NOTES ON A GEOLOGICAL RECONNAISSANCE OF THE MT. LA PEROUSE RANGE.

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Plates I.-VIII.

(Read 14th April, 1924.)

SYNOPSIS.

1. INTRODUCTORY.

(a) GENERAL.

The notes here published are the outcome of a hasty general reconnaissance made during a trip to Mt. La Pérouse at Christmas time, 1923, by a party consisting of Messrs. A. V. Giblin, H. R. Hutchison, V. C. Smith, V. E. Chambers, Dr. J. Walch, Major P. G. Dodson, and the writer.

(b) GEOGRAPHICAL POSITION AND ACCESS.

The country commented on is that part of Southern Tasmania lying between Southport and the mouth of New River. Only the more elevated portions of the ranges lying between those places were examined. The general position of the area here described can be seen from Plate I.

Access to Mt. La Pérouse can be obtained from any of the settlements south of the Lune River. Only one track exists, and that is scarcely better than a line of blazes with some of the undergrowth cleared away. It follows the ridge forming the southern edge of the Lune River Valley, starting from a timber tramway near the limestone quarries, south of the Lune, and about five miles from the Ida Bay settlement. Thence it rises very steeply nearly two thousand feet to Moonlight Flat. From this place there is no track, but once on the top of the main range the going in any direction is easy. The party referred to followed the above route. Access can also be gained from any of the settlements surrounding Recherche Bay, but first the dense forest to be penetrated, and then the steepness of that side of the mountain, would render an approach from anywhere but the Lune River very arduous.

(c) Previous Literature, Explorations, and Nomenclature.

The writer has been unable to find any description of the La Pérouse Range. In 1898 Mr. H. W. Nicholls read a paper on the Geology of La Pérouse before this Society (Nicholls, 1898), but, unfortunately, the paper was not published in full. The abstract in our proceedings is too brief to be useful, and the paper has now disappeared. The coastal plain from Strathblane to the mouth of the New River has been very fully described. (See Twelvetrees, 1915 (i.) and (ii.), and references to previous work there given, and Reid, 1922.) This paper deals with a triangle of country surrounded on the east and south by these districts.

The name *La Pérouse* first appears on Sprent's map of 1856, and it appears to have been given when the trigonometrical survey was being carried out, obviously after the great explorer for whom D'Entrecasteaux and Kermandec were searching when they mapped and named the adjacent coast. D'Entrecasteaux's chart, 1793, does not name the mountain, but shows four peaks, evidently Precipitous Bluff, Leillateah, La Pérouse, and the conical hill west of Recherche Bay. Cook, in a chart made during his third voyage in 1777, marks a range of mountains, and places the words "*Peaked Hill*" alongside what is evidently Leillateah. In an accompanying panoramic sketch, made from the south-west of South-East Cape (his South Cape), he shows a peculiarly-shaped hill, evidently Precipitous Bluff. Leillateah and

La Pérouse can also be picked out, but they were not named. Hayes, in 1793, sketched in the range of mountains from the South Coast to New Norfolk. He named Leillateah *Pinder's Peak*, and writes the words, *"Rugged Mountains,"* alongside La Pérouse. Hayes's nomenclature was evidently overlooked during later surveys.

Lady Franklin, in her diary of 1838, written when weather-bound in Recherche Bay on the way to Port Davey, and now, through the generosity of Mr. W. F. Rawnsley, her great-grand-nephew, and the activity of Mr. A. H. Ashbolt, in the hands of the Royal Society of Tasmania, mentions this range. She states that her party named it the Research Range, and the two prominent peaks, now known as Leillateah and La Pérouse, as *Mt. King* and *Snow Ridge* respectively. These names likewise do not appear to have ever found their way on to official maps. In 1849 Dr. Milligan published his careful report on the occurrence of coal in this district, and does not give a name to the mountains.

Mr. James Sprent visited the mountain during the course of the trigonometrical survey, 1844-1856, and evidently bestowed the name La Pérouse, but, strange to relate, does not appear to have plotted Leillateah, the most outstanding feature to the south of La Pérouse. Mr. G. S. Perrin made a report on the area between Adamson's Peak and La Pérouse for the Lands Department in 1886, and Mr. T. B. Moore crossed the range when constructing his track to Port Davey in 1900, and again in 1901. Both these gentlemen left maps which are now preserved in the vaults of the Survey Department, but they show too little detail to be of any great assistance.

Mr. T. B. Moore seems to have given the names to *Mts. Bisdee, Victoria Cross, Wylie, Alexandra,* and *Precipitous Bluff*, although from his sketch the exact location of the peaks he so named is not always clear. He also gave the name *Mt. King Edward VII.* to the peak shown on the accompanying sketch as Leillateah. Mr. Twelvetrees speaks of a Mt. Leillateah (Twelvetrees, 1915 (i.), p. 20), but the hill he so names is the conical hill a couple of miles west of Leprena. Mr. Reid copied this nomenclature on to the map of the area in "The Coal Resources of Tasmania." After exhaustive inquiries the writer is satisfied that the mountain named Leillateah on the accompanying plans, and so called herein, is the original peak of that name, and has been thus known by residents of the neighbourhood at least since 1890. If ever the cartography of this area is revised by authority, it would be a fitting tribute to Hayes's work, and following the established practice of restoring the names first bestowed, to call the peak now named Leillateah *Pinder's Peak*, and leave *Leillateah* to the hill Mr. Twelvetrees so labelled. It is interesting to note, in passing, that Ling Roth gives the word "Leillateah" as the aboriginal name for what we now know as "Recherche Bay." The writer is indebted to Mr. C. E. Lord for calling his attention to several of the historical details set out above.

2. PHYSIOGRAPHY—A GENERAL DESCRIPTION.

(See also Twelvetrees, 1915 (i.), p. 5.)

The range of mountains stretching from the Huon Valley, between the junctions of the Picton and Arve with that river, southward to the sea at South Cape, is the dominating feature of the topography of the south-eastern side of the southern extremity of Tasmania. It is shown on the Survey Department's maps as the isolated peaks of Mt. Hartz, Adamson Peak, and La Pérouse, but in reality it is a continuous range, nowhere less than 2,000 feet in elevation, over 35 miles long, and several miles wide, out of which the prominences above named rise for another 2,000 feet.

On the western side of D'Entrecasteaux Channel lies a fertile coastal plain, some ten miles wide towards the north, narrowing to under five miles in the south. It is generally hilly, but its undulations are seldom over 500 feet in height, and are usually heavily timbered or cultivated to the summit. To the west the main range rises suddenly from this plain, with its eastern face, in general outline, a steep wall running somewhat west of north and east of south, projecting occasionally into the coastal plain in wooded spurs, and cut into deep gorges where the main streams descend. Approximately five miles farther west the plateau drops as suddenly to the Picton River, winding through a very fertile valley some three miles wide. To the south the range falls away precipitously to a narrow plain fringing the south coast, and on the north it descends in a series of thickly timbered ridges to the Huon Valley. This paper deals with the southern extremity of this range, from the Lune River Valley, southward.

The La Pérouse Range is the remnants of a plateau that once extended south from Adamson Peak for about ten miles, to within five miles of the coast, but which has been so dissected that it is now a mere jumble of twisting ridges separated by deep precipitously-sided valleys. (See Plates I. and II.) The main range reaches its lowest elevation about half-way between the summit of La Pérouse and Adamson Peak, and this is a convenient point to start the description of the La Pérouse Range, although there is no definite feature at which it can be said that La Pérouse ends and Adamson Peak begins.

On the north of the La Pérouse Range, at about this junction, the Lune River rises in several branches. One has cut a great gorge in the southern slope of Adamson Peak, and another, rising in a deep, sheer-sided cirque in the heart of La Pérouse, flows for several miles due north towards Adamson Peak, then, joining other branches, flows still in a precipitously-sided canyon eastward to Southport. It thus cuts the northern portion of the La Pérouse Range into two parallel ridges, divided by a precipitous valley a thousand feet deep and about a mile wide. The western one of these two ridges curves gently, first west of north and then east of north, until it reaches Adamson Peak, which has considerable spurs running both east and west from the summit. This ridge consists of several wide, gently-sloping flats, divided by rough diabase or smoother sandstone prominences, the southern one of which is *Mt. Alexandra*, and its eastern slopes are drained by several branches of the Lune. The eastern ridge, known as *Moonlight Flat*, is about two miles wide from east to west and three miles from north to south, and forms a lower buttress to the main ridges of the La Pérouse Range proper. It drops sharply away on the east to the steep side of the mountain, and on the north and west to the cliffs of the Lune canyon, and averages about 1,800 feet in altitude.

To the south, Moonlight Flat rises in a succession of steps, often lines of low, broken cliffs, attaining an elevation of about 2,600 feet about four miles from the northern edge, and some three miles south of where the Lune track debouches. From this point the long ridge shown on the accompanying sketch as *Sandstone Ridge* rises for another 800 feet. Sandstone Ridge runs north and south for about two miles. Its summit is a sharp razor-back, cut by erosion into four prominent hills separated by saddles some two hundred feet lower.

The most northerly of these four prominences of Sandstone Ridge (indicated as *No. 1 Hill* of Sandstone Ridge on the accompanying plan) presents a steep even face to the north as it rises above Moonlight Flat. To the east it is extended in a spur running out a few hundred yards to the general line of the eastern slope of the mountain, and to the west it drops sharply to the cliffs which fringe the Lune River cirque. This height is joined by a saddle, some 200 feet lower than the summit, to the next prominence in succession to the south. From this second height a long, flat-topped ridge runs for about a mile to the eastward. The top of this ridge, a couple of hundred feet or so lower than the average height of Sandstone Ridge, is almost horizontal and quite straight, but only a few yards wide. Its eastern end is flanked with diabase cliffs, but here the diabase does not rise above the general level of the ridge. Looking at it from north or south it appears to be the edge of a level plateau, and the name of *Tabletop* has been given to it. From the top of Tabletop and the easterly extension of the first hill the ground drops precipitously to the bottom of a wide valley a thousand feet below, which cuts into the mountain from the east, and is called, on the accompanying sketch, the *North D'Entrecasteaux Cirque.* It is drained by a branch of the D'Entrecasteaux River, which empties into Recherche Bay at Leprena.

A little south, and on the western side of this second height, the Lune canyon ends abruptly in a continuous half-circle of cliffs a thousand feet high. (See Plate IV., Fig. 2.) This canyon, as has been explained, cuts deeply into the main mass of the mountain. Where it ends a narrow col connects Sandstone Ridge with the Mt. Alexandra and the western ridge running north to Adamson Peak. This col is only a couple of hundred yards wide, and then the ground dips sharply to the south. The highest point is right on the edge of the cliffs overlooking the Lune gorge, and from this point the drainage is all to the south, to a branch of the Picton River. The south end of the Mt. Alexandra spur extends about half a mile farther south than this col, and here a branch of the Picton that drains a considerable portion of the La Pérouse Range runs in a valley over a thousand feet below the level of the ridges. So this col provides the only high level connection between the eastern and western ridges of the north of the La Pérouse Range. In 1900 and 1901 the late Mr. T. B. Moore explored a route from Southport to Port Davey, and used this col as a means of access to the western ridges. The name, *Moore's Bridge,* has been given to this col in honour of the memory of one of our greatest explorers.

whose name is hardly commemorated at all, though he gave names to most of the features of Western Tasmania. The stakes marking Mr. Moore's track can still be easily followed, skirting the north-west of Sandstone Ridge and crossing the Bridge.

The second height of Sandstone Ridge is connected to the third by a saddle slightly lower than that connecting the first and second. This third prominence rises straight up from the eastern end of Moore's Bridge. It, also, has a long extension to the eastward. A sharp-crested, level-topped sandstone ridge runs east for about three-quarters of a mile, parallel with Tabletop, half a mile across a second deep, steep-sided valley to the north, named the *Centre D'Entrecasteaux Cirque,* and also drained by a branch of the D'Entrecasteaux River. This ridge terminates in a mass of diabase, standing several hundred feet above the level of the ridge, to which the name *Mt. Hippopotamus* has been given. It is a peculiarly gnarled piece of rock, only ascendable by occasional chimneys, and with many overhanging ledges. It forms one of the most characteristic features of the range. From its summit the ground drops in a series of precipices to the coastal plain nearly three thousand feet below. On the west side of this third hill of Sandstone Ridge a small stream rises, which, after flowing in a steep gully to the north-west onto the eastern end of Moore's Bridge, swings round to the south and eventually joins the Picton. The fourth rise of the top of Sandstone Ridge is connected to the third by another saddle. This is the southern terminal of Sandstone Ridge, which drops in a series of steps to an elevation of about 2,900 feet, leaving a high level pass between its southern end and the next ridges to the south.

A mile to the south and south-west of this southernmost top of Sandstone Ridge and running in a north-west-south-easterly direction is *Maxwell Ridge* (so named by parties visiting the mountain after Mr. Eustace Maxwell, who has led several trips to this district), a narrow flat-topped sandstone ridge 3,500 feet in elevation, and connected to the south-east with the summit of La Pérouse by a low saddle. Between Sandstone Ridge and Maxwell Ridge lie the two largest lakes on the range. The north-eastern side of Maxwell's Ridge drops in beech-clad cliffs for 800 feet. Close under these is the end of the upper lake, a small triangular-shaped sheet of water about four hundred yards long and two hundred and fifty yards wide at the northern end, at which end it overflows to the second lake. The water is dammed by a bar of rock, gently sloping on the southern, or upstream side, and forming a small cliff on its northern side. This rock bar from a little distance looks so artificial that it at once suggests a man-made reservoir, and the name *Reservoir Lakes* has been suggested for these two sheets of water. (See Plate V., Fig. 1.) The lower Reservoir Lake lies about a hundred yards north of the rock bar damming the upper lake, and is about 30 feet lower in altitude. It is of irregular outline and dammed by a morainal wall over which the outlet of both lakes flows as a stream running a few hundred yards north and then swinging in a wide circle to the westward. Moore's Bridge lies a mile north of these lakes. On its southern side a steep-sided amphitheatre has been cut into the Bridge and the south-east of Mt. Alexandra. Into this flows the stream mentioned before as rising in the third hill of Sandstone Ridge. Several other streams flow south from this amphitheatre, and, joining that rising in the lower Reservoir Lake, form a very considerable branch of the Picton. This branch flows to the main stream westward in a deep gully between Maxwell Ridge and the southern spurs of Mt. Alexandra.

Maxwell Ridge stands about 3,600 feet in altitude, a level, razor-backed ridge of sandstone, dropping sheer to the Reservoir Lakes on its north-east side and to the tributary of the Picton before mentioned on the north-west. Between these a long ridge runs out to the bend of the outlet stream of the lakes, giving a means of access to the summit from the north. Another spur runs out half a mile or so to the west, decreasing in height from the top of the ridge by a series of steps, until it overlooks the wooded slopes of the Picton Valley, which winds northward past the Hartz Mountains to the Huon Valley, faintly discernible against Mt. Weld and the Snowy Mountains on the northern sky-line. To the south, Maxwell Ridge is connected by a saddle to Mt. Leillateah. This will be referred to later. To the south-east a low saddle, about 3,000 feet high, connects Maxwell Ridge to the ridge on which the trigonometrical station of La Pérouse stands.

This main summit of La Pérouse is the highest portion of the range, the trigonometrical station standing at an altitude of 3,800 feet above sea level, and is the highest point between Leillateah and Adamson Peak, although the highest points of Maxwell Ridge, Sandstone Ridge, and Mt. Alexandra are barely a couple of hundred feet lower. (See Plate IV., Fig. 1.) This portion of the mountain is a circular bastion, only four hundred yards in diameter at the top and surrounded with cliffs over a thousand feet high, except for the north-east corner, where a spur runs off to the eastward, and the western side, where the saddle mentioned before connects it with Maxwell Ridge. On the north face a mass of diabase, which projects from under the sandstone capping of the mountain in a straight line with Mt. Hippopotamus on the end of the next spur, a quarter of a mile farther north, has been exposed by the erosion of the soft sedimentary rocks on both sides, and now stands out as a spur of La Pérouse into the valley to the north. Its sides and end are perpendicular, and its summit has been eroded to a succession of points. For this reason it has been called *The Comb Ridge,* and it presents one of the finest scenic features of the range. (See Plate III., Fig. 2.)

Between the summit of La Pérouse and the saddle connecting it with Maxwell Ridge on the south, and Mt. Hippopotamus and the ridge connecting it with Sandstone Ridge on the north, lies a deep, steep-sided valley, marked on the sketch as the *South D'Entrecasteaux Cirque,* into which the Comb Ridge projects at right angles from the southern side for about half a mile. (See Plate VI., Fig. 1.) This gorge is narrow, precipitous, and straight-sided, although flat-bottomed up to a line between the Comb Ridge and Mt. Hippopotamus. Then to the west its head has been considerably enlarged, and a great quarry-like amphitheatre has been cut in the northern face of the main La Pérouse ridge. It terminates in a semi-circle of cliffs about two hundred feet high, at the southern end of which a considerable stream descends in a fine waterfall. Above these cliffs is a ledge several hundred yards broad, running round the eastern face of the fourth or southern prominence of Sandstone Ridge. This ledge averages about 2,800 feet above sea level, and has been extended westward between the end of Sandstone Ridge and the saddle connecting the summit of La Pérouse and Maxwell Ridge until it meets the southern end of the valley in which the Reservoir Lakes lie, thus forming the high level gap between the branches of the D'Entrecasteaux and Picton Rivers, the highest point of which is about 600 feet lower than the average height of the top of the surrounding ridges, although topographical difficulties render it useless as a means of passage through the range.

The highest point of this gap naturally forms the watershed in this locality between the branches of the D'Entrecasteaux and Picton Rivers. Somewhat to the south-west of the southern end of Sandstone Ridge lie three small tarns. The most northerly drains into the centre of the three, and their overflow then finds its way to the north into the upper Reservoir Lake. The most southerly, separated from the centre one by only a few yards of peaty swamp, drains east to the D'Entrecasteaux.

A hundred yards east of the trigonometrical station at the summit of La Pérouse the edge of the mountain drops away in a cliff some hundred feet high to a ledge less than a hundred yards wide, which runs round the eastern face of the mountain. From the north-eastern corner of this ledge a high spur, the divide between the D'Entrecasteaux and Catamaran Rivers, extends in an easterly direction for three or four miles, its lower extremities reaching nearly to Recherche Bay, between Leprena and Catamaran. It leaves the main ridge of the mountain at an altitude of about 3,600 feet, but rapidly decreases in height by a series of steps which consist in most cases of cliffs of fluted diabase. In front of one of these, about a mile east of La Pérouse, is a handsome stack or pillar separated from the main cliff by erosion. Towards the eastern end of this ridge the direction changes to north-east, and after a comparatively low saddle the ridge terminates with a very handsome conical hill—a prominent landmark, both from La Pérouse and Recherche Bay. (It was this hill that Mr. Twelvetrees called Mt. Leillateah, and he mentioned its altitude as 2,630 feet.)

South of this long spur is a line of diabase cliffs, perhaps six hundred feet high, forming the eastern face of the summit of La Pérouse, and extending right across the southern face of this summit ridge and the saddle connecting it with Maxwell Ridge. They are unbroken except by one steep gully running south from the lowest portion of the above-mentioned saddle. From these the side of the mountain descends very steeply, probably for a further depth of 2,000 feet, to the bed of the wide valley of the Catamaran. So steep is this southern slope of La Pérouse that the face of the mountain is scarred with numerous landslides, some very recent, others more or less healed by time and covering vegetation.

Under these diabase cliffs lie two remarkable little lakes. The northern edge of the more northerly lies in the corner between these cliffs and the eastward spur mentioned above. It is roughly circular, and about four hundred yards in diameter. The cliffs descend for six hundred feet sheer to the water's edge. A hundred yards farther round, on the south-east side of the mountain, is the second lake, remarkably like the other in every respect but about half the size. These two lakes, clinging to the face of the mountain like a swallow's nest stuck on a wall, are impounded on the very steep mountain slope each by a semi-circular embankment 150 feet above the level of the waters of the lakes. The lakes appear very deep and are one of the scenic sights of the mountain. There is no apparent outlet, although at no very distant date the larger appeared to flow into or to join the smaller by a channel close under the cliffs. Probably there is a certain amount of soakage through the loose material of the impounding bank.

The summit of Leillateah stands about a mile and a half (H.E.) due south-west from the top of La Pérouse. (See Plate VII., Fig. 1.) It is a very handsome, symmetrical, concave-sloped peak, with four precipitous sides, each separated by a buttress-like ridge. Its altitude is 4,200 feet above sea level. This reading was given by carefully checked aneroids set at the trigonometrical station on La Pérouse. It is also the height given on the Admiralty Chart for Leillateah, which is shown there in its correct place, but not named. It is curious that this rugged peak, one of our finest mountain features, should not have received more notice. Although it is within a day's easy walk from La Pérouse, and the most prominent feature in the landscape of the extreme south of this range, the trigonometrical survey did not indicate it on their map, and it has been ignored by the Survey Department. Even Mr. Perrin, who sketched the rest of the range on his plan and ascended to the summit of La Pérouse, does not indicate the existence of Leillateah. Perhaps this extreme sentinel is so often wreathed in mists blown from the southern seas that it has not been observed by the survey parties.

From Maxwell Ridge, several hundred yards west of the saddle connecting it with La Pérouse, a second saddle branches off to the south. This saddle, leaving Maxwell Ridge at an elevation of about 800 feet lower than the summit, and after descending slightly for a few hundred yards, rises quickly to a pointed eminence about 3,700 feet in altitude. This is followed in a southerly direction by a second eminence slightly higher than the first, to which it is joined by a somewhat lower saddle. To the east these saddles and peaks drop in a precipice sheer from the summit to the bottom of the Catamaran Valley a thousand feet below. To the west the ground drops sharply for a few hundred yards, and then very steeply to the bottom of the valley of a tributary of the Picton, which is divided from the valley of the Catamaran by this very narrow but high ridge.

