THE GLACIATION OF THE KING VALLEY, WESTERN TASMANIA

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(With 1 Figure and 1 Plate)

ABSTRACT.

That a glacier once flowed down the King Valley is shown by glacial deposits in this valley and in the adjacent Nelson, Comstock and Linda Valleys. East of Mt. Lyell it was at least 1,000 feet thick, but south of this point it decreased rapidly in thickness due to widening of the valley and to loss of ice to the distributary glaciers in the Linda and Nelson Valleys. During a brief maximum phase the glacier reached the Crotty Plains six miles south of the Lyell Highway and may have just crossed the West Coast Range at Gormanston Gap. A series of retreat stages is represented by moraines in each valley.

A study of aerial photographs indicates that the King Glacier resulted from the conjunction of major glaciers flowing in the North Eldon and South Eldon Valleys. These were fed from the east side of the Tyndall Range and from the Eldon Range respectively.

Evidence of only one glacial phase was found and it is contended that the glaciation was contemporaneous with that at Lake Margaret. A radio-carbon dating of problematical significance indicates an approximately Wisconsin age for the single advance and retreat.

INTRODUCTION.

The existence of glaciation in the West Coast Range area has long been known (Sprent, 1886; Montgomery, 1891; Power, 1892; Dunn, 1894; Johnston, 1894; Moore, 1894; Officer, Balfour and Hogg, 1895; Moore, 1896; and Gregory, 1904). Of these many reports those of Dunn (1894), Moore (1896), and Gregory (1904) are of the most value. The first two of these discuss the glaciation of the Tyndall-Sedgwick-Dora region and Gregory, in reporting on the Linda Valley area, concluded that the glacial deposits of the Linda Valley came from a distributary of a larger glacier in the King Valley. This view has been supported by the work of Bradley (1954) and Carey (1955), but no actual study of the King Valley glaciation and especially of the limits of the glacier has been reported previously.

The present study consisted of a week's field work in the southern part of the King Valley and in the Linda and Nelson Valleys and a careful study of aerial photographs of the West Coast Range and Eldon Range areas. Two of the authors (Ahmad and Bartlett) have also visited the areas around Mt. Sedgwick and Lake Dora.

The authors wish to thank Professor Carey, of the Geology Department, University of Tasmania, who suggested the study of the area, and also to thank Mr. M. R. Banks and Mr. J. Davies for a number of very helpful suggestions. We also wish to acknowledge the help of the Lands Department in making available photostats of their Lyell Sheet prior to publication. Heights are based on aneroid readings in closed circuits on a Mt. Lyell Company bench mark at Gormanston Recreation Ground and were checked, where possible, against the photostats.

PHYSIOGRAPHY.

The King Valley runs almost north-south on the eastern side of the West Coast Range and about 20 miles from the western coastline. The valley is crossed by the Lyell Highway about seven miles from Queenstown and there is a vehicle track running south to the Crotty Plain where the King River turns west to flow in a 1,000-feet gorge between Mts. Huxley and Jukes.

The area which must be considered in a discussion of the King Glacier can be divided conveniently into four physiographic units (for localities see Fig. 1):—

(*a*) *The Western Margin of the Central Plateau.*—A strongly-dissected, early-mature area extending west and south-west from near Castle Mt. and Rocky Hill.

(*b*) *The Eldon Range.*—An east-west range which changes from plateau-like near Eldon Bluff to the sharp Eldon Peak (4789 feet) at its western end.

(*c*) *The West Coast Range.*—A series of rugged peaks with Mts. Tyndall (3,800 feet), Geikie and Sedgwick (3,755 feet) in the north forming the western and southern margins of the Dora-Spicer plateau. South of Mt. Sedgwick the range is broken by the broad Comstock Valley (about 900 feet above sea level) and again on the south of Mt. Lyell (2,821 feet) by the Linda Valley (900 feet). South of this valley are the several peaks of Mt. Owen (3,760 feet) and further south-east the Thureau Hills form an eastward extension of the range.

