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REPORT ON COUNTRY ON THE EAST SHORE OF LAKE SORELL, AND ON A DISCOVERY OF COAL NEAR OATLANDS.

Government Geologist's Office,
Launceston, 17th March, 1902.

SIR,

As instructed by you, I proceeded on the 28th January to Lake Sorell to examine the geological structure of the country through which the tunnel will pass, which it is proposed to drive from the north-east corner of the lake through the rim-rock to the eastern fall overlooking the low country round Tunbridge. At the same time I took note of the geological features of the country generally.

Lakes Sorell and Crescent are, geologically, one lake, though at present they are separated by a narrow strip of flat land not exceeding half a mile in width. At no very distant date in the past they were connected, as proved by evidences of either a rise of the land or shrinkage of the lake to the extent of a few feet in recent times. Mr. K. L. Rahbek, the hydraulic engineer in charge of the lake survey, informed me that the water-level of Lake Crescent is 2·16 feet lower than that in Lake Sorell.

Lake Sorell is a fine sheet of water, 5 miles from N. to S., and nearly 6 miles from E. to W., while Lake Crescent is much smaller, being 3½ miles long by a couple of miles broad. As a rule, undulating wooded shores bound these lakes, but at the northern and southern extremities lofty mountains close in the view. Thus, Mt. Franklin, rising from the north end of Lake Sorell, attains a height of 3600 feet. Further north are Molly Hawk's Nightcap and a mountain mis-named Cradle Mountain. Table Mountain forms an imposing object at the south end of Lake Crescent, rising to about 3600 feet above sea-level. It is a flat-topped mountain, hence the name.

The beds of the lakes themselves consist of a shallow depression in the lofty central plateau of the Island. My aneroid reading of their height above sea-level was 2750 feet. Using the temperature of the vapour of boiling water in a Casella's hypsometer, I made the height to be 2729 feet. Walch's Red Book gives it as 2688 feet. The mean of the

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three readings is 2722 feet. Lake Sorell, according to Mr. Rahbek, is only 13 feet deep in the middle, and Lake Crescent, 8 feet.

The elevated position of this great plateau with its numerous lakes is a dominant feature in the configuration of the Island. The table-land occupies a tract averaging 60 miles x 60 miles, at an average elevation of 3000 to 4000 feet above sea-level, with points rising to 5000 feet. The surface is often remarkably level, otherwise hills and mountains diversify the plateau. At the Dog's Head, on the east side of Lake Sorell, it is very level, being covered with a sheet of Tertiary basalt, which has had little time for erosion. The edge of the table-land on the southern, eastern, and northern fronts is steep and often precipitous, forming high mural escarpments. On the western edge it connects easily with the high lands of the West Coast.

In the midst of much that is perplexing, the geologist readily sees that the plateau has not formed a central boss or nucleus, around which the sediments of the low country have been deposited. Stratified rocks—sandstones, lithologically similar to the Lower Mesozoic strata at Ross—occur on the shore of Lake Sorell. They have therefore been lifted from sea-level to that height. This elevation was manifestly not due to our granites, which had consolidated prior to the Permo-Carboniferous Period. Some of it may be due to a rising movement in Tertiary times; but there is more reason to connect it, as a whole, with the stupendous eruptive processes which formed and faulted the diabase rock.

From the sea, on the east, the same formations, Mesozoic sediments and the diabase intrusive into them, rise successively in tiers to the central plateau. On the sea-shore Mesozoic sandstones and diabase occur at water-level; inland, a lofty tier, 1000 and 2000 feet high, fronts the east, on this level diabase and Permo-Carboniferous, with Mesozoic strata, also occur; further west, the country round Ross and Oatlands, at an elevation of 1000 to 1400 feet, consists of the same formations. Again rising from Oatlands to 2000 feet, the same sandstones and eruptive rock are met with; and the final ascent, 500-700 feet to Lakes Sorell and Crescent, brings us still again on a plateau with precisely the same geological features as were observed at sea-level. It is impossible to avoid the conclusion that a series of huge step faults has taken place, and that the sandstones which we see on the lofty plateau were originally continuous with others at lower horizons; otherwise, an unwarrantable thickness would have to be ascribed to the sedimentary formations. Hence it is, too, that we meet at high horizons with beds lower in the geological series than others at lower levels.

At that time a large part of the Island was in the throes of deep-seated diabasic convulsions. It was fissured and shaken on a large scale by intrusions of the molten mass, as dykes, intrusive sheets, perhaps laccolites, disturbing and penetrating the coal measure sandstones, but without, as far as the evidence goes at present, ever reaching the then surface of the ground. Possibly volcanic pipes ascended to the surface as basalt through overlying sediments now removed by denudation. The surmise that the actual diabase masses are sub-aërial lava flows is unsupported by any positive evidence. Inspection of the diabase sills at Blackman's Bay and Frederick Henry Bay, where they are covered by beds of Permo-Carboniferous age, serves to show the ease with which an erroneous impression may be formed. Imagine an inspection of the same places at some time in the geologically near future, when the overlying sedimentary covering has been wasted away, and all evidences of intrusion gone. The same surmise of a thick lava flow might then be hazarded, and an entirely wrong conclusion drawn.

I know that there is a certain amount of difficulty in realising how thick masses of molten rock may insinuate their way into and between superincumbent strata, and without much alteration of the latter. On these points the great basic sills of Scotland and Ireland are highly instructive. Sir A. Geikie, in his work on the Ancient Volcanoes of Great Britain, delineates their features with the hand of a master. He describes (Vol. II., p. 301) the great Tertiary sill of coarsely crystalline ophitic olivine dolerite entering into the composition of Fair Head, Antrim, and presenting a vertical cliff face 250 feet in height, rudely columnar from base to summit. This is intrusive into carboniferous shales and the chalk. He then goes on to give an account of the basic sills of the Shiant Islands, north of Skye; one of these shows a sheer face with columnar structure 500 feet high, and its total thickness may even exceed that, as it passes down below sea-level. Some of the prismatic columns are stated to be 300 or 400 feet in length. These sills have been injected between Jurassic shales. Thick columnar sills of dolerite or gabbro occur on Skye, intrusive into the Jurassic. One of these is quoted 200 feet thick. Some of the illustrations in Sir A. Geikie's volumes faithfully reproduce many of the typical escarpments of columnar diabase rock in Tasmania. The contact-effects on beds of clay are exactly similar to those often noticed in this Island. He says of Fair Head (Vol. II., p. 300), "The contact metamorphism . . . consists mainly in an intense induration of the argillaceous strata. These pass here from their usual condition of fissile, laminar, dull, dark shales into an exceedingly compact, black, flinty substance, which in its fracture, colour, and hardness reminds one of Lydian stone."

Again, it is pointed out how insignificant is the amount of contact alteration which is produced by these huge sills. "It seldom goes beyond a mere induration of the strata for a few yards, often only for a few inches from the surface of junction."

There are proofs on the western edge of the great plateau in Tasmania that in late Tertiary times it constituted a snow field which fed glaciers descending the West Coast gorges nearly to sea-level, if not to sea-level itself; but evidences of glaciation are wanting in the eastern part. I see nothing in Lakes Sorell and Crescent to indicate Tertiary glaciation in this part of the country.

Country near Tunnel.

On the eastern shore of Lake Sorell there are several little bays with sandy beaches. These are covered with fine quartz sand, which cannot possibly have been derived from the hills of basalt and diabase which skirt the shores. There is such a beach a little east of Interlaken House, another further north (marked as Diamond Beach on the Government chart), and a longer one at the north-east corner of the lake where it is intended to drive the tunnel. The sand on all these beaches has undoubtedly come from the degradation of beds of sandstone, and I feel pretty certain that these must exist somewhere on the floor of the lake. Though there is a good deal of sand in the north-east corner, I could not find any sandstone. The water there is very shallow, the depth being said not to exceed two feet for a quarter of a mile out into the lake. Four or five years ago, the lake in this corner was dried up for that distance out, and the bottom was seen to be sandy. The bed-rock is probably sandstone, but the trial holes which Mr. Rahbek is going to sink here will settle the matter decisively. However, the light yellow quartz sand has already determined my view of the nature of the underlying rock. Mountain Creek, which comes from the north from Molly Hawk's Nightcap, is the main feeder of the lake, and, as

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this flows through diabase and not sandstone, it cannot have brought the sand which is seen on the beaches.

Proceeding along the line of the proposed tunnel, the country for nearly half a mile east of the shore of the lake is flat and covered with sand, much of which may be wind-blown. A gentle rise then takes place to the summit of a saddle of diabase rock, higher diabase hills being situate N. and S. This saddle is 90 to 100 feet above the shore of the lake. The surface then plunges down eastwards towards the Tunbridge Plain. No lake sand is seen on the eastern side of the saddle; boulders and protuberances of diabase are visible, and no sandstone is met with until 500 feet below lake level, when steep cliffs of it appear on the hillside. The deduction which I make is, that on the shore of the lake and in the low marsh east of it the tunnel channel will probably be in sandstone, but that it will enter diabase rock at the base of the saddle, and continue in it for the remainder of its length. There is a remote possibility that sandstone may be found passing under the diabase at tunnel-level, but no sign of it is seen on the eastern side of the ridge, where it would crop out upon that supposition, and I think it safer to assume that the saddle referred to has cut it off.

This diabase rock, consisting of plagioclase felspar (labradorite), titaniferous magnetite, and augite, is not so hard a rock as granite, but it is much tougher, in virtue of the interlocking of the crystals which compose it. Where it is fresh and massive, the absence of jointing makes it more difficult shooting ground than granite. In tunnelling through the same rock in connection with the Electric Light Works at the Second Basin, Cataract Gorge, Launceston, one hard unjointed portion was encountered, in which a power drill could only make 6½ feet in a week's work of 18 shifts. I do not think this hard variety of the rock will be met with on the line of tunnel at Lake Sorell, as the works will be shallow and for the most part within the zone of surface decomposition. The rock seen at surface, though tough enough, is distinctly decomposed.

Dog's Head.

All along the shore south from the locality just described, as far as Bennett's cottage in Dog's Head Bay, the lake rim is comparatively flat, rising here and there into low ridges of diabase. South of the bay is the Dog's Head, a flat-topped promontory of basalt. Small knolls of broken basalt protrude here and there through the grassy plain on top. On the lake side, the waves appear to have undermined the cliff, bringing large masses away and giving rise to huge clefts and chasms in the rock. The basalt is of Tertiary age, compact and dense in grain, with crystals of honey-yellow brilliant olivine scattered through its substance. I could find no vesicular lava nor volcanic ash.

Diamond Beach.

A little over a mile south of the Dog's Head is the Diamond Beach, so-called from the numerous small stones of pellucid (yellow, red, brown) cornelian, jasper, and allied varieties of quartz, of which the sand is largely composed. The stones vary from the size of a pin's head to that of a pea, but though some of them are brilliant and attractive in appearance, none are of any real value.

Various speculations have been entertained as to their origin. The view which, on the spot, appeared to me the most likely, is that the veins or seams of which these stones are the degraded fragments were the result of the diabase-sandstone contact. I accordingly searched for sedimentary rocks, and eventually found sandstone at both ends of the beach. At the south end of the bay they occur at the water's edge, hidden underneath the beach sand, and at the north end they extend out into the water and form the low grass-covered bank a couple of feet above lake-level. At the south end the flat beds are fissured with vertical joints, giving them a quasi-tesselated appearance, probably due to the proximity of the intrusive diabase. The colour of the sandstone is light buff, its nature is somewhat clayey, and it contains pebbles of quartz. It is hardly possible, without further evidence, to determine whether these strata are Mesozoic or Permo-Carboniferous; from the appearance of the stone, I am inclined to refer them to Lower Mesozoic. Such sandstones are certainly the origin of the sand of the beaches.

Lake Echo is also said to have a sandy bed; there are sand banks and sandy bottoms at the Great Lake. Lake St. Clair is bounded by mountains, the lower part of which is sandstone, the upper part diabase. Thus, it would not be correct to conceive of the Tiers as a uniformly solid mass of eruptive rock. The plateau is evidently a replica of what is met with at lower levels; areas of sandstone capped with and intersected by diabase.

The Diamond Beach is not without its intrusive diabase at water-level, and both the horns of the bay are of the same rock. On the beach are several boulders of coarse, yellow, cemented sand, containing the beach pebbles. These consist really of the consolidated sand of the beach, and are also found a little distance from the shore up the flat eastwards, and a few feet above water-level. This shows the former existence of the beach a little higher than it is now, and consequently the former greater extent of the lake.

About half a mile east of this beach are one or two small cones of Tertiary basalt. One of these is a truncated cone of ideal contour, not more than 15 or 20 feet in height. The flat top is perfectly level, grass-covered, with blocks of basalt protruding through the floor. Its elliptical margin is edged all round with broken columnar basalt rock. The cone is about 100 feet in diameter at its base, and is the most perfect survival of a volcanic cone which I know of in the Island. No ash or scoriæ are to be seen. Close to the east of this is another cone, larger, but worn down by denudation.

The neck of land at Interlaken House between the two lakes is diabase, but east of it is a basaltic floor of lava containing large yellow aggregations of olivine crystals. Further east again before the junction of the roads to Tunbridge and Oatlands the diabase rock peeps out again; and again further north on the Tunbridge Road the basalt recurs.

From a mineral point of view, this part of the plateau is hopeless. There are no outcrops of granite, serpentine, or the older slates and schists. The only formations are the sandstones and diabase of Upper Mesozoic Age—posterior to the date of origin of our great mineral deposits. The only hope is in the possible occurrence of coal, but I believe the sandstones on Lake Sorell to be below the horizon of the Upper Coal Measures.

A phenomenon of scientific interest is the occurrence of the well-known but mysterious noises heard from time to time resembling the distant booming of cannon. They have been erroneously referred to the blasting operations at Mt Lyell, on the West Coast, but were in fact known long before the Mt. Lyell Mine was started. They are also heard occasionally on Clarke Island, Bass Straits, where they go under the name of "Cape Barren Guns." They the sound seeming to come from the direction of that island. In India similar noises are called "Barisal Guns." They occur also in other parts of the world. Whether they are of atmospheric or subterranean origin has not yet been determined. The latter seems the more probable, though it is difficult to explain the absence of earth vibration.

Coal at Mike Howe's Marsh.

This marsh lies at the foot of the last great rise to the lakes' plateau, about 7 miles N.W. of Oatlands, and 4 miles S.E. of the southern end of Lake Crescent. The main road, an excellent one, from Oatlands to Lake Sorell, intersects it. The coal seam is a few hundred yards S.W. of the road on Mr. Askin Morrison's land at the base of a hill rising a couple of hundred feet above the marsh, which, in its turn, is 2000 feet above sea-level.

The upper part of the hill consists of diabase, coming down to within about 40 feet of the marsh, when it gives place to sandstone. This is a soft yellowish variety, in beds dipping N.W. at angles from 10 to 20 degrees. From its appearance, I should judge that it belongs to the Mesozoic series, but, in the absence of fossils, no decisive determination can be made.

Near the S.E. boundary line, and at the base of the hill, a seam of coal has been struck near its outcrop by a shallow pit 6 feet deep. A dip 20 to 25° has been put in on the seam for about 15 feet, bearing N. 40° W. The roof is sandstone, the floor clay, and the seam 3 ft. 6 ins. to 4 feet thick. The dip had only been cleared out specially for my visit, and all the coal which was accessible must have suffered to some extent from the standing water. It is a consistent seam, free from bands, but the coal was somewhat clayey, and broke in small pieces.

The samples which I broke off from the walls of the drive were the brightest which I could knock out, and even then they looked none too pure; the walls being fairly-well saturated with moisture. When assayed by the Government Analyst they returned—

Fixed Carbon.	*Gases, &c.*	*Ash.*	*Moisture.*
33·4	20·2	21·0	25·4

These results are disappointing in every particular. I am disposed to think the coal has been under water too long for fair samples to be taken without fresh work being done on the seam.

Mr. Loone gave me some drier samples, which yielded a much more satisfactory assay. Mr. Ward returned these as—

Fixed Carbon.	*Gases, &c.*	*Ash.*	*Moisture.*
62·4	18·4	10·8	8·4

If this assay be taken as a guide, the coal would appear to be a strong durable one, capable of giving out a good heat, but of no use for making coke. The Government Analyst mentions in his return that no coke was found in either assay. The fixed carbon is high enough, and the ash low enough in the latter sample to make the coal suitable for steam purposes; but, to be sure of this, the iron and sulphur contents would require determining.

About 20 feet north of the above a small dip has been started on the same seam, but the timber in it has become insecure, and it was full of water at the time of my visit.

It has been thought that prospecting might reveal the outcrop of the same seam on Pillinger's land, which is the adjoining estate on the S.E., but I hardly think that likely. There is a valley of erosion between the two localities, and the seam would come to surface in the space now occupied by the gully; at least, it is only barely possible that it would strike across to the higher ground beyond, and once a certain height is reached, the eruptive diabase comes in.

Driving on the seam about a couple of hundred yards N.W. will bring the face below the contact of the sandstone with the eruptive diabase. Whether the coal measures pass under the latter, or whether the diabase intrudes into them and abruptly cuts them off, is impossible to say at present. It can be determined in three ways:—

I. By driving on the seam till the vertical plane of the supposed contact is reached;

II. By putting down a bore, in advance of the drive, higher up the hill into the diabase, and continuing it to a depth at which it would strike the seam if the measures are present;

III. By cutting down the surface-soil to the bedrock at the contact line of the two formations, when it can be seen whether there are signs of the sandstone being indurated or otherwise metamorphosed by the intrusion of the molten diabase material.

In some of these sandstone and diabase areas there are evidences of intrusion and severance; in others, it is possible that the coal measures underlie the flat intrusive sheets of diabase, so that it is impossible, where the junction is obscured, to predict, in any given case, one way or another, without actual work.

The seam plunges at an angle of 20°, and by pushing the works well down it could be followed under the marsh, where, however, water would have to be contended with.

I am afraid the diabase of the hill cuts the coal off, and thus restricts the area of the seam to the marsh aforesaid and the immediate base of the hill. Before commencing operations, bores ought to be put down all over the marsh, between the hill and the lake road, for the double purpose of ascertaining the extension of the seam and its quality, and seeing whether others do not exist below.

Towards the N.W. end of the hill, about 10 feet from the fence, and just where the hill begins to rise, I saw a couple of small pits, with slack coal thrown out on the bank. The pits were full of water. This seam would be a higher one than that described above, but it is too near the diabase for one to be very confident about its continuance. Its occurrence, however, makes it likely that there is a series of coal seams in these sandstones, and that others may be found below if the ground is prospected by the drill.

The conveyance of the output to Oatlands would be by tramway, but I did not go into the question of what route this would take. It is probable the distance would be over 10 miles, and the construction outlay would be £10,000 or £12,000.

It seems to me probable that the coal raised from this place would not at present be able to compete, in point of cost, with that which exists in more easily accessible parts of the State. There would be little use in dealing with it on a small scale, and a good deal of preliminary work is necessary before it can be definitely said that large quantities are available.

Whether these sandstones belong to the Mesozoic or Permo-Carboniferous, it is impossible to say without fossil evidence. The same alternations of diabase and sandstone continue S.E. all the way to Oatlands, in a succession of diabase-crowned hills and sandstone valleys, the diabase, in some cases, cropping out of the valley floors as well.

Oatlands, a substantial-looking stone-built town, is on a plain 1400 feet above sea-level, encircled by hills of moderate elevation. The building-stone, when properly smoothed, has an attractive appearance for architectural purposes; some of it has been used in Launceston for the handsome building of the Australian Mutual Provident Society, and in the construction of Trinity Church now in course of erection.

The buff sandstone is quartzose, with spangles of white mica rather loosely aggregated, friable, and apt to decay when exposed to the weather in its rough state, especially where impaired by ferruginous segregations. Some varieties of it, however, are very durable when smooth-dressed. Lake Dulverton, on the east side of the township, is in a shallow depression in the sandstones, which are exposed on the banks in horizontal beds. The lake water has fallen several feet in the dry weather of the last five or six years. When full, I was told, it is 12 feet deep, but not now more than 3 feet in the middle. Any scheme which would keep this lake full would be a great boon to the town.

This quartzose sandstone belongs to the Lower Mesozoic (homotaxially probably equivalent to the European Trias), and hitherto no Mesozoic coal has been found below it. There is, of course, the possibility of the Permo-Carboniferous strata existing beneath it, and these might contain seams of the Lower Coal Measures, but this could only be determined by boring. At what depth these measures, if present, would be struck, it is not possible to say, for we do not know to what extent the upper sandstones have been denuded, nor do we know whether the lower ones, if ever present, have been cut out or not by the intrusive diabase which is visible on the surrounding hills. Of course there is the possibility that any greenstone found underlying these sandstones might be a sill or sheet, below which the sedimentary beds recur, but to prove this by boring would be a great undertaking. It will be well for those interested in the discovery of coal at Oatlands to bear in mind that the indications are, that the geological horizon of the buff quartzose sandstones is below that of the Upper Coal Measures; consequently, in the search for coal, the higher sandstones of felspathic character, so common in the eastern coal fields, must be looked for, otherwise, the sandstones lower in the series will have to be either reached by boring, or found raised by faults in connection with the diabase. It is not absolutely certain that some of these raised beds do not occur somewhere in the district, but if they do, they do not appear to have been recognised. The most likely positions for their occurrence are on the higher ground, and in proximity to the eruptive trap-rock.

I have the honour to be,
Sir,
Your obedient Servant,
W. H. TWELVETREES,
Government Geologist.

W. H. Wallace, *Esq.*,
Secretary for Mines, Hobart.

JOHN VAIL,
GOVERNMENT PRINTER, TASMANIA.