From each of the two prominences on the southern end of this connecting saddle, spurs run out a short distance in a north-westerly direction, enclosing a ledge at an elevation of about 3,000 feet, on which rests a pretty tarn. (See Plate VII., Fig. 2.) This is roughly circular, and several hundred yards across, but very shallow, and with a deposit of yellow ooze on its floor. Dr. Walch, who examined some of this mud microscopically, reports that it consists of at least 50 per cent. of remains of diatoms of several well-known varieties. On the surface of the mud, and on water plants, were quantities of a small bivalve shell, which Mr. W. L. May reports belong to the genus *Spærium*. The species, he says, is indeterminate, but from the specimens brought back by the writer, he thinks the shells are immature specimens of *Spærium tasmanicum*. (See May, 1921.) Tenison-Woods described the species under the genus *Cyclas*. (Tenison-Woods, 1875.) As the specimens collected were the largest visible, and many dead shells were seen, none of which was any larger, it appears to the author that they may not be immature specimens, but a different variety. The subject is interesting, and well worth investigating by some student with a biological training. The whole subject of the life in our mountain lakes opens a fine field for an enthusiastic naturalist.

From the southern of these two prominences, after a slight dip, the northern spur of the main peak of Leillateah rises steeply. To the west of this spur are broken cliffs, and to the east a precipitous but largely plant-covered face, dropping several hundred feet to a wide ledge on which repose two small tarns about two hundred yards long by a hundred wide. From this ledge the side of the mountain drops sheer a further five hundred feet or so to the bed of the Catamaran. Leillateah can be ascended without difficulty by descending from Maxwell Ridge to the connecting saddle, thence to the lake on the west of the ridge, and up the spur on its south to the crest, and after crossing the top of the northern spur of Leillateah, by proceeding to the eastern spur along the face of the mountain, crossing this spur, and then completing the ascent by a vertical climb up the eastern face of the summit for the remaining couple of hundred feet.

As well as the spur just mentioned, three others leave the summit of Leillateah. One runs out a short distance from the south-western corner of the mountain, curving round in a bread half-circle to the north-west, until it meets Mt. Wylie, and thus forms the southern watershed of the head of the Picton River. A second spur runs off to the east, for about two miles, forming the southern side, first of the ledge, mentioned above, at the head of the Catamaran, and then of the main gorge of the Catamaran River. In the northern side of this spur, which along its whole length descends steeply to the Catamaran, are two great amphitheatres, ringed with cliffs and drained by branches of the Catamaran. In the western and smaller one is a pretty lake perched half-way between the crest of the spur and the bottom of the forest-covered Catamaran Valley. East of the second gorge this spur merges into the fourth buttress of the main mountain, which, leaving the summit in a south-easterly direction, runs out towards South Cape Bay.

These two spurs on the east of the mountain are quite distinct close to the summit, but soon merge and enclose a flat several miles long and half a mile broad on which lie three considerable lakes, with a fourth and several large pools close up under the mountain. The outlet from these lakes appears to drain south through a gap in the ridge to one of the rivers running into the sea at the south coast, perhaps into South Cape River. These spurs all drop steeply away from the summit of the mountain, which ends in a perfect point. The crests of the spurs are extremely rough, with projecting ends of broken diabase columns. Between the spurs the slope of the mountain is precipitous, and in most places quite unascendable. From the summit, and from the crests of the south-eastern and south-western spurs, the face of the mountain drops precipitously to sea level. A narrow coastal plain, a couple of miles wide, near the mouth of the New River, and much narrower farther east, skirts the foot of the mountain. (See Twelvetrees, 1915 (ii.), for a description of this.)

Parallel with the La Pérouse Range and about five miles farther west runs another range, the three highest portions of which Mr. Moore named Mts. Wylie, Victoria Cross, and Bisdee. These are rugged, forbidding masses of diabase, capping the sandstone composing the lower levels of the range, and they attain approximately 4,000 feet. (See Plate VIII., Fig. 1.) Between these mountains and the western ridges of La Pérouse runs the Picton Valley, here straight, broad-bottomed, and flanked with many precipices. The western tributaries of the Picton rise in gorges cut deeply into the mountains mentioned above.

From Mt. Wylie a spur runs out several miles farther west to the base of Precipitous Bluff, a great mass of rock, perhaps half a mile long, from north to south, and standing five hundred feet perpendicularly above the surrounding ridges, with a close resemblance to Cradle Mountain from the Plateau at Katherine's Tarn. To the west, Precipitous Bluff drops straight down to the bed of the New River, which empties into a deep lagoon dammed by sand dunes several miles long extending from the sea beach to the foot of Precipitous Bluff. (See Plate VIII., Fig. 2.)

3. GEOLOGY.

(a) Stratigraphy.

The stratigraphy of the La Pérouse Range is simple. The only rocks exposed in the area covered by these notes are Trias-Jura sandstones and shales, which form the bulk of the mass of the La Pérouse Range, and intrusive diabase (dolerite) of Cretaceous age. The rocks of the coastal plains to the east and south have been described in detail. (See Twelvetrees, 1915 (i.) and (ii.), and Reid, 1922.) These are outside the limits of this paper.

Here, as elsewhere in Tasmania, it is difficult, without very close work, to decide the point of junction between the Permo-Carboniferous sediments and those of Trias-Jura age. The strata of the higher levels of the mountain consist of massive beds, several hundred feet thick, of grits, evidently the basal grits of the Trias-Jura, succeeded by five hundred feet or more of Ross series sandstones (see Geological Survey of Tasmania, 1922, p. 6), which corresponds to the Knocklofty series of Mr. Twelvetrees's earlier classification. The sandstone is mostly of a coarse variety, but varying locally from a grit to a shale, and varying sharply in colour from layer to layer, but it is predominantly pale yellow, changing to grey-white on weathered surfaces. It is interbedded with numerous, relatively thin, layers of shale often with a high carbon content and varying in colour from grey to black. Together, these give a banded appearance to all the cliff faces and other exposures. The beds are almost horizontal, dipping very slightly (seldom more than 2 degrees, but up to 5 degrees under the summit of La Pérouse) in a north-westerly direction. This dip can only be distinguished in places where the beds are exposed for a considerable length. In places the sandstone changes to a grit, often quite coarse and occasionally becoming a conglomerate of fine round water-worn pebbles of quartz. In places, notably on the ledge forming the first step rising south of Moonlight Flat and in the cliff face south of the Reservoir Lakes, thin layers of this conglomerate can be traced interbedded in the sandstone layers for many hundred yards.

Microscopic examination of several casually collected specimens of this sandstone shows the component particles to consist predominantly of quartz grains as is usual with the Ross sandstones throughout Tasmania. The proximity of the derivative beds of quartzite to the west would account for this. The sandstone is very much cross-bedded. This and its general coarseness and the many interstratificated layers of pebbles indicate that it is a much closer inshore deposit than the rocks of the similar series round Hobart and those of the type locality in the Midlands. It is interesting to note that on the crest of the ridges where frost and wind erosion are now very active the sandstone invariably weathers along the planes of the current bedding. This at first sight gives the appearance of high inclination and even folding to the surface exposures, but the true stratification planes can be clearly seen in the sides of the many cliffs.

Above the 3,500 feet contour there is a change from the Ross series to the felspathic sandstone series (the Ida Bay coal measures of Twelvetrees), small residuals of which still remain on the tops of Sandstone and Maxwell Ridges. The last 200 feet of the summit of La Pérouse consists of rocks of this series. Proof of the age of these beds was found right under the cairn on La Pérouse by the discovery of numerous specimens of *Phœnicopteris* in the mudstone of the mountain top, and two hundred yards due north of the cairn a fine spray of *Thinnfeldia odontopteroides* was found. (See Twelvetrees, 1915 (i.), p. 15, for references to descriptions.) These fossils were exposed by weathering, but were still in an excellent state of preservation. Doubtless, search would disclose other varieties. Some of the bands of black shale are full of plant remains, stems, etc., but no specimens sufficiently distinct for identification were found. These beds are apparently the very base of the coal measures, the great bulk of which has been removed by denudation.

Probably the sandstone beds pass downward into beds of Permo-Carboniferous age, but none such was seen on the higher levels of the ranges examined. Frost and wind have eroded the sandstones and shales of the ridge crests into flat slabs often exceedingly thin, and have given some very fine weathering effects. (See Plate III., Fig. 1.) The result is that the mountain top presents an aspect different from that of any Tasmanian mountain the writer has examined, and makes walking quite easy—very different from the *ploughed field* effect of the typical diabase cap. The general aspect of the topography resembles—apart from glacial forms—that of the higher ridges of the Blue Mountains of New South Wales.

The nature of the intrusions of the diabase (dolerite) can be studied here better than in any other place known to the writer, the cirques having exposed the whole "interior economy" of the mountain to view. As is usual with the intrusion of great sills of igneous rock the source of the ascending magma is not discernible, but in many places the *base* of the sill resting on the sedimentary rocks is exposed to view. The area of maximum occurrence seems to have been in the vicinity of where Leillateah now stands, whence the diabase pushed north and north-east.

That mountain is capped with 800 to 1,000 feet of diabase which, right to the summit, is of the coarse grained variety common in these masses, e.g., on the summit of Mt. Wellington. It rests on sandstone which can be seen passing out below it on every side of the mountain, and cirques have cut so deeply into the mass of the mountain without disclosing diabase below approximately 3,000 feet that if any connecting pipe exists it must be of very small dimensions and of much less diameter than the capping mass. It certainly looks, as far as field evidence can show, that this cap is portion of a sill, probably a locally enlarged magmatic reservoir formed in the course of the intrusion of the sill. Similarly Mts. Wylie, Victoria Cross, Bisdee, and Precipitous Bluff appear to be diabase caps resting on sandstone, and, with Mt. Leillateah, may be a chain of laccolithic cores connected by horizontal, sill-like pipes, or they may be residuals of a large sill, similar to Cradle Mountain, the diabase cap of Mt. Anne, Mt. Wedge, and other portions of undoubted sills.

From the mass of Leillateah a dyke-like mass of diabase runs northward and forms the backbone of the saddle connecting that mountain with Maxwell Ridge. The eastern face of this saddle consists of a vertical wall of diabase resting on sandstone. The diabase here is some 500 feet deep. The exposure on the top of the ridge is a narrow band of glassy diabase obviously originally very near the edge of the intrusion and weathering in a way more resembling basalt. No diabase appears in the wall of the cirque cutting into this saddle from the west, so it is obvious that this dyke cannot be many hundred yards in horizontal width.

The diabase extends under Maxwell Ridge, rising again several hundred feet higher than the exposure on the top of the saddle, but to a height that falls short of that of the top of the diabase cap of Leillateah by a thousand feet, and then turning towards the north-east passes under the summit of La Pérouse. It outcrops along the south-eastern corner of Maxwell Ridge and right along the south-eastern and eastern face of the summit ridge of La Pérouse, forming the cliffs mentioned before. Here it is about 500 feet in vertical height, resting on sandstone and capped by over a hundred feet of felspathic sandstones. It caps the ridge that extends eastward from the summit towards Recherche Bay and the conical hill overlooking that arm of the sea. Close under La Pérouse the diabase is covered with a few feet of sandstone. An extension of this mass passes under the top of La Pérouse and projects as the Comb Ridge into the South D'Entrecasteaux Cirque. (See Plate VI., Fig. 2.) This occurrence is well over a thousand feet in vertical height and its bottom is not exposed in the floor of the cirque, which cuts right through it. It is here only a few hundred yards broad. Mt. Hippopotamus is a continuation of the same dyke, as are also the diabase cliffs on the eastern edge of Tabletop. Diabase occurs again flanking the eastern slope of Moonlight Flat and is observable here down to at least the thousand-foot contour. It does not reach through to the western end of the South D'Entrecasteaux Cirque, which has enlarged its head in the sandstones of the summit ridge of La Pérouse behind the diabase dyke.

Several smaller sills and dykes branch from the main mass. Several masses appear in the northern face of the saddle connecting the summit of La Pérouse with Maxwell Ridge. The present surface of the north side of this saddle appears to have been the maximum distance reached by the diabase here. In many places masses of sandstone, more or less metamorphosed, can be seen included in the diabase. Opposite the end of Sandstone Ridge is a vertical face of diabase, jointed into a distinct, if irregular, hexagonal pattern, closely resembling the cooling surface of a basalt flow. This is evidently the termination of an off-shoot from the mass on the other side of the saddle.

A little farther west a small sill extends for several hundred yards under Maxwell Ridge, and can be traced in the cliffs overhanging the upper Reservoir Lake. It is about six feet high and has pushed its way through the strata along a band of soft shale, entirely replacing this rock, while the more massive sandstone strata above and below it have not been disturbed at all. There is a slight trace of metamorphism, but on the average not extending more than an inch from the contact. The diabase ends suddenly and the replaced black shale continues the stratum round the wall of the cirque. In one place, just above the D'Entrecasteaux-Picton divide in this cirque, a small enlargement or local reservoir has formed. This is a mass about 30 feet in height. Even here there has been no disturbance of the strata above and below. Beyond this bulge the sill continues through the strata exactly as before. A smaller sill has intruded for a short distance about 100 feet above the one just mentioned. In every case of these smaller or branch intrusions the diabase appears to have insinuated its way entirely by stooping, a bed of weak strata, usually shale or coal, having been attacked, and there is little, if any, evidence of force behind the intruding mass. In every case, including that of the biggest diabase masses on the field, there is very little metamorphism, the sandstone having been indurated for only a few inches from the contact. There is a small occurrence of diabase, south of the fourth prominence on the top of Sandstone Ridge, but with no indication of its connection with any other occurrence. This is in line with the rock bar damming the upper Reservoir Lake, which consists of a band of indurated mudstone. Probably these are portions of another sill, the rest of which has disappeared in the erosion of the cirques.

With the exception of some small deposits of morainal material these are the only rock types on the La Pérouse Range.

(b) DEVELOPMENT OF THE PRESENT TOPOGRAPHY.

(i.) Diabase Intrusions and Block Faulting.

The most striking physiographical feature of the district is the escarpment to the south of Leillateah and the dissected escarpment forming the eastern face of the whole La Pérouse range. The problem of the origin of these escarpments is the problem of the origin of the whole mountain system, and much work has yet to be done throughout Tasmania, which for this purpose must be considered as one geologic province, before the genesis of our mountains can be proclaimed with certainty. Obviously the diabase intrusions exercise a great influence on our present topography, and are, in order of time, the first factor controlling our landscape.

It is most interesting to follow, through the works of the last sixty years, the development of thought on the question of the origin and effect of our diabase. In 1915 Mr. Twelvetrees, after nearly twenty years' work, gave his opinion, which is in outline as follows (Twelvetrees, 1915 (i.), p. 17):—

(i.) The diabase intruded as a sill or intrusive sheet, slowly penetrating between beds of Permo-Carboniferous-Trias-Jura strata.

(ii.) It is older than the Tertiary Basalt.

(iii.) Block faulting subsequently produced the existing difference in level

(iv.) Original differences of level of the surface of the sill and differential weathering have produced minor inequalities

(v.) Erosion has largely removed the original covering from the diabase caps of the mountain summits.

(vi.) Sill rocks exist in various places concealed beneath sedimentary beds in the low country.

(vii.) There have been uprising columns of magma in some places, but these are few and far between.

(viii.) "It is straining possibilities to urge that the dia-"base on every mountain summit is part of an "ascending pipe restricted to each mountain."

The Geological Survey departed from this view, after much detailed study of the subject, in the course of their investigations of the Coal Resources of Tasmania. Their conclusions, due largely, the writer understands, to the work of Mr. P. B. Nye in the Midlands, may be summarised as follows (Geological Survey of Tasmania, 1922) :—

(i.) The date of the intrusions is probably Cretaceous.

(ii.) The diabase intruding the Permo-Carboniferous-Trias-Jura sediments *brought about* the existence of completely separated blocks of sedimentary rocks, located at any height above sea level varying from zero to over 4,000 feet.

(iii.) The structure of the diabase varies from place to place.

(iv.) Sills or intrusive sheets are known to exist in various localities.

(v.) Only a few forms of typical laccolithic structure have been located.

(vi.) "The greater portion of the diabase in Tasmania "can best be described as an asymmetric transgres-"sive igneous mass of a general laccolithic type."

(vii.) This rose upward lifting the sedimentary rocks bodily with it. It rose to a height greatly varying from place to place with a range of variation up to 5,000 feet, and this difference has caused the presence of different blocks of sedimentary rock at different heights above sea level. The higher blocks of covering sediments have been subsequently removed by denudation.

(viii.) A common structure is that of a broad and persistent dyke-like mass with numerous other dykes intruding as upward tongues.

The difference between these two opinions thus is: Have the major mountain systems of Tasmania (exclusive of the West Coast) been caused by post diabase block faulting, or are they due to the diabase intrusions alone? The rest of the observations in both opinions are now probably undisputed and can be considered proved.

Bearing on this problem the following observations on the La Pérouse district have been made by the writer:—

Firstly, diabase does not form the main mass of the mountain. Although it has modified the topography by presenting a harder surface to erosion than the softer sedimentaries, it occurs only as dykes and sills. It could in no way be compared to a batholith. It does not appear to have affected the western or northern portions of the range, and the sedimentary rocks there show a perfect continuity with those of the southern and eastern portions intruded by the diabase, and where it does occur it appears to cut across major topographical features and not to govern them.

In the second place, the elevated block forming the range stands over three thousand feet above the surrounding coastal plain, and nearly as high above the Picton Valley. Of this mass not a thousand feet in vertical height is diabase. Under the igneous rock are beds of sedimentaries. If the diabase raised the mountain block to its present level, how were the underlying sedimentaries raised, at least a thousand feet above rocks of a similar series a mile or so to the east?

Thirdly, there is a very sharp alteration of slope from the steep face of the mountain side to the undulating coastal plain, which the mountain escarpment meets at a well-defined angle. This slope exists in most places, if not throughout, in soft sedimentary rocks. Had erosion continued uninterruptedly from Cretaceous times, it would be difficult to account for this sharp alteration of slope. The streams which on the coastal slope have developed to a stage well on the way towards maturity, in their upper reaches are mere mountain torrents. It seems clear to the writer that normal river erosion has been interrupted. Also, the top of the plateau possesses a topography, apparently, to a certain extent, independent from the escarpments that form the flanks of the range. There are hills and valleys on the top of the plateau that cannot be accounted for by headward erosion of the few streams that drain down the sides, and for which glaciation cannot be wholly responsible.

Again, could a mountain of 4,000 feet elevation, consisting of soft coal measures and sandstone, have existed since Cretaceous times? Admittedly a certain depth of sediment has been removed, but at most not more than a thousand feet. Mr. Reid gives the greatest thickness of the adjacent beds of this age at Catamaran as 800 feet (Reid, 1922, p. 160), which very probably includes many feet of the underlying Trias-Jura Sandstone, while at least a hundred feet of coal measures still remain on the summit of La Pérouse. Probably only a few hundred feet of the original beds have been removed by erosion. Had these beds stood at that elevation throughout the whole Tertiary period, it seems to the writer that a much more mature cycle of erosion would have been reached.

And lastly, to the south of the Lune River, we have the following section running west from Southport. On the east, about four miles of Permo-Carboniferous strata with Cretaceous diabase and Tertiary basalt, seldom rising a hundred feet above sea level, is followed to the west by Silurian quartzites and limestones (Twelvetrees, 1915 (i.), p. 8) that rise to a height of 1,500 feet (Twelvetrees, 1915 (i.), p. 35). On their western border these old rocks abut on Trias-Jura sediments rising in one slope to 3,800 feet and persisting for several miles, after which they drop sharply to the Picton Valley, from 1,000 to 1,500 feet above sea level. This certainly appears to be the result of an upward *horst* in this particular area. (Also see Geological Survey, 1922, Plate IV., showing a very considerable fault following the present coastline from Recherche Bay to north of Port Esperance.)

These features all appear to be evidence of post-diabasic block faulting on a large scale. The writer does not presume, at any rate for the present, to dispute the conclusions of the Geological Survey as to the origin of our diabase capped mountains, a conclusion arrived at after several years in intensive study of this problem in the Midlands and elsewhere. But it certainly seems that the existence of the La Pérouse Range is not due to the uplifting of this block of country by the diabase, but by later block faulting on a large scale. The main lines of the east, west, and south coasts of Tasmania are admittedly governed by Pliocene or early Pleistocene block faulting, which has been very prevalent along the whole of eastern Australia. It seems to the writer that the theory advanced by the Geological Survey should not be considered, at present at least, as the last word on the subject for all Tasmania. No evidence is as yet forthcoming whether the movement was upwards—a great upthrust of the block of country now comprising the range—or downwards—a dropping away of the coastal plain region—although the writer certainly prefers the former alternative. The movement was perhaps a very gradual one, but was certainly sufficiently rapid to prevent the streams regrading their courses during its progress. The coastal plain seems to have been subjected to oscillations during Tertiary and Quaternary times. (Twelvetrees, 1915 (i.), p. 19, and (ii.), p. 5.)

The writer therefore suggests the following stages in the development of the physiography of the region:—

(1) In Trias-Jura times a close inshore coastline receiving sediments from adjacent land to the west gradually rising to fresh-water conditions.

(2) Great earth movements *accompanied* by the intrusion of diabasic sills in great masses.

(3) The erosion of a definite topography, in process of which the diabase sills were exposed in many places.

(4) An epoch of major block faulting when the general outline of the landscape as we have it to-day appeared.

(5) The moulding of the details of the topography of the higher elevations by ice action.

(ii.) Effect of the Pleistocene Glaciation.

On this range, as in the case of most of the elevated portions of Tasmania, excepting some of the hills of the east coast, it is glaciation that has given us the actual landscape we see to-day. The cliffs that ring round the head of the Lune are the walls of a cirque, enlarged in the soft sandstones at the head of a glacier that, fed from the snow fields on Moonlight Flat and Mt. Alexandra, pushed in a stream over a mile broad for several miles down the Lune River Valley. This cirque now stands as a horseshoe of unbroken cliffs rising nearly a thousand feet from the valley floor. Its southern crest forms Moore's Bridge, a remnant of the original surface standing now as a high-level col between this cirque and the small one to the south of the bridge which is now drained by the Picton. (See Plate IV., Fig. 2.)

To the east of Sandstone Ridge were the seats of three glaciers which moved several miles to the eastward and were responsible for the three great cirques now drained by the D'Entrecasteaux River. These cirques increase in width from north to south, but they are all of approximately the same depth, viz., about a thousand feet below the general level of the ridges. They are very steep-sided, but cliffs are not common except on the south of the South D'Entrecasteaux Cirque. Several landslips of considerable size can be seen round their sides, and on the north side of the last mentioned one, a quarter of a mile of hill side has slipped and formed a small landslide lake on the side of the cirque. This has now been drained by a stream which was once its outlet. These cirques have extended their head until they have cut into the original crest of Sandstone Ridge for a hundred or more feet, forming the four hills that rise above the general surface of this ridge, the saddles between which being eroded during the erosion of the cirques below. In the South D'Entrecasteaux Cirque there is a ledge, also due to glacial action, several hundred feet broad, about a third of the way down from the general level of the top of the ridge to the floor of the cirque. From this ledge the walls of the main cirque drop precipitously. The glacier has cut right through the diabase intrusion which can be traced on the sides of the cirque, of which Mt. Hippopotamus and the Comb Ridge are remnants, and then has extended its head very considerably in the soft sandstones behind. (See Plate VI., Fig. 1.) A minor cirque has cut into the north-western side of the summit of La Pérouse and extended into the heart of the mountain until it has laid bare about half a mile of the diabase dyke. Another cirque has cut into the sedimentary rocks on the north-east of the mountain until now the more resistant diabase stands out like a wall, with its sheer sides over a thousand feet high projecting several hundred yards into the cirque. The top of the diabase evidently protruded from the ice at its maximum, and intense nivation has cut the crest of the diabase into a succession of sharp unscalable peaks, hence the name Comb Ridge.

Another very handsome cirque with a cliff face of 800 feet has cut into Maxwell Ridge from the north, and the glacier rising here was responsible for the Reservoir Lakes. (See Plate V., Fig. 1.) Its floor is at a greater elevation than the floor of the four cirques just mentioned; the height of the upper Reservoir Lake being 2,700 feet above sea level.

It thus approximates in height to the ledge above the South D'Entrecasteaux Cirque. The glacier from this cirque moved north for about a mile between Sandstone and Maxwell Ridges, and was then met by a short ice flow moving south from the south side of Moore's Bridge. Together these then bent west and passed between the end of Maxwell Ridge and Mt. Alexandra towards the Picton Valley. It was not ascertained to what point this glacier reached. In its track it met a band of indurated sandstone hardened evidently by contact with diabase, and riding over this while excavating the soft rocks above and below it, left it standing fifty feet above the general slope of the valley as a rock bar, crossing from one side of the valley to the other and completely damming it, banking back the waters of the upper Reservoir Lake. The glacier has worn the upstream side of this bar into a smooth, gently sloping incline, and has cut into the soft rocks on its downstream side, leaving there a sharp cliff about thirty feet high. (See Plate V., Fig. 2.) The portion of the valley around and below the lower Reservoir Lake is strewn with morainal deposits, and a high bank of this material deposited against the north-eastern spur of Maxwell Ridge dams this lake, and has been cut through to a depth of fifty feet by its outlet.

The general appearance of this valley suggests that the original pre-glacial drainage was from the vicinity of Maxwell Ridge straight north, across Moore's Bridge to the valley of the Lune. The main features of the parallel pair of ridges, Sandstone Ridge on the east and Maxwell Ridge and Mt. Alexandra and its continuations on the west, do not seem to be due entirely to the action of the cirques. Probably the original ice flow was in this direction, and later a cirque, cutting in from the Picton Valley, divided Maxwell Ridge and Mt. Alexandra and tapped the mountain valley south of Moore's Bridge. As has been explained, the ledge above the South D'Entrecasteaux Cirque has cut westward and joined an eastward extension of the Reservoir Lakes cirque, forming a gap between Sandstone Ridge and the summit ridge of La Pérouse. In this movement the D'Entrecasteaux Cirque seems to have been the active member, and has cut a small cirque at an altitude of 3,000 feet well into the southern end of the Reservoir Lakes cirque, and the numerous erratics strewn over the floor of this extension indicate that here the last movement of the ice was eastward and not northward. Again, the moraine impounding the lower Reservoir cirque consists largely of diabase boulders. To-day scarcely any diabase appears in the wall of the cirque from which this glacier rose, but the eastward extension of the D'Entrecasteaux Cirque is largely lined with it. So it seems that the whole of the space between Sandstone Ridge and Maxwell Ridge was once occupied by a glacier flowing north over the site of the lakes, but later the D'Entrecasteaux glacier cut through the divide and captured the southern extremity of this cirque, in the process of doing which it has pushed back the present divide between the two rivers for half a mile or more to the advantage of the D'Entrecasteaux. It is interesting to note that here diabase and sandstone have been plucked together from the cirque wall, consisting predominantly of sandstone. In a moraine a mile down the valley diabase boulders predominate, the softer sandstone having been reduced to a rock flour and now forming a muddy binding for an agglomerate of rounded diabase boulders of all sizes with a few small slabs of sandstone.

To the east of the summit of La Pérouse the two remarkable lakes perched on the steep slope of the mountain are obviously of glacial origin. The two small glaciers that were responsible for these were derived from the foot of a snow cap that evidently descended to about the 3,000-foot contour. Here the head of the glacier cut into the face of the mountain, leaving a vertical cliff wall seven to eight hundred feet in height. The ice could only have moved out a few hundred yards from the base of these cliffs, and here it dropped the blocks of rock plucked from the cliff faces. These have formed a pair of semi-circular ridges banked two hundred feet or more above the slope of the mountain, behind which the waters of these remarkable hanging lakes are impounded. The glaciers that caused these banks were little more than small extensions of the covering ice cap, developing as the snow level rose towards the close of the glacial age, into a pair of horseshoe or hanging glacierettes. Another small cirque cuts from the south into the saddle connecting the summit of La Pérouse and Maxwell's Ridge.

The largest glacier in the district occupied the great gorge of the Catamaran, between La Pérouse and Leillateah. (See Plate VIII., Fig. 1.) The floor of this, at an elevation between 1,000 and 2,000 feet, was certainly covered by a glacier and exhibits the characteristic features of wide U section, truncated spurs and steep, straight sides. It probably did not fill the valley, but was fed by numerous tributaries, the heads of which can be seen in the numerous minor cirques that make up the head of the main valley. This valley terminates in a grand cirque, consisting of many bays with the more prominent projections flanked by cliffs many hundreds of feet in height. On the south side of the valley cut out of the eastern spur of Leillateah are two fine tributary cirques which hang at a considerable height above the bed of the Catamaran. From the top of La Pérouse you look straight into them. In the western one lies a considerable lake, evidently dammed by a moraine. The greater length of this lake lies at right angles to the slope of the hillside, not an unusual feature with lakes so formed (e.g., Lake Belton).

To the west of the saddle connecting Maxwell Ridge and Leillateah is another great cirque drained by the Picton, and which, cutting into the connecting saddle from the side opposite to the cirque just described, has reduced it to a razor-backed col. In the upper levels of both the Catamaran and the Picton cirques are a series of minor cirques which still further reduce the col and have considerably reduced its height. They are separated by bays on their inner side but coalesce to form a very appreciable ledge on both sides of the col, from which step the cliffs of the larger cirques descend. On this ledge above the Catamaran cirque and reposing under the northern face of Leillateah are two pretty tarns, evidently rock basins, separated by a high ridge of glacial débris, evidently a medial moraine, that can be traced some distance into the major cirque below. On the western side of the col one of these small cirques has been formed between the two diabase prominences, mentioned before, in the centre of the saddle, probably dividing an original single mass into its existing pair of peaks. In this cirque lies the lake, already mentioned, in which the specimens of *Spærium* were found. After a narrow shelf immediately west of the lake the ground drops precipitously to the Picton cirque below. (See Plate VIII., Fig. 2.)

Four of these higher level cirques have cut into the faces of Leillateah, giving the peak its shape, and the buttress spurs described earlier are the residual divides between these cirques. The walls of one form the northern face that the mountain opposes to La Pérouse, and materially contributed to the formation of the shelf and lakes above the Catamaran cirque. A second from the north-west is responsible for the cliffs on that side of the summit that drop in a succession of precipices to the Picton Valley close below. Between these a low divide runs from the summit to the saddle connecting the mountain with Maxwell Ridge, the divide between these upper cirques and the saddle between the major ones below being part of the same feature. To the south the widest cirque of the four gives the mountain a square face to the sea, and the divide between this and the north-western cirque circles round the head of the Picton to Mt. Wylie, with its crest two thousand feet below the summit of Leillateah. To the east a glacier rose in the fourth cirque and extended for two or three miles over the elevated plain between the eastern and south-eastern spurs of the mountain. It strewed morainal matter over this plain, and behind banks of this the four considerable lakes and several tarns mentioned before have been dammed up.

West of the Picton Valley numerous hanging cirques can be clearly distinguished cutting into the eastern face of Mts. Wylie, Victoria Cross, and Bisdee. Several fine amphitheatres, ringed with sandstone cliffs, can be seen on that range, and an elevated glacial ledge exists there as well as on the Pérouse Range. Ice clearly descended into the head of the Picton Valley, but to what extent or how far it reached could not be ascertained from the mountain top.

(c) Contributions to Tasmanian Glaciology.

In the La Pérouse Range we have an elevated plateau, largely of the same rock and with a uniform opportunity throughout for the development of glaciers and their characteristic topographical forms. We find that during Pleistocene times glaciation developed here to an extent to which the geographical position of the range would lead us to expect. Glaciers occupied the upper reaches of pre-existing stream valleys, moulding them into the typical glacial landscape but not materially affecting the drainage of the pre-glacial country side.

There is ample evidence of an early ice cap stage in the smooth contours of the tops of the ridges. (See Plate IV., Fig. 1.) From the foot of this cap ice pushed down the valleys. The level to which it reached was not ascertained on the trip during which these notes were made, but in the two largest glacial valleys, those of the Lune and the Catamaran, ice probably pushed down to within 1,500 feet of sea level and perhaps to a much lower level in the case of the latter. This is a thousand feet lower than the level glaciers reached on Mt. Field and Cradle Mountain. Latitude and the greater precipitation over this part of Tasmania will fully account for this. Further evidence of the elevation of the foot of these glaciers would be welcome, and could be best collected by working west from Catamaran township.

At the head of these glaciers, fine cirques have been formed. These are all in the stages of adolescence. They have cut so deeply into the mountain mass that the original plateau has been reduced to a series of twisted ridges. They have, in fact, removed the entire interior of the plateau, and reduced the divides to narrow ridges. In all cases they have commenced to extend their heads laterally and are more or less nail shaped, and in a few cases they have attacked the dividing remnants of the original table-land, but neither of these processes is at all far advanced. The stage of glacial erosion reached is that of the adolescent early fretted upland, similar to that reached on Mt. Anne and Mt. Field.

In one place, a pair of cirques have eroded their divide into a splendid comb ridge. (See Plate III., Fig. 2.) This occurs where the divide is composed of diabase which is sufficiently hard to respond to this form of erosion. It seems that the soft sandstones will not weather into this rugged figure, even when the conditions of the ice flows are suitable, but erode with an even skyline. The "Comb Ridge" is the best example of this feature yet seen by the writer in Tasmania.

Here, as elsewhere, small glacial "monuments" have commenced to appear at the entrance to the cirques, especially Mt. Hippopotamus and the summit of La Pérouse, respectively north and south of the South D'Entrecasteaux Cirque, the process here being assisted by the existence of the belt of hard diabase. (See Plate VI., Fig. 1.) The writer again stresses the view advanced in his previous paper (Lewis, 1923) that the cycle of glacial erosion does not progress in the order its greatest exponent, Professor W. H. Hobbs, appears to indicate, viz., first the formation of a channelled upland, and, when this is completed and erosion still continues, to the fretted upland, then, when this stage is reached, to the monumental upland. But it seems to the writer that from the earliest development of the cirque the incipient monuments commence to appear. Later, as the cirques erode the hinterland these monuments increase in topographical importance until they alone persist after the rest of the plateau has disappeared. Every feature that in full maturity will be a glacial monument commences to show itself from the earliest stages of the glacial erosion, so at any particular stage of the incipient features all of the later stages can be traced.

Leillateah is one of the best examples of a glacial "horn" to be seen in Tasmania. (See Plate VIII.) Four cirques have attacked what was probably a pre-glacial hill. The divides between these cirques have been reduced to low level (relatively) cols, and the mountain now rises as a regular concave-sided pyramid. This result, however, is due to four independent cirques attacking an isolated mountain rising above the general nivation level and is not a residual of a plateau lying at the heads of cirques which have removed the rest of the surrounding rocks, a difference, however, which is merely one of degree.

It is most noticeable in this area that the cirques have grown in every case from the sheltered side of the main ridges or have been sheltered by some feature on their weather side. In Tasmania the weather comes from the west. The high winds swept the snow from the western slopes of the mountains, and only on the sheltered eastern, northern, or southern sides could it accumulate sufficiently for cirques to grow. As they grew this influence was intensified. This is true throughout the island, and for this reason the western side of any of our mountains or ridges is less rugged and broken than the eastern, and it is on the eastern where we look for cliff scenery.

Here, as elsewhere, there is ample evidence in every direction of two "phases" of the Pleistocene Ice age. (The writer prefers the word "phases" rather than periods, for the present, until evidence is forthcoming of the existence of an inter-glacial epoch.) Most of the larger cirques have minor ones carved in their walls at a height of 500 to 1,000 feet above the floors of the main cirques. (See Plate VI., Fig. 2.) In many places a definite high level ledge runs for a considerable distance round the mountain, and most, if not all, of the lakes on this range, and the outstanding form of Mt. Leillateah, are the result of the second phase. The nivation layer during the very long period when these upper cirques were eroded stood at about 3,000 feet above sea level, a thousand feet lower than it stood on Mt. Field during the same phase. Evidence of a phase earlier than the one responsible for the major cirques must be sought at the base of the mountain.

One further discovery must be recorded. Right under the eastern edge of the summit of La Pérouse, about 3,700 feet above sea level, is a ledge about a hundred yards wide. On this lies a persistent summer snow bank. This snow bank evidently in winter time, when it would be greatly augmented, moves a few yards down the gentle slope of the ledge. As it passes over the corrugations of the various beds of strata of soft coal measures it has scratched the rock with the fragments it has torn from the adjacent cliff face. The whole length of this ledge shows these very typical glacial scratches, many of which are of so recent origin that they must have been done last winter, and none could have persisted for many years. These scratches are of various ages, many of older date having been crossed by more recent ones, and apparently the scratching is repeated each winter. For further proof the writer scraped some snow away from the foot of the bank and found the process continuing there. This is the first report of an actually proceeding erosion from nivation in Tasmania. It is interesting to note that Lady Franklin records the existence of this snow bank in December, 1838, and it is shown in a photo. taken by Mr. E. Maxwell in December, 1897.

4. ECONOMIC POSSIBILITIES OF THE DISTRICT.

These are very few. The soil of the valleys and the northern ridges, especially towards Adamson Peak, is deep and good, and could provide excellent mountain pastures in summer time, but land hunger must become acute in Tasmania before its use as such could be advocated. To the west the Picton Valley is one of our considerable reserves of farming land, but the chief means of access must be by way of the Huon Valley. In time it will be absorbed into the settled areas of Tasmania, but with so much of our cleared and easily accessible country barely used no one could advocate for the present the expenditure of the large sum necessary to open it up. It has considerable timber resources, but these have been greatly wasted by fires.

No hope of the existence of coal can be held out. Probably any seams that once existed have been removed by erosion, and if any lower measures are found they will probably be so dissected that the bulk has gone. No sanguine promoter need think that, if the writer's surmises as to recent land movements are correct, there is a hope of oil. These movements are not of a nature to hold out any expectation of the formation of oil, and if it had been formed the erosion of the cirques would have long since tapped any possible reservoirs. These Trias-Jura sediments definitely do not bear commercial minerals.

If the Catamaran collieries ever flourish, the ranges, especially the lakes east of Leillateah, should be examined as potential sources of hydro-electric power. This is a highly glaciated region, and it is such that usually provide the terrain for such schemes. If the reserves of water and suitable sites for dams are present, the other conditions for a small hydro-electric scheme exist.

The greatest future for the mountain will lie in its scenic assets. It is one of the finest areas of mountain scenery in Tasmania, and would provide less difficulty for the construction of a suitable road than most of our mountains, but without a road it is closed to the people from whose interest the State would derive the greatest benefits.

5. APPENDIX.

(a) Explanation of Plates.

Plates I. and II.—Maps of La Pérouse region.

Plate III., Fig. 1.—This shows a typical example of the flake weathering of the sandstone on the top of the ridges, effected mainly by frost and wind. The photo. was taken about 300 yards S.W. of the trigonometrical station at an altitude of 3,800 feet.

Fig. 2.—This is a view of the Comb Ridge, taken looking east from the ledge at the head of the South D'Entrecasteaux Cirque. The rock is diabase. The photo. shows the smoothed surface where the glacier has polished the side of the cirque and the jagged crest which protruded from the ice and was eroded by severe nivation.

Plate IV., Fig. 1.—This was taken from No. 1 hill on Sandstone Ridge, looking south. The first ridge is Tabletop, with the connecting spur to Mt. Hippopotamus behind. The summit of La Pérouse stands in the centre of the background with the east of Maxwell Ridge to its right and Leillateah in the right background. The Comb Ridge appears end on in front of La Pérouse. This photo. shows the "karling" effect of the cirque erosion on the plateau.

Fig. 2.—This is a photo. of the cirque wall of the Lune Cirque taken looking south from the north-western spur of No. 2 hill of Sandstone Ridge. Across the horizon is Moore's Bridge. Mt. Wylie shows in the right background.

Plate V., Fig. 1.—This shows the north end of Maxwell Ridge, with the cirque at the head of the Reservoir Lakes and the two Reservoir Lakes in the foreground. Leillateah shows in the left background.

Fig 2.—The rock bar damming the upper Reservoir Lake. This is solid rock, and not beach.

Plate VI., Fig. 1.—This is taken looking east towards Recherche Bay, down the South D'Entrecasteaux Cirque, with Mt. Hippopotamus on the right and the Comb Ridge on the left, and the conical hill west of Leprena in the middle distance.

Fig. 2.—This is a photo. of the summit of La Pérouse looking south of east from the south of Sandstone Ridge, and shows the glacial ledge at the head of the South D'Entrecasteaux Cirque and the smaller upper cirque. Note also the diabase of the Comb Ridge protruding through the sandstone of the plateau.

Plate VII., Fig. 1.—Leillateah looking S.W. from La Pérouse, looking across the Catamaran Cirque. Note one of the glacial tarns on the side of Leillateah in the middle distance.

Fig. 2.—Leillateah looking south from Maxwell's Ridge. The tarn in which the *Spærium* were found is seen in the middle distance. South-West Cape can be distinguished in the distance on the right.

Plate VIII., Fig. 1.—This photo. is taken looking south of west from the summit of La Pérouse, and shows Maxwell Ridge and the ridge connecting it with Leillateah, then Mt. Wylie and Mt. Victoria Cross in the background, with Precipitous Bluff behind.

Fig. 2.—This shows Precipitous Bluff looking west from the top of Leillateah. The ridge connecting the latter with Mt. Wylie can be distinguished in the foreground. The north end of the lagoon at the mouth of the New River can be seen on the left.

(b) List of Works Referred to.

Geological Survey of Tasmania. 1922. "The Coal Resources of Tasmania," Mineral Resources Papers No. 7.

Lewis, A. N. 1923. "Notes on a Geological Reconnaissance of Mt. Anne, etc." P. and P Royal Soc. of Tas., 1923, p. 9.

May, W. L. 1922. "A check-list of Tasmanian Mollusca" (Govt. Printer).

Nicholls, H. W. 1898. "Notes on the Geology of La Pérouse," Pap. and Proc. Royal Soc. of Tas., 1898, Abstract of Proceedings, p. xlvi.

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Tenison-Woods, Dr. J. 1875. "Tasmanian Fresh-water Mollusca," Pap. and Proc. Royal Soc. of Tas., 1875, pp. 81-2.

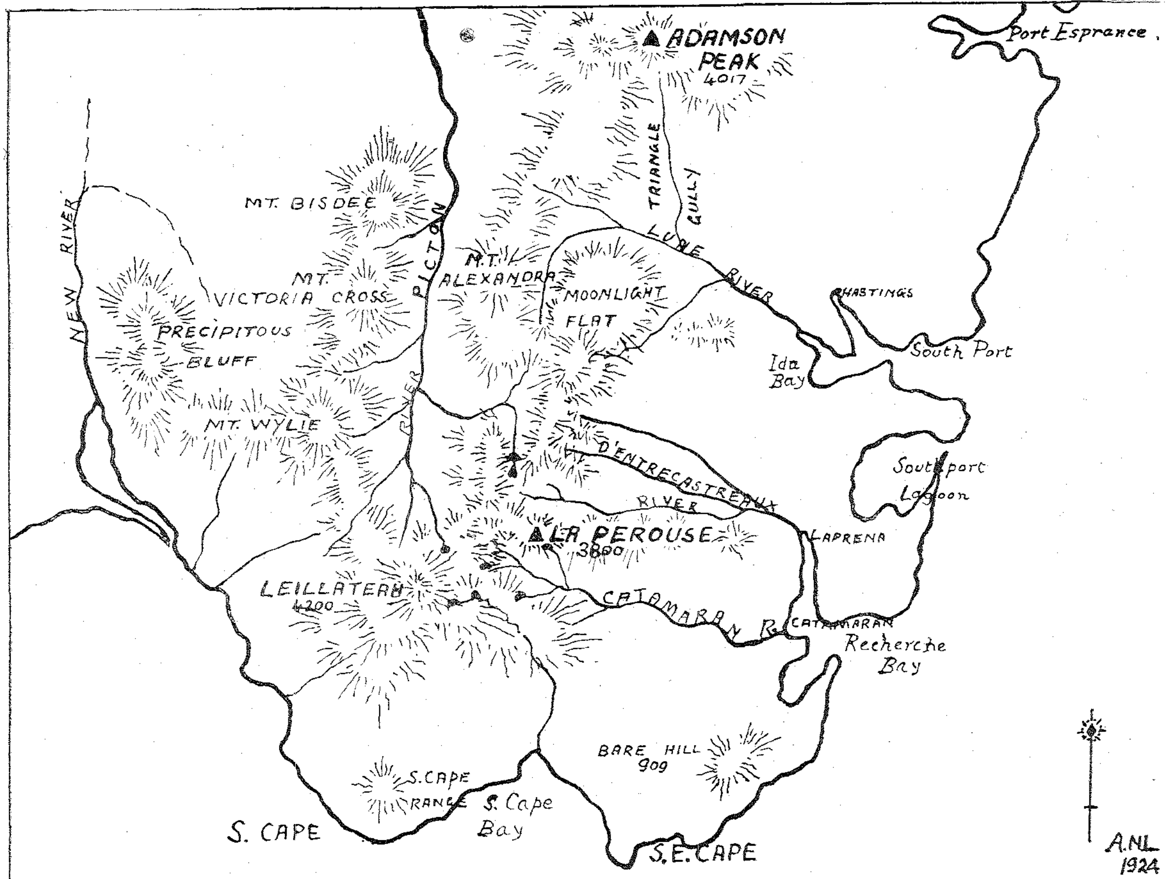
Twelvetrees, W. H. 1915 (i.). "The Catamaran, etc., Coal Field and Limestones at Ida Bay," Geol. Surv. of Tas. Bulletin, No. 20.

1915 (ii.). "Reconnaissance between Recherche Bay and New River," Geol. Survey of Tas. Bulletin No. 24.

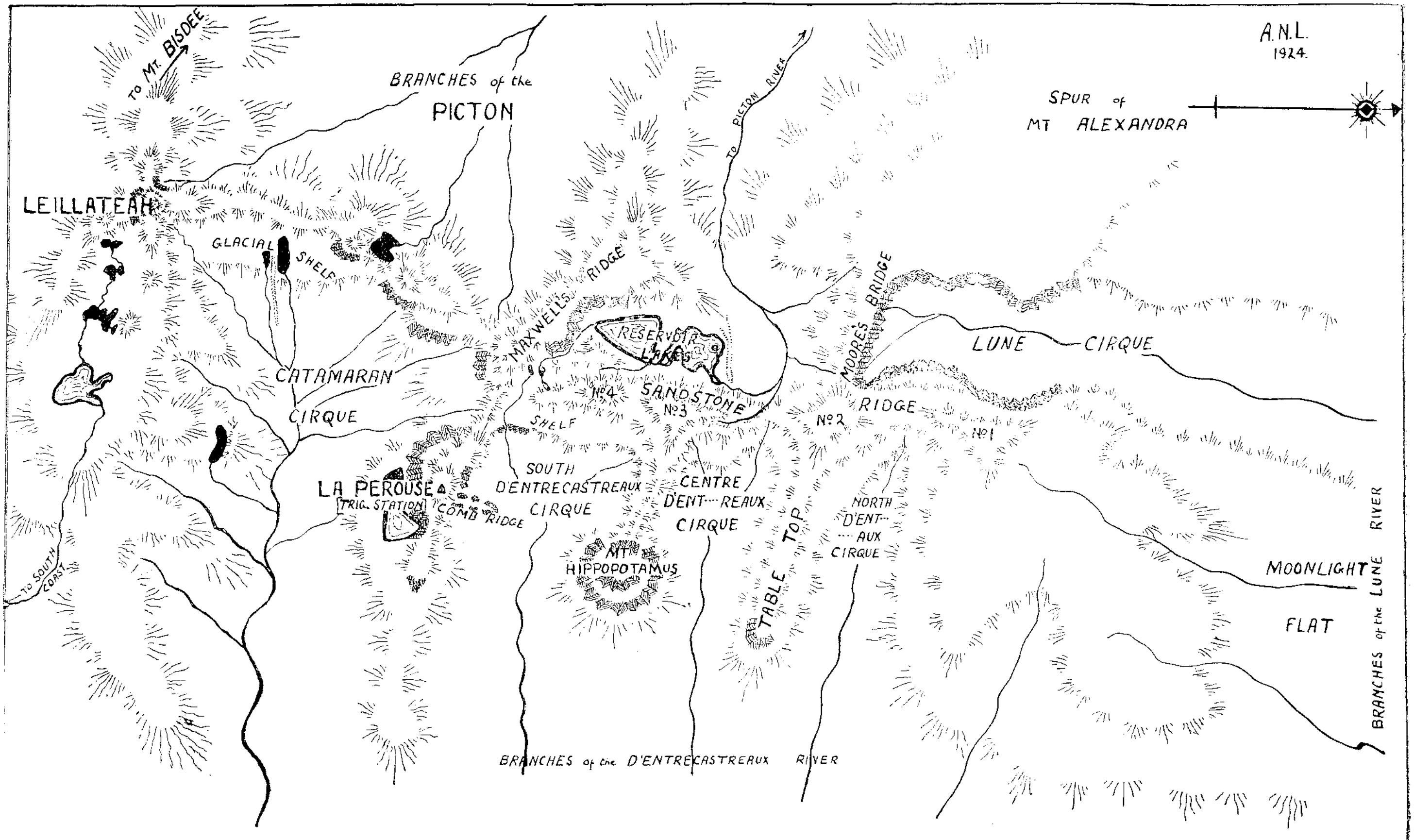
(c) Note on Low Level Glaciation at Recherche Bay.

Since writing the above, the following observations were made on a trip to Catamaran, kindly arranged by Mr. E. C. Tregear.

Two miles west of the shore at Recherche, lies a plain stretching back to the previously described cirques of the ranges. This presents typical glacial aspects, and is so



Locality Plan. Approx. Scale: 1 inch equals 5 miles.



Sketch Plan of La Perouse Range. Approx. Scale: 2 inches equal 1 mile.

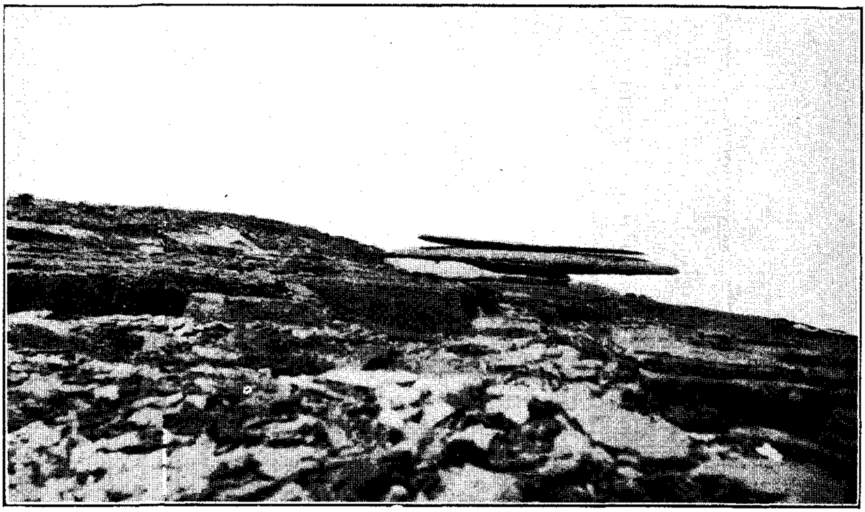


Fig. 1. Sandstone Weathering on Summit of Mt. La Perouse.

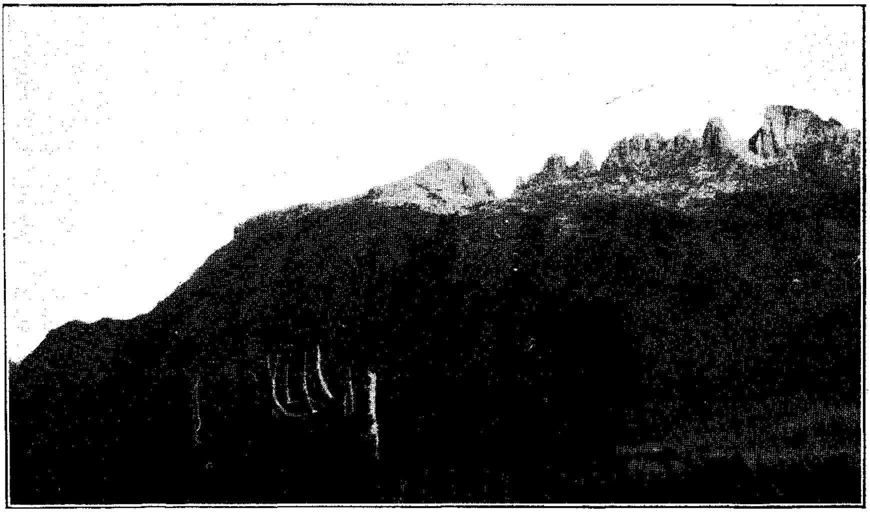


Fig. 2. The Comb Ridge.

A. N. Lewis, photo.

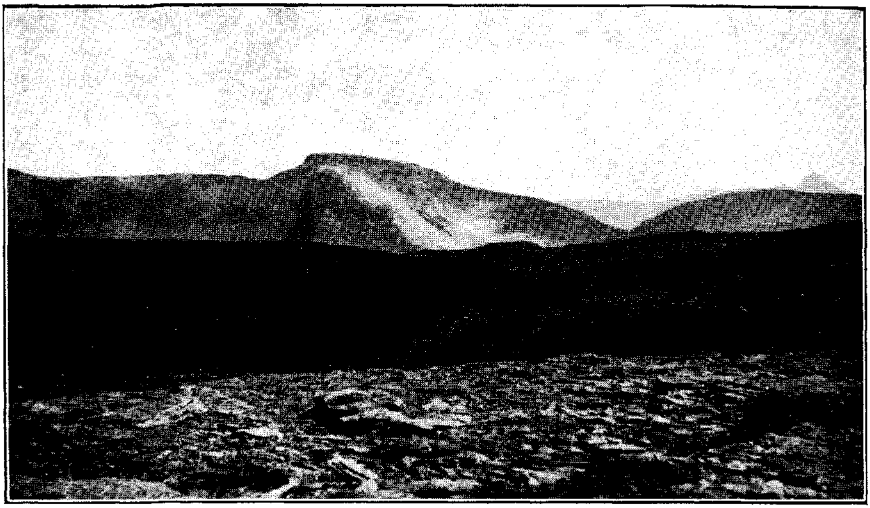


Fig. 1. Summits of La Perouse (centre) and Leillateah (distant right).

Fig. 2. The Lune Cirque and Moore's Bridge.

A. N. Lewis, photo.

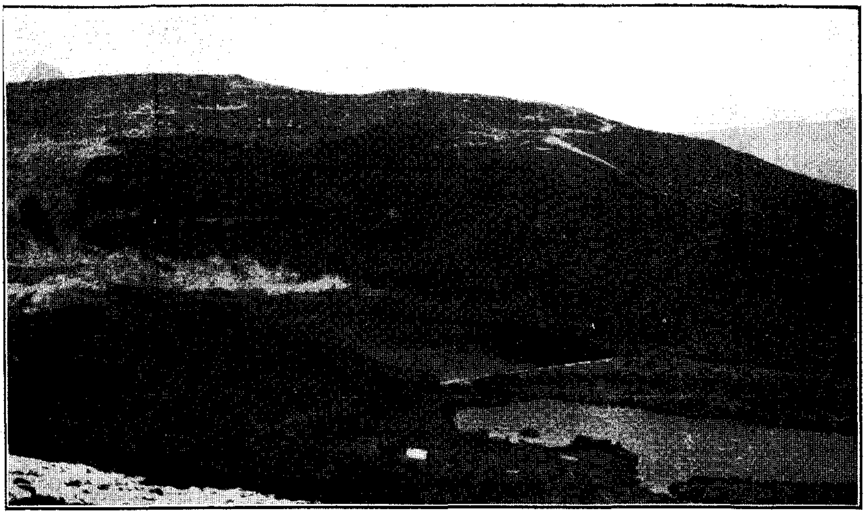


Fig. 1. The Reservoir Lakes.

Fig. 2. The Rock Bar, upper Reservoir Lake.

A. N. Lewis, photo.

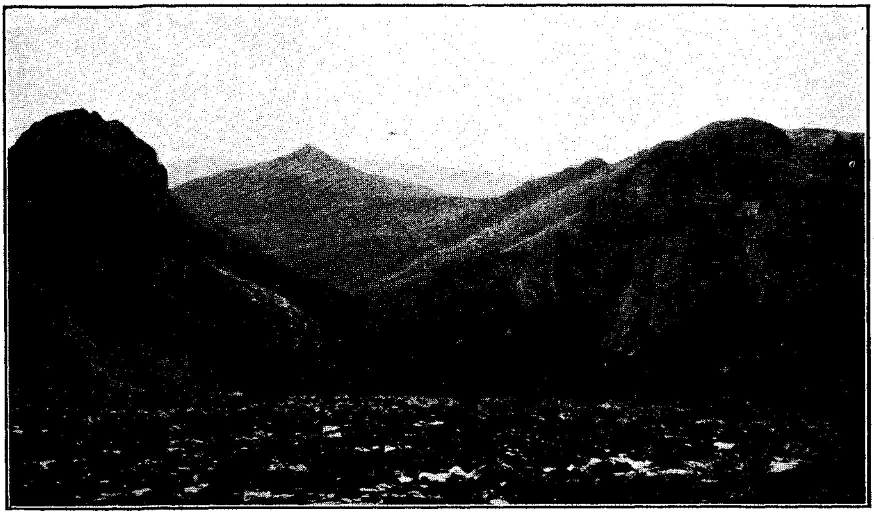


Fig. 1. The South D'Entrecasteaux Cirque.

A. N. Lewis, photo.

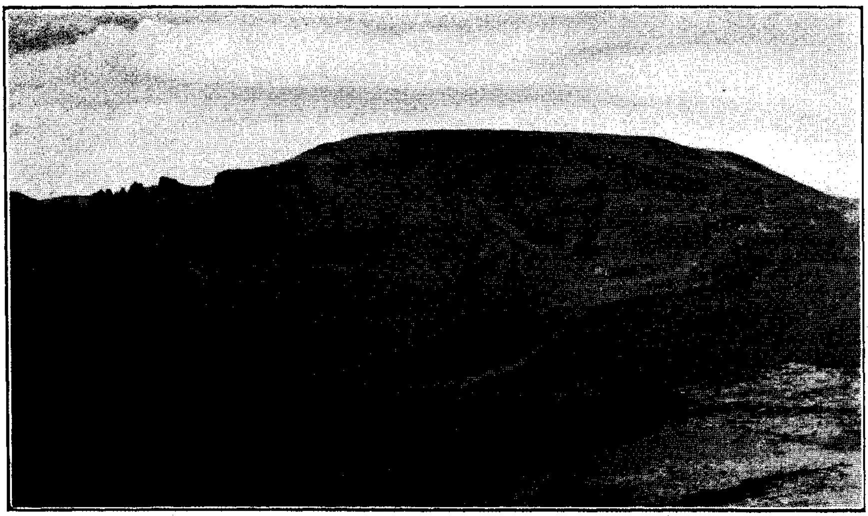


Fig. 2. The Summit of Mt. La Perouse.

Dr. J. Walch, photo.

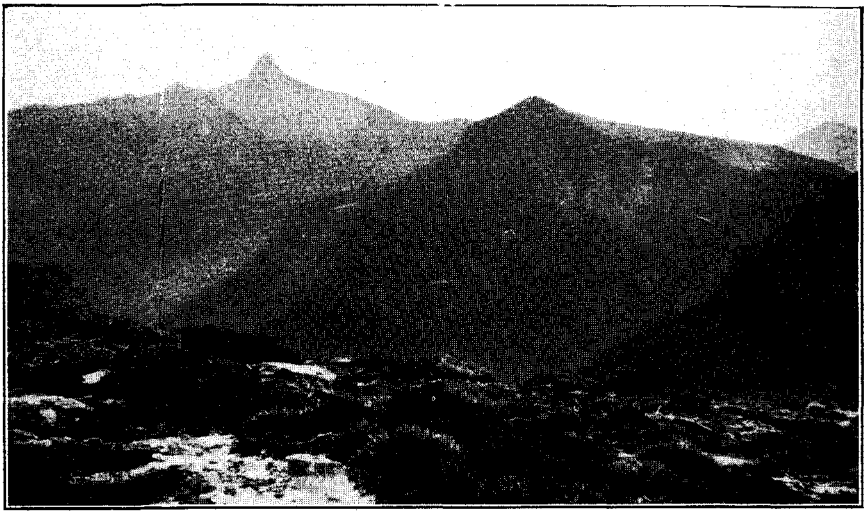


Fig. 1. Mt. Leillateah from Mt. La Perouse.

A. N. Lewis, photo.

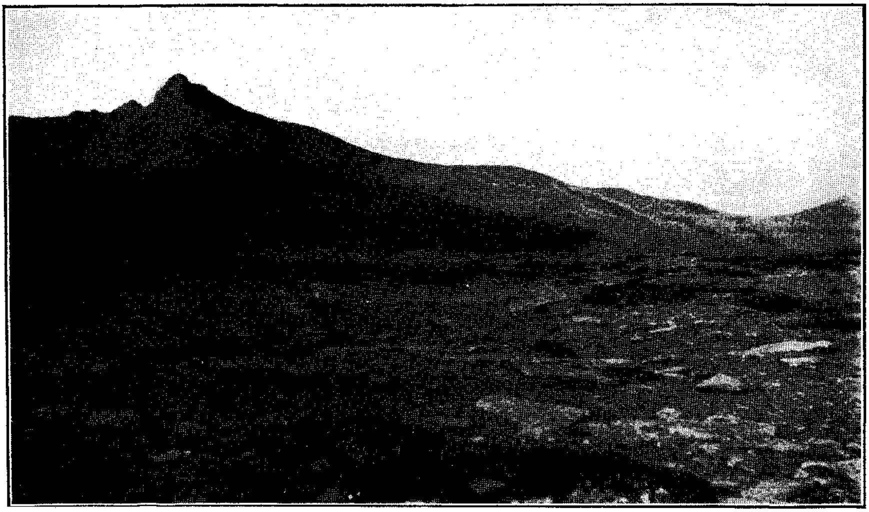


Fig. 2. Mt. Leillateah from Maxwell Ridge.

Dr. J. Walch, photo.

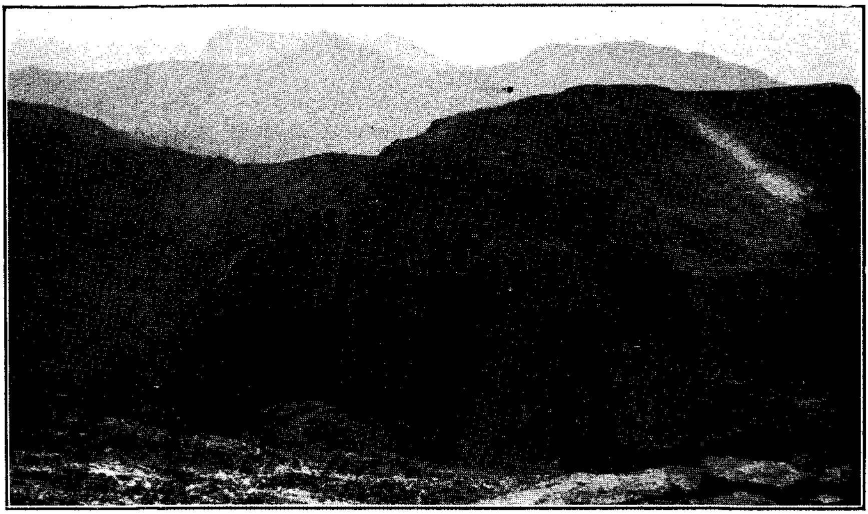


Fig. 1. Maxwell Ridge (foreground), Mt. Wylie and Mt. Victoria Cross (middle distance), Precipitous Bluff (distance), from Mt. La Perouse.

Fig. 2. Precipitous Bluff and mouth of New River, from Mt. Leillateah.

A. N. Lewis, photo.

obviously portion of the same feature as the cirques, that there is no hesitation in saying that it was recently invaded by ice. This brings the level of the ice down to 500-200 feet above sea level. Farther north this plain reaches sea level around the Southport Lagoon. Glacial aspects are not pronounced here, but scattered boulders and indeterminate drainage indicates the former nearness of a melting glacier.

The leases of the Catamaran Colliery Co. are covered with isolated boulders and aggregations of scattered diabase of all sizes, and there are no indications of surface occurrences *in situ* of this rock. They occur on tops of ridges, on steep hill sides, and in swamps, to many of which places no existing stream could have carried them. In many places they present the jumbled appearance of a moraine. These occur from 500 feet to 50 feet above sea level.

Although the bush is so dense that little idea of the details of the topography can be formed, the country just west and south of the old shaft of the Catamaran Mine has all the appearance of typical terminal morainal country. In a cutting on the tramway between the mine and the wharf there are many diabase boulders embedded in clay. These may be residuals of soil erosion, but their lay and the fact that the small parallel fractures do not lie the same way in adjacent boulders indicate that they have been dropped from ice. Just west of Leprena, there is a long ridge, through which the D'Entrecasteaux River has cut, that has the appearance of a terminal moraine. All these indications are below the 100-foot contour.

Joseph Milligan, in his report on "Coal at Whale's Head and South Cape" (Pap. and Proc. Royal Society of Tas., 1849, p. 17), indicates on his sketch and refers to "Rubbishy mixture of Earth with Greenstone and fragments of Stratified Rock." This points to ice action at sea level on the south coast.

[It is not out of place here to refer to the fact that Dr. Milligan there refers to a granite erratic in shale at Southport, and attributes its existence to ice. This would be referable to Permo-Carboniferous glaciation. The reference does not appear to have been noticed by later writers and is, as far as the writer has yet ascertained, the first reference to glacial action in Tasmanian geological literature. The date was 1848.]

The indications seen by the writer on this flying visit are not quite positive, but indicate that ice from the D'Entrecasteaux Cirques reached sea level towards Leprena on the north of Recherche Bay, and perhaps in the vicinity of Southport Lagoon, and that ice from the Catamaran Cirque reached sea level in the vicinity of Cockle Creek, in the south of Recherche Bay. Also that these glacial systems, with distinct sources, were kept separate throughout most, if not all, of their course, by the ridge running east from La Pérouse to the before-mentioned conical hill west of Recherche Bay, which may perhaps be the *Mt. King* of Lady Franklin although there is evidence of a coalescing, during the period of maximum glaciation, to form a narrow piedmont ice sheet for perhaps a mile in front of this hill. The ice that was responsible for the indications here noted was essentially that of an extended valley glacier pushing down from the mountains not five miles away, and keeping to a single defined path, and not in the nature of an ice sheet.