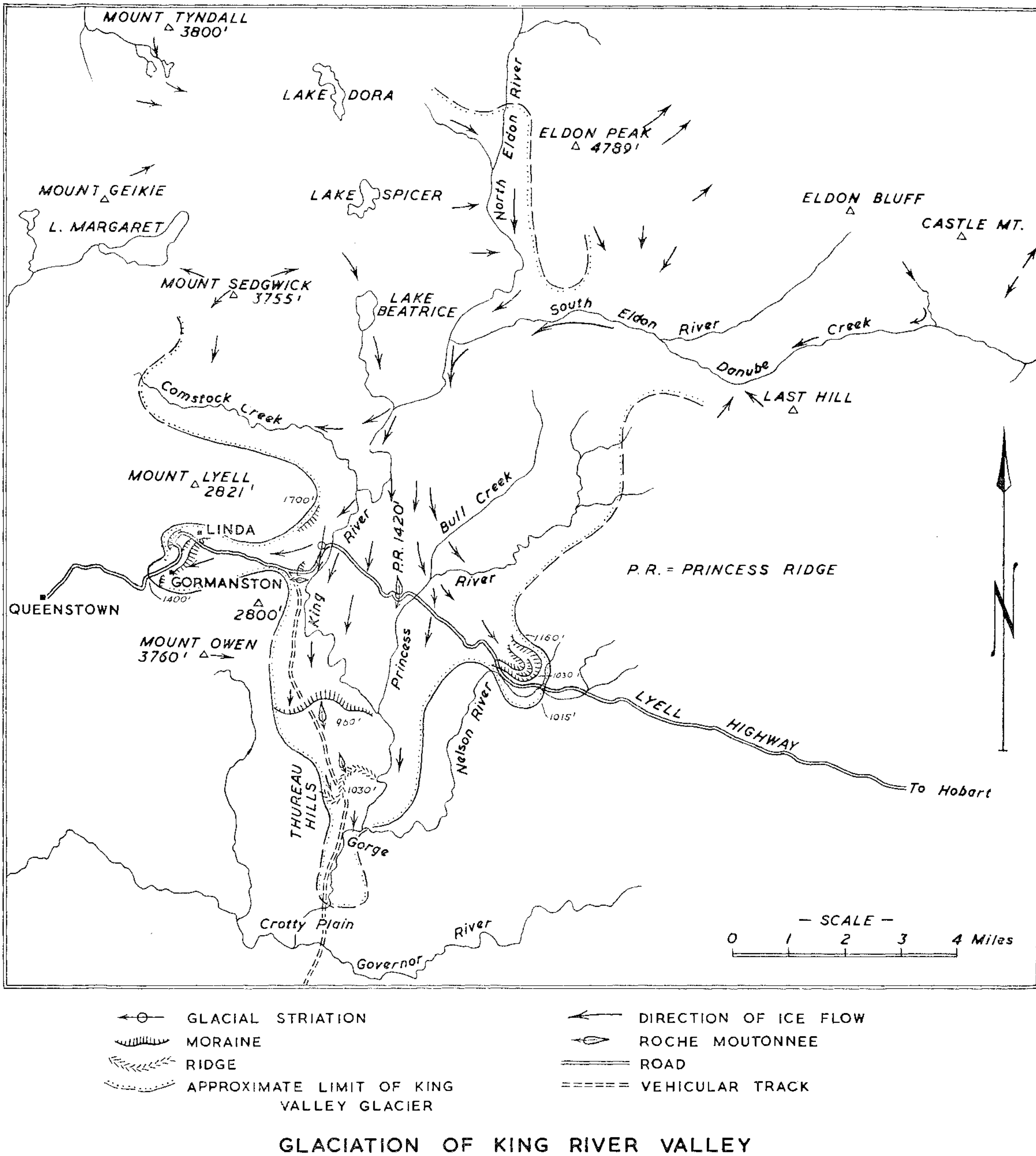
MOUNT TYNDALL 3800'
LAKE DORA
ELDON PEAK 4789'
MOUNT GEIKIE
LAKE SPICER
ELDON BLUFF
CASTLE MT.
L. MARGARET
North Eldon River
MOUNT SEDGWICK 3755'
LAKE BEATