SOME GEOGRAPHICAL NOTES ON A MODEL OF THE NATIONAL PARK AT MT. FIELD, TASMANIA.

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Plates XXIX., XXX., and Five Text Figures.

(Read 5th December, 1921.)

Early in February, 1919, I had the pleasure of visiting the Tasmanian National Park with a party organised by the Hon. Secretary to the Park Board. The whole journey was filled with interest to the geographer, especially as my suspicions of a glacial topography were abundantly verified by the fine examples of cirques, moraines, erratics, and glacial lakes which I identified on the plateau.

I collected topographic data sufficient to construct a rough contour map (Plate XXIX.), using the reconnaissance survey of Mr. Propsting and others as a basis. From this on my return I constructed the model which is illustrated in Plate XXX. Owing to the pressure of other research, I was unable to complete a memoir on the glacial features, and these have since been worked out with great care and success by Mr. A. N. Lewis, *M.C.* (1)

There are a few aspects of the problem which do not appear in his lengthy memoir, and I feel that the geographical literature of Tasmania is so scanty that these brief notes may not be out of place.

The most striking feature of the region perhaps is the marked parallelism of the valleys. The Plateau is so dissected that in plan it is somewhat like a gridiron (see Fig. 1), with three or four main ridges all trending north-west to south-east. Almost the whole area consists of one geological formation, a medium-grained dolerite or diabase, so that we are not concerned here with dip or strike topography. Jointing is a more probable cause, and a reference to Tasmania as a whole shows that the major tectonic features have the same direction. I have elsewhere (p. 176, "Australian Environment," 1918) drawn attention to this "grain"; which is well seen in the three main lines of weakness in the island. These are the Tamar-Macquarie lineament, the Lake St. Clair-Derwent lineament and the Macquarie Harbour-Gordon lineament. (See Fig 1.)

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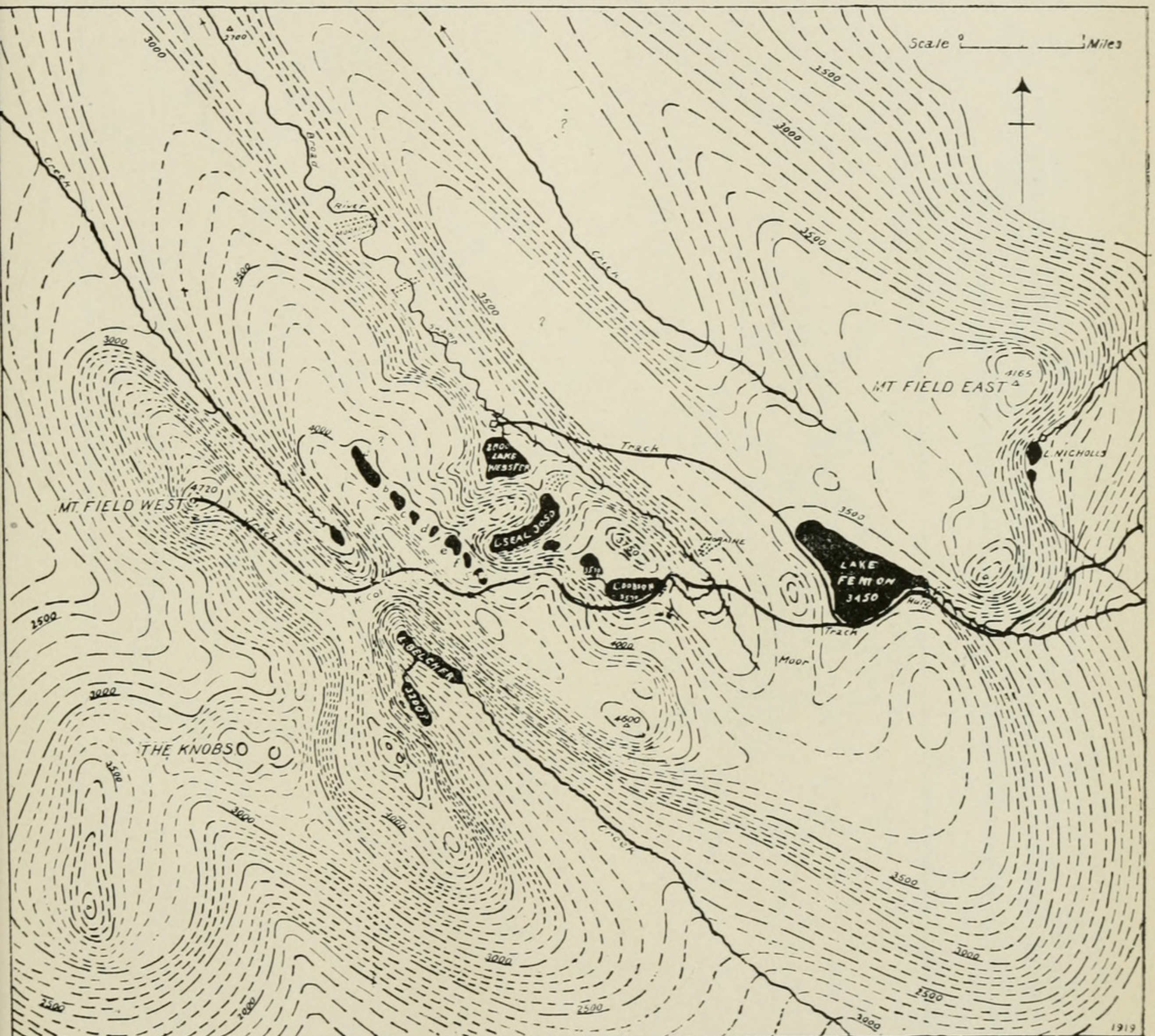
(1) P. & P. Roy. Soc. Tas., 1921, pp. 16-36.

SKETCH MAP

MOUNT FIELD. NATIONAL PARK. TASMANIA

BY DR. GRIFFITH TAYLOR BE. BA. FGS. FRGS.

APPROXIMATE TOPOGRAPHY BY FORM-LINES



NOTE.—Lakes shown black, thick lines are main tracks. Form-lines only approximate.

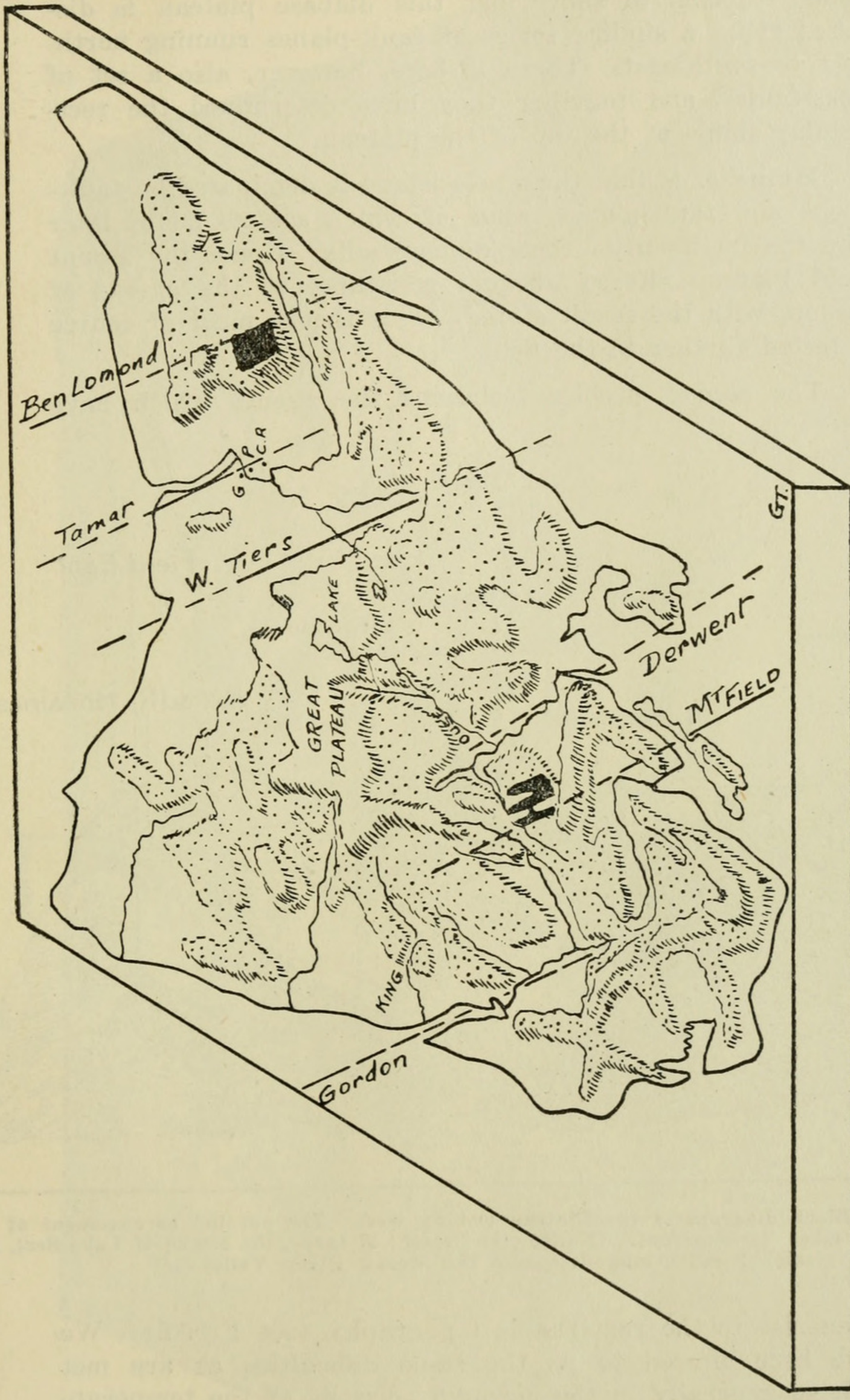


Fig. 1.—Block diagram illustrating some of the main "lineaments" of Tasmania. The Mount Field Plateau is the black "gridiron" in the south. Ben Lomond Plateau is the black rectangle in the north-east. The Gorge, Punchbowl, and Corra Lynn at Launceston are indicated. The 1,000 foot and 3,000 foot contours are shown by the dotted and a higher plain "layers."

The trellis-work drainage of the summit of Ben Lomond(2) seems to show that this diabase plateau is dissected along a similar series of fault-planes running north-west to south-east. There is here, however, also a set of cross-faults, and together they have determined the rectangular shape of the top of the plateau.

My belief is that the whole island is dominated by fault-blocks and fault-planes, some of which are no doubt later than the intrusion of these diabase sills. Hence the Mount Field Plateau offered unequal resistance to the agents of erosion, with the result stated. This theory must of course be tested further in the field.

The second problem concerns the agents which have

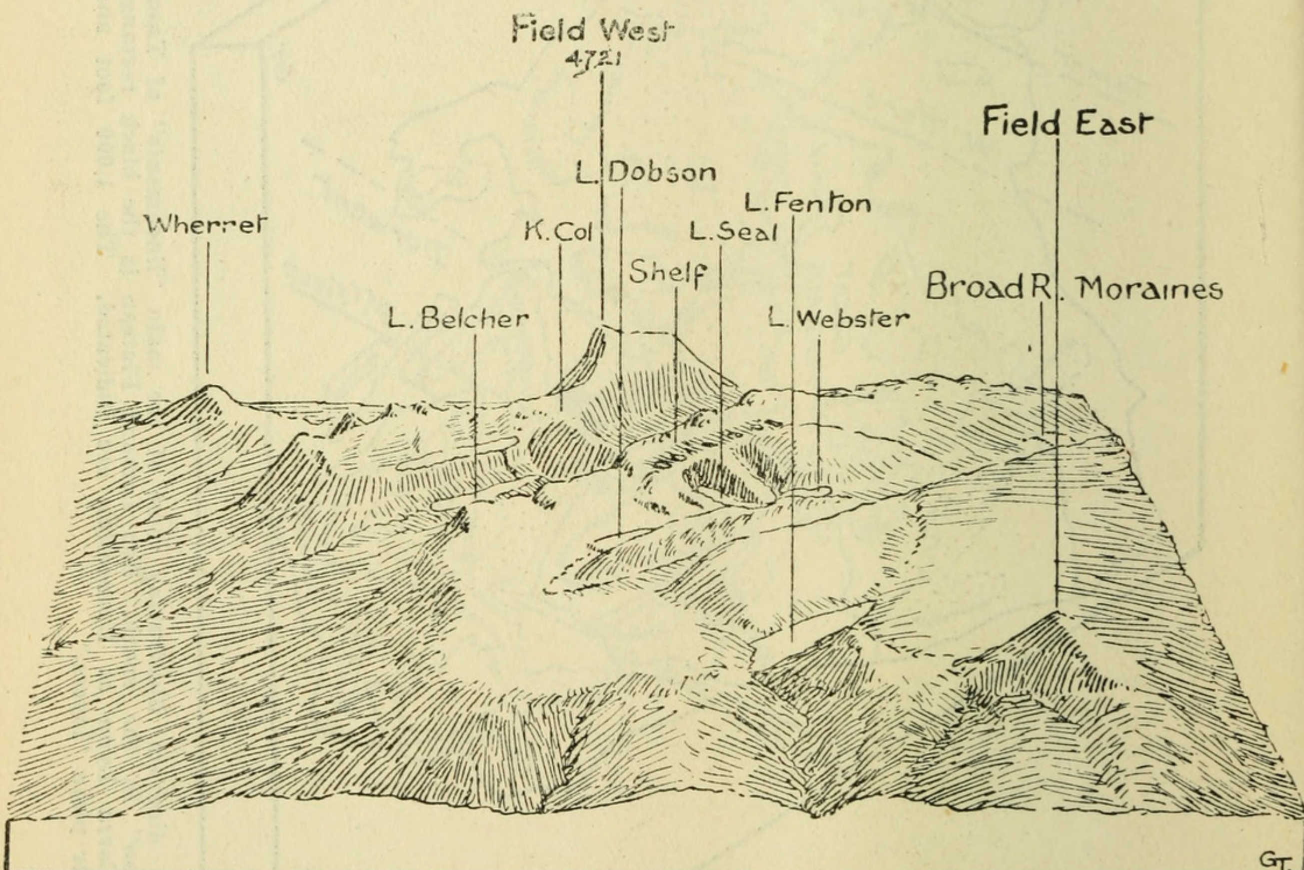
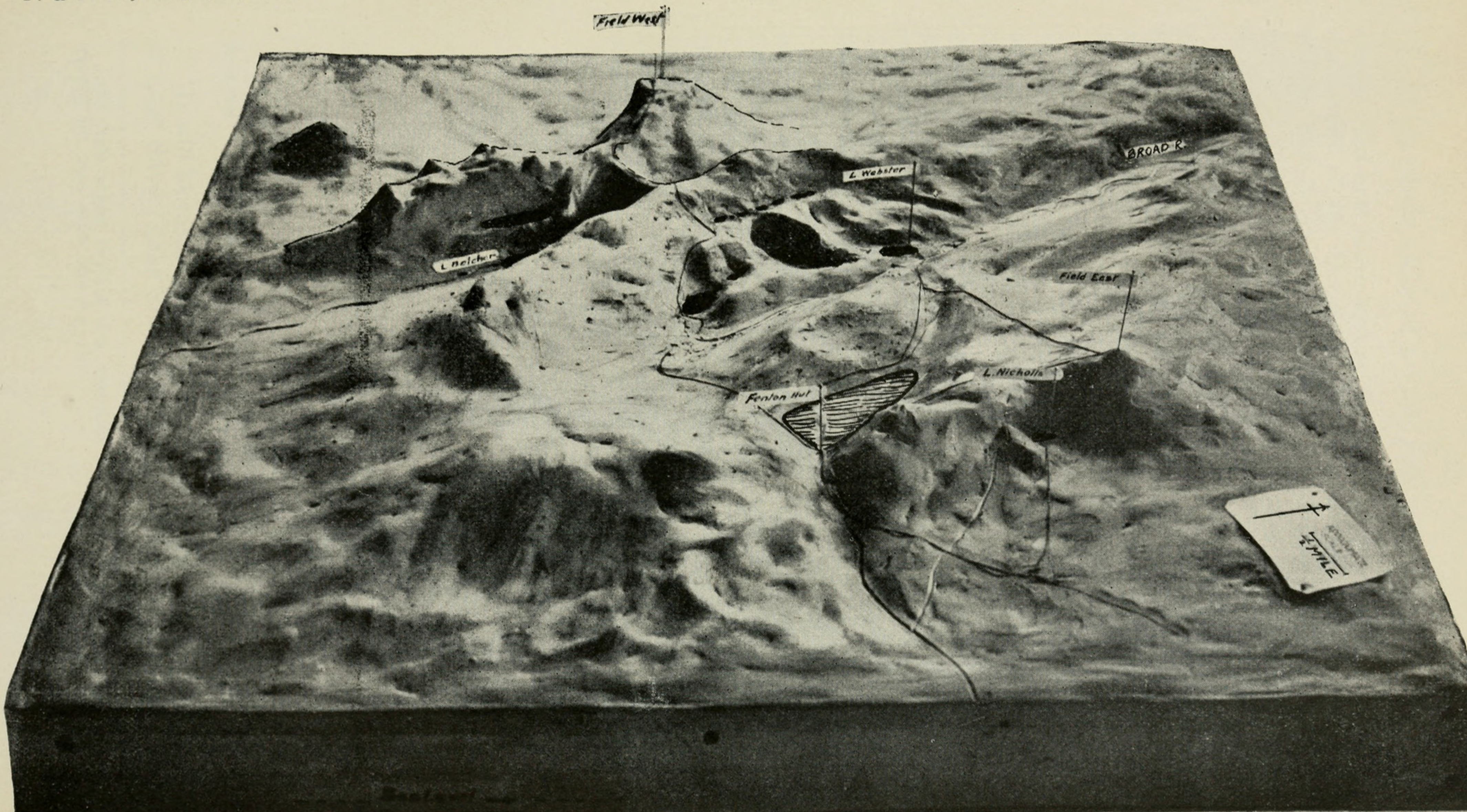


Fig. 2.—Block diagram of the Plateau looking west. The parallel arrangement of the valleys and lakes is apparent. Notice the "shelf" of tarns, the cirque of Lake Seal, and "K" Col. A glacier 5 miles long descended the Broad River Valley.

given rise to the remarkable topography (see Fig. 2). We have here offered to us the same difficulties as are met with so generally in the elevated portions of the temperate zone. The special facies of the region is due to glacial

(2) P. & P. Roy. Soc. Tas., 1913. Map by Colonel Legge.



Model of the Mount Field Plateau—National Park, Tasmania.
A Key to the model appears in fig. 2.

(Photo. by Beattie.)

erosion; but how much erosion by ordinary streams preceded the advent of the Ice Age? And further, was the glacial erosion due to glacier *planation* (*i.e.*, by the rasping and plucking due to debris cemented on the sole of the glacier) or to the method which has been termed "*nivation*"?

Evidence as to the great amount of erosion accomplished since the last period of uplift is obvious throughout Tasmania. The gorge of the Ouse is cut down 1,200 feet, while the King River canyon is even more striking. A better-known example lies in the suburbs of Launceston, and offers a wonderful study to the Tasmanian geographer. Here the South Esk enters the Tamar estuary through a most picturesque notch giving the clearest evidence of late uplift; though later subsidence(3) has drowned the mouth of the gorge. Probably Corra Lynn gorge and the Punchbowl, a few miles to the south-east, are due to the same differential movement between the Tamar estuary and the environs of Launceston. The positions of these most interesting examples appear on Figure 1.

We may therefore, I think, postulate a considerable amount of erosion in the pre-glacial period, giving rise to valleys, perhaps 500 feet deep, where now flow the Broad River and the creeks draining north and south from K Col, through Lake Hayes and Lake Belcher. These pre-glacial valleys would be of a juvenile type with V cross sections, and the thalweg would fall rapidly in the first mile of each stream. (See Fig. 3.)

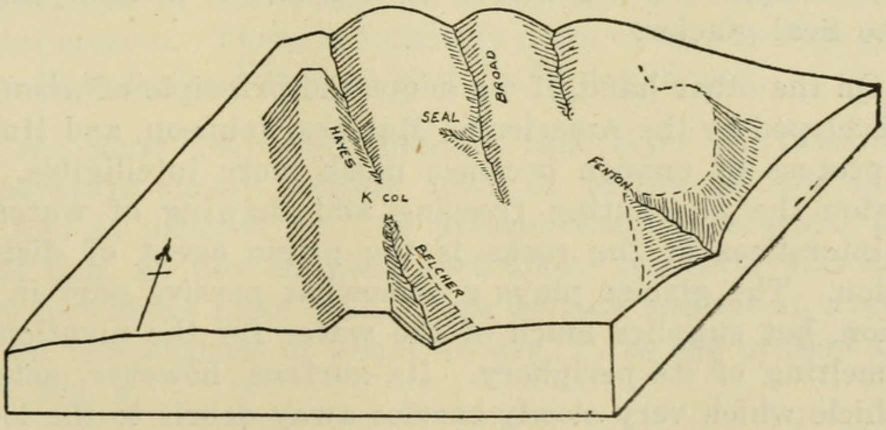


Fig. 3.—Block diagram illustrating approximately the pre-glacial drainage of the Plateau.

It will be seen, therefore, that the striking cirque valleys of Lake Hayes, Lake Belcher, and Lake Seal were originally

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(3) Daly would explain this drowning as due to the melting of the world's ice caps after the Ice Age.

not unlike the steep valley which leads from Fenton Hut down the outer slope of the Plateau towards Russell Falls. There was, therefore, a good deal of material to be removed during the Ice Ages before these valleys developed the characteristic cirque-heads of to-day.

In each of these three typical cases the cirque has a maximum wall of about 1,000 feet, lying approximately between the 3,000 and 4,000 feet contours.

It is further to be noted that these cirques lie largely on the sheltered easterly aspect of the ridges, so that they are protected from the hot afternoon sun.

To understand the way in which the ice has eroded these valleys we must, I think, further consider two aspects of the problem. Firstly, the alimentation of the glaciers; and secondly, the life history of the latter. We shall then, I believe, see that nivation probably played a more important part than planation in carving out the main cirques. This type of erosion also helps to explain the interesting shelf-tarns above Lake Seal, and the unusual position of Lake Belton "perched" above Lake Belcher.

The snow-fields nourishing the glaciers of the plateau must have been very circumscribed. The collecting ground for the Hayes and Belcher glaciers was the original K Col and the adjacent narrow ridges. It seems to me unlikely that the Belcher glacier resulting from this meagre snowfield had sufficient power to gouge out a bowl-shaped hollow *right at its head* to the depth of one thousand feet. The same objection applies to the Hayes glacier, and to a lesser degree to the Seal glacier.

On the other hand, if we adopt the principle of *nivation*, as developed by the Americans, Matthes, Johnson, and Hobbs, the process of erosion becomes much more intelligible. In nivation the alternating freezing and thawing of water in the interstices of the rocks is the prime agent of disintegration. The glacier plays a somewhat passive part in the erosion, but supplies much of the water for the nivation by the melting of its periphery. Its surface, however, acts as a vehicle which very slowly carries away debris to the lower end. The thaw-water streams at the side of the glacier also are of great importance in eating down the rock edges of the valley. The glacier also acts something like the scour-wall at a river mouth which directs the removal of debris. (See the paper on Antarctic Glaciology by the writer—Geogr. Jnl., 1914, p. 562.)

In my brief report(4) on the glaciology which I made in February, 1919, I wrote as follows:—

> "In the early days of the Ice Age a great drift of "snow occupied a shallow valley where now is Lake Seal.. "Freezing and thawing took place continually around "this snow-drift, and broke down the structure around "the drift. Small streams surrounded the drift, and not "only supplied the ice wedges, but carried away some of "the debris. The sapping extended outward by slow "degrees as the snow-drift increased, and gradually a "flat valley was eroded, much like the embryo cirque on "the 4,300-foot level above (and south of) Lake Seal. "(See Fig. 5 at A.) The deepening process would ad- "vance into the hill at the foot of the snow-drift and "would be especially strong during the dwindlnig of the "ice-slab (into which the snow would soon be converted) "as the Ice Age passed away."

It is important to realise that the oncoming and waning of the Ice Age were both gradual. Hence the controls determining the erosion varied more or less continuously. The major control was, of course, the temperature; and the point is not sufficiently stressed in glacial literature, that there is an optimum temperature as far as frost-action is concerned. It is obviously near the melting point of ice, and probably from 32 deg. to 35 deg. F. (or around 34 deg. F.) is about the most favourable temperature. One of the most striking results of my Antarctic investigations was to find that the temperature in the Antarctic is too cold for the maximum glacial erosion. There is infinitely more of this erosion going on in New Zealand than in latitude 78 deg. South.

We must therefore imagine this layer of favourable temperature slowly settling down on to the plateau as the Ice Age is ushered in. At present the temperature layer of 34 deg. F. lies at 6,000 feet above sea level and about 3,000 feet above Lake Seal. Here we may assume an average annual temperature of about 44 deg. F. at the present time. (See Fig. 4.)

If now we imagine a cooling of about 10 deg. F. at the maximum of the Ice Age, this "nivation-layer," as we may term it, will descend to the level of Lake Seal, and the maximum amount of frost action will occur at this level. Above

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(4) A report prepared for the Tasmanian Government Tourist Bureau.

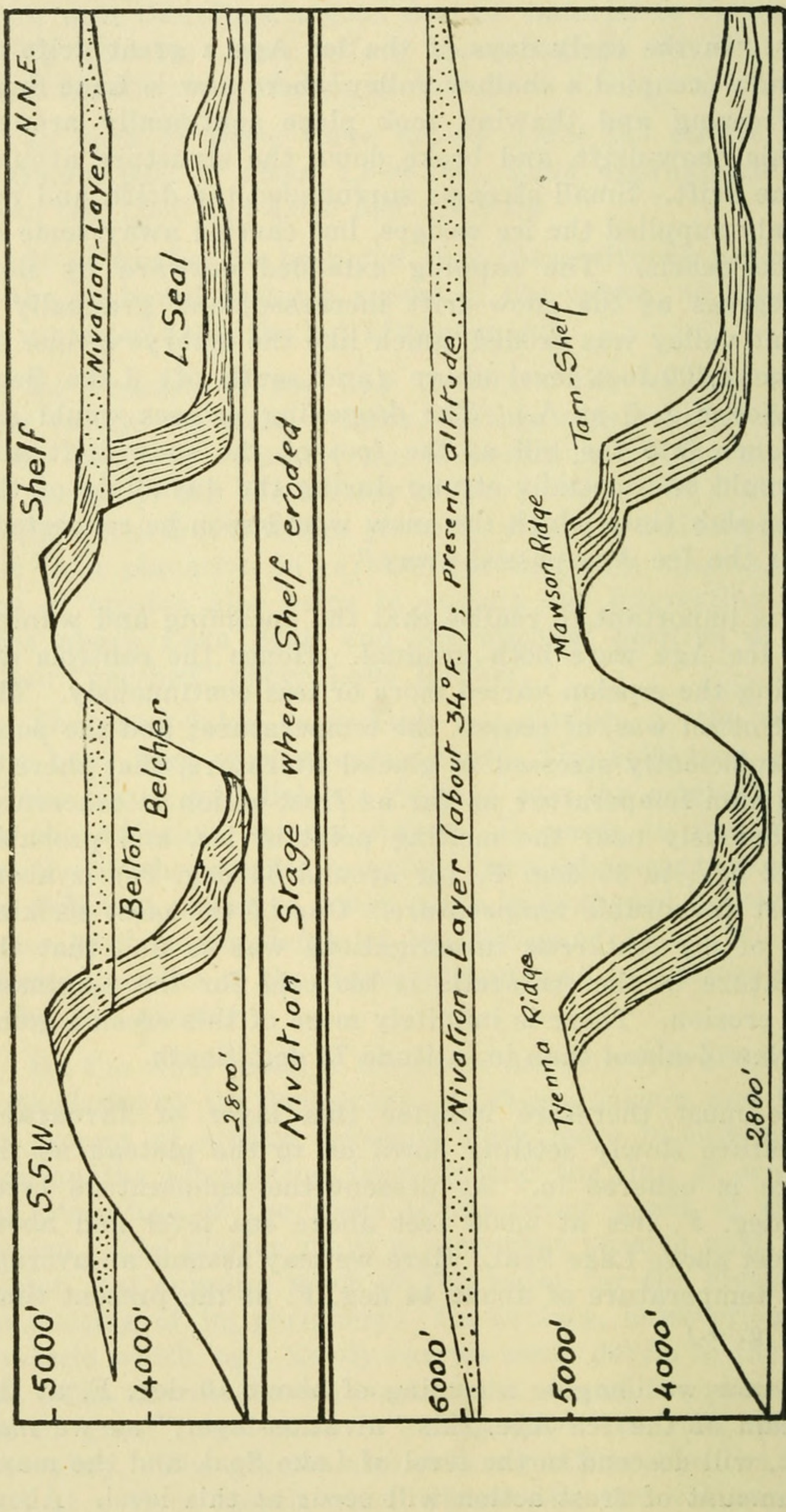

Fig. 4.—Block diagrams showing the movements of the layer of maximum sapping ("nivation-layer"). Upper figure, in Ice Age, when 4,300 feet above sea level. Lower figure, at present time. At maximum of Ice Age it descended to 2,800 feet.

this level the temperature will be somewhat too cold for the maximum effect, and below this level it will be too warm for ice to form.

We know that there were colder and warmer stages during the Pleistocene Ice Ages. This implies that the nivation-layer halted at various elevations in its descent from and ascent to its present elevation of 6,000 feet above sea level. I imagine that we have evidence of two such phases in the topography of the Plateau. At the maximum cold period the layer was at its lowest; and the low-level cirques of Lakes Seal, Hayes, and Belcher were cut out while the great Mount Field glacier moved down the river valley for some five miles as the beautiful moraine crescents (5) clearly show. At this period the edges of the Broad River Valley were "cleaned out" and the cross-section converted from a V into the catenary curve of the glacial type. All the lower moraines were laid down also at this phase. Two well-marked halts are indicated however by the grouping of the moraines, above and below the two enormous erratics in Broad Valley (which I learn from the paper by Mr. Lewis have been named after myself). This stage would be indicated in Figure 4 if we imagine the nivation-layer at the lowest level in the section.

The seven tarns named after Johnston and Newdegate lie on a shelf (see Figs. 4 and 5) whose origin can best be explained in a similar fashion, I think. They are at an elevation of 4,300 feet, or 1,200 feet above the floors of the cirques described previously. The shelf is about one mile long and varies in width from 80 yards in the south to a quarter of a mile at the somewhat lower northern end. The whole shelf is jewelled with rocky tarns lying in the hollows between rounded rock hummocks whose surface has certainly been smoothed by ice action. Their most striking feature, however, is the way in which some of the lakelets have two openings, one passing *along* the shelf to the north, and the other opening directly *over* the great thousand-feet cliff. Large erratics perch precariously on sloping platforms just as they were dumped by the ice. All this indicates that no long interval has elapsed since the topography was initiated, for the longitudinal drainage of the seven tarns must suffer capture in the near future by the streams flowing directly over the edge.

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(5) These were, I believe, first identified on February 3rd, 1919. See my brief report in American Geographical Review, December, 1919.

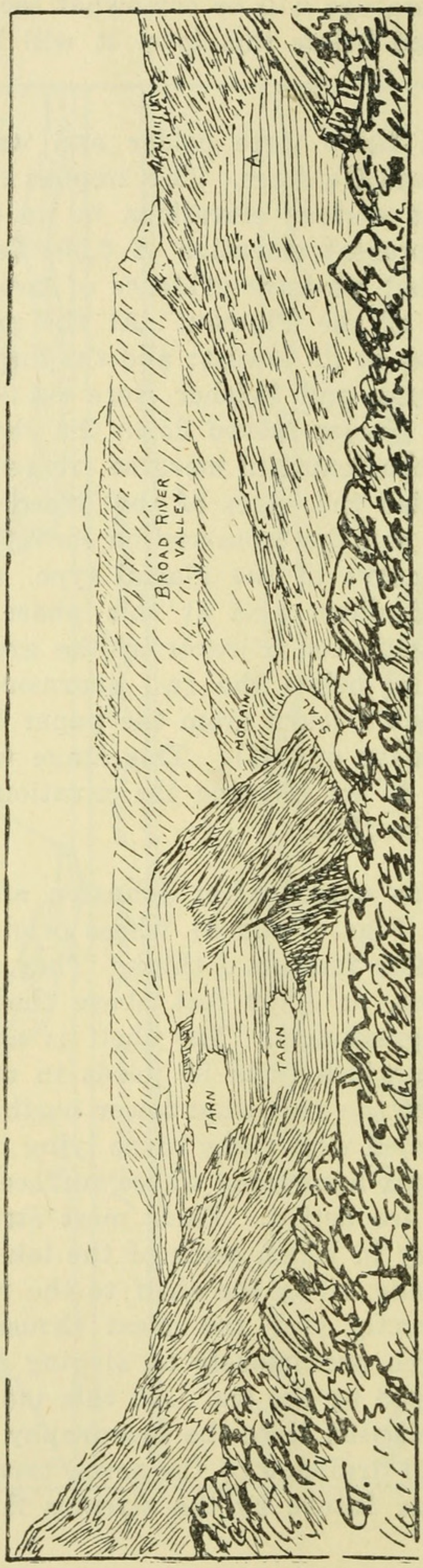

Fig. 5.—Sketch looking north-east over the tarns on the "shelf" above Lake Seal, showing the thousand feet of drop to Lake Seal. On the right at A is an immature cirque.

There are two possible explanations of this unusual shelf with its rock-tarns. One involves the filling of the whole Broad Valley with ice, so that the lateral drainage flowed to the north along the position of this shelf and so cut a notch between the glacier and the containing ridge to the west. This is not well supported by the field evidence, though it accounts for the shelf sloping to the north.

The more plausible explanation involves the nivation-layer which I have described above. I imagine that for some long period this layer with a temperature around 34 deg. F. halted at the 4,300 feet level, possibly both in the advancing and retreating hemi-cycles of the Ice Age. (See Fig. 4 above.) The shelf was favourably situated for collecting snow, which was not readily removed by the sun from its sheltered position. A series of cirques were sapped out in the course of time, and these became apposed sideways in much the same fashion as Nussbaum has described in the Swiss Alps.(6)

A shelf is thus produced by the sapping action of seven adjacent cirques. The ice-slabs are competent to carry the erratics to the positions noted, and also to round the rocks forming the rim of the shelf. Since a cirque glacier *"burrows" into the hill* (as Hobbs has shown in his "Characteristics of Existing Glaciers") rather than erodes the valley under its snout, we see why the edge of the shelf remains almost entirely unaffected by the shelf glaciers.

The evolution of Lake Belton, perched some 300 feet up the side of the Lake Belcher Valley, may be partly explained in a similar fashion, but this demands much more field work than I was able to give to this locality.

It is in the hope that these brief notes will stimulate local interest in the innumerable geographical problems of Tasmania that I have written the paper.

LIST OF ILLUSTRATIONS.

PLATE XXIX.

Sketch survey of the Park. The form-lines are approximately correct near the routes marked, but are only filled in from sketches, etc., elsewhere.

(6) Die Taler der Schweizer-Alpen; Berne, 1910.

Plate XXX.

Model of Mt. Field Plateau, National Park, Tasmania. A key to the model appears in Text fig. 2. (Photo. by J. W. Beattie.)

Text Figures.