seeing the occurrence of these asphaltum blocks mixed with the general wreckage strewn along the coast, yet the likelihood of this being the source is negatived by the widespread occurrence on the shores of the southern portion of Australia.

Mr. L. K. Ward has published, in the bulletin above referred to, a map showing the distribution and trend of the ocean currents in the Southern Ocean. These currents will explain the known distribution of the asphaltum fragments if we assume their source to be from a point somewhere in the Southern Ocean. More than this cannot be said at present as to the origin of the asphaltum.

(3) The Birthday Copper Deposits.

These deposits occur about 3 miles south of Albina. They were visited by Mr. G. A. Waller, then Assistant

Government Geologist, in May, 1902, and his report thereon is dated at Zeehan, 30th June, 1902. Since his visit, no work has been done in the district except some trenching by two prospectors under Mr. Hartwell Conder, M.A., State Mining Engineer. Inasmuch, therefore, as practically all the work done was located on the sea-beach, sometimes below high-tide mark, it is impossible to see now what work was actually done. The information contained in Mr. Waller's report is therefore the maximum that is available. This is especially noticeable with regard to the occurrence reported by Mr. Waller of a boulder of very rich ore, no sign of which is now visible. About 2 tons of rich ore were sent away from this deposit, which consisted of bornite and copper glance disseminated in limestone. When followed downwards this ore gave place to barren limestone. Operations then ceased at that spot.

The reader is referred to the abovementioned report for information concerning these copper deposits; suffice it here to say that those which are now observable have no value in themselves, but are of indirect value in assisting to demonstrate that some mineralisation, at least, has taken place in this region. The general character of these occurrences, excepting the rich deposit mentioned above, is that of irregular and inconstant veins of white quartz carrying pyrite, and some chalcopyrite. Neither their metallic contents nor their structural features warrant any attention at present.

(4)—The Other Mineral Occurrences in this Region.

Apart from these copper deposits at the Birthday there are very few signs of mineral deposits in this region. Just south of the mica-syenite "boss" there occurs an outcrop on the beach of white dolomite. This outcrop is circular in shape, the diameter being about 20 feet. The surrounding rock (quartzite) is seen to be dipping away from the periphery of this dolomite for the whole of the circumference. It is the crest of a quâ-quâ-versal fold, the quartzites having been removed from above the dolomite, which, along with the accompanying beds, has been here thrust upwards from below, forming a dome-shaped fold which dips in all directions from the central axis. Its position is only about 10 feet away from the contact of the igneous rock with the sedimentaries. The dolomite carries disseminated blebs of pyrites, mostly iron, but undoubtedly

with some copper associated therewith. It would be interesting to open up this deposit by means of a few shots, to see how a few feet in depth will affect the amount of sulphides showing.

In the basic rock south of Point Hibbs there occur in places a few splashes of iron sulphide.

Beyond a few scattered veins of specularite in the Pre-Cambrian schists there are no other mineral occurrences at present observable in the area traversed during this survey.

(5)—The Possibilities of the Occurrence of Ore-deposits in this District.

Before making any statement as to the possibilities of this region as a mineral field, we must have decided in a satisfactory manner the mode of origin or genesis of the ore-deposits of Tasmania. It is not necessary in this report to discuss this question, as it has been dealt with in previous publications of the Geological Survey. Suffice it here to say that the tin deposits are genetically connected with the Devonian granitic irruptions, but that it has not yet been possible to definitely decide whether any of the copper deposits are connected with the porphyroid granite, or whether all are genetically related to the Devonian granites. This latter question is fully discussed by the writer in the bulletin dealing with the Jukes-Darwin field,(6) where it is stated that a definite pronouncement must be postponed until further research is conducted on the ore-bodies in the Lyell field. Most probably, however, it will be ultimately established that most of these copper deposits are genetically connected with the Devonian granite. Certainly the genetic connection of some copper-bearing deposits with granite *massifs* of that age has been established.

Now, in the region under discussion it has been proved that intrusions of Devonian igneous rocks occur, and the inference is naturally drawn that this is an area affected by Devonian granite intrusions. This fact, taken in conjunction with the known occurrence of strong evidences of mineralising action, leads us to the conclusion that we may expect to find certain localities where these mineralising solutions have been present in considerable amount. This being the case, it is evident that the controlling fac-

(6) See Geol. Surv. Tas. Bull. No. 16.

tors, which will determine the formation of a payable ore-deposit, are the structural features and the nature of the country-rock. The quartz veins mentioned above are the result of the mineralising solutions acting under adverse conditions of both structural features and country-rock; the occurrence of the rich ore in the limestone described by Mr. Waller was apparently the result of such solutions acting on a congenial rockmass.

Since we have an abundant development of limestone beds in this region, and since it is a recognised fact that limestone is a rock which is specially favourable to the formation of extensive "replacement deposits," the conclusion is justifiable that the mineralising solutions which we have demonstrated were present may have acted under conditions favourable to the development of important ore-bodies. The existence of much folding and faulting in the rock series carrying these limestone beds is at any point likely to result in the presentation of conditions which would enable the solutions to form an extensive "replacement deposit" in the limestone.

It is therefore apparent that prospecting for such ore-deposits must be confined to the neighbourhood of the limestone beds.

At the same time it must not be overlooked that there occur, in the Permo-Carboniferous conglomerates on Point Hibbs, boulders of greisenised granite. These fragments indicate the existence of a granite zone influenced by mineralising solutions which probably carried tin compounds. They have reached their present position most probably by means of glaciers, and therefore it is probable that their origin is situated somewhere in this region. Search for this granite outcrop and the possible tin-deposits in this region is therefore justified.

In another direction the field is deserving of prospecting. This is in connection with the fact that south of Point Hibbs there is a rather extensive development of the basic facies of the granitic magma, amongst which is serpentine. As this latter rock has been proved to be the parental source of osmiridium, search for further outcrops of serpentine is justified in the expectation that these may carry osmiridium. These basic rocks also are genetically connected with deposits of copper and silver-lead ores, and therefore search for these in the belt is justified.

V.—CONCLUSION.

It will thus be seen, therefore, that this region is one which is uninhabited and neglected. There are no mines in operation therein, and no industries whatsoever. There certainly was an attempt made 12 years ago to start copper-mining at the Birthday, but this ended in failure, as no copper deposits of importance were disclosed. At the present time an attempt is being made to open up the asbestos deposits on the southern shore of Macquarie Harbour.

Although there are no mineral deposits of value (excepting, perhaps, the asbestos deposits) known to exist in this region, yet it has been conclusively shown in this bulletin that there are indications which point to the fact that stronger zones of mineralisation may exist. The evidence therefor is certainly sufficient to warrant the writer in stating that the field is one well worthy of prospecting.

It must, however, be realised at the outset that such prospecting will be difficult, as both the topographical features and the forest growth combine in bringing about conditions which do not permit of the existence of prominent surface outcrops of ore-bodies even if the latter exist. The directions, however, in which prospecting operations should be conducted are pointed out in this bulletin, and, in short, are as follow:—

(1) The examination of the southern continuation of the serpentine belt at Asbestos Point for further asbestos-bearing zones.

(2) The examination of the region in the locality of the general strike of the limestone beds.

(3) The search in the district generally for outcrops of Devonian granite.

(4) The search for outcrops or serpentine and associated osmiridium and lodes of copper and silver-lead ore.

Apart from the mining aspect the field has potentialities as regards agricultural and pastoral industries. The annual rainfall is about 50 inches, thus being far less than that which is characteristic of the remainder of the West

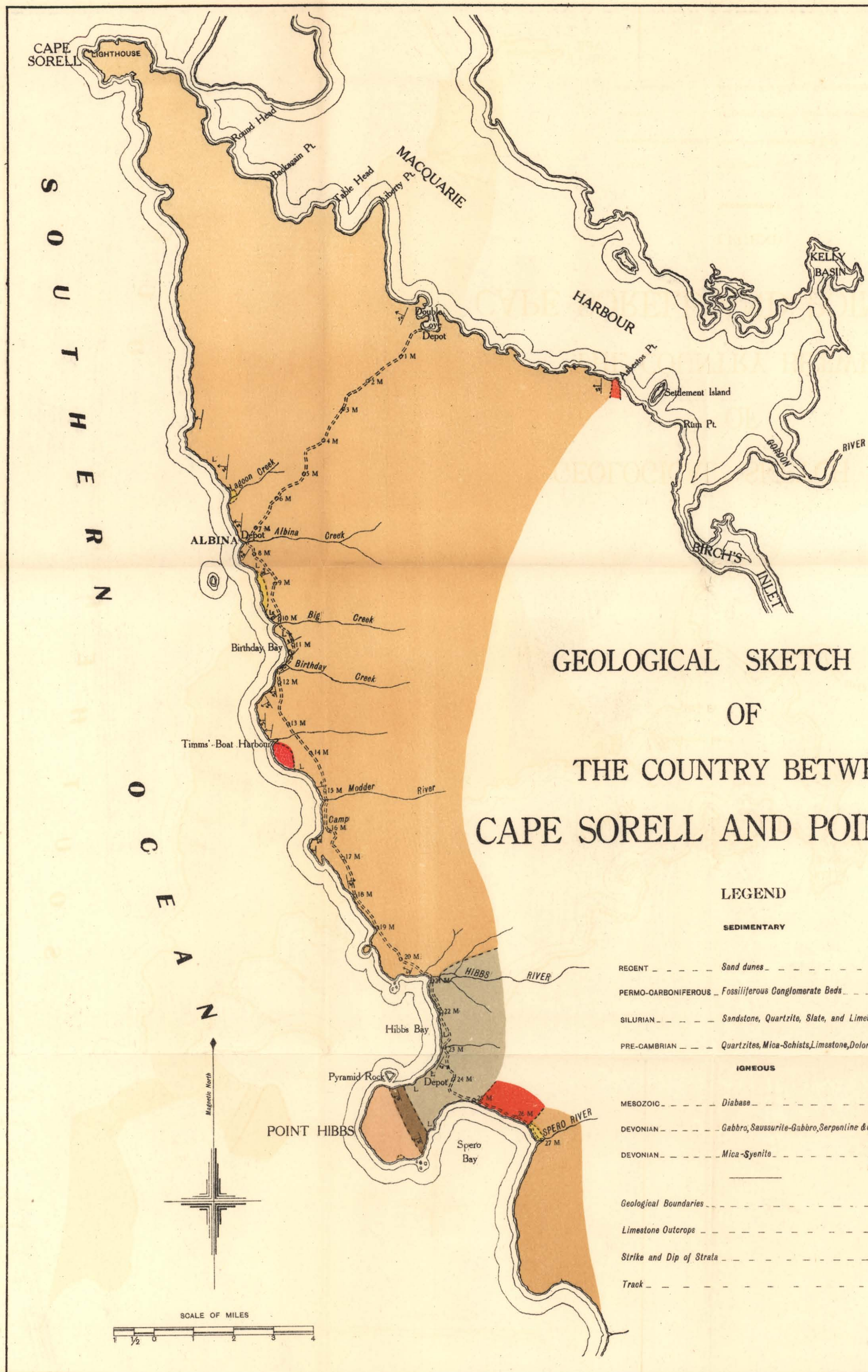
Coast, and the climate generally is milder. This fact, combined with the occurrence of areas of good soil, present conditions which are favourable to the success of agricultural and pastoral pursuits.

LOFTUS HILLS, M.Sc.,
Assistant Government Geologist.

Launceston, 25th February, 1914.

GSB18

PLATE II.



GEOLOGICAL SKETCH MAP OF THE COUNTRY BETWEEN CAPE SORELL AND POINT HIBBS

LEGEND

SEDIMENTARY

RECENT	Sand dunes	
PERMO-CARBONIFEROUS	Fossiliferous Conglomerate Beds	
SILURIAN	Sandstone, Quartzite, Slate, and Limestone	
PRE-CAMBRIAN	Quartzites, Mica-Schists, Limestone, Dolomite &c	

IGNEOUS

MESOZOIC	Diabase	
DEVONIAN	Gabbro, Saussurite-Gabbro, Serpentine &c	
DEVONIAN	Mica-Syenite	

Geological Boundaries	
Limestone Outcrops	L.
Strike and Dip of Strata	
Track	

Loftus Hills M.Sc.
Assistant Government Geologist
25th Feb 1914

Photo Litographed by John Vail Government Printer Hobart Tasmania.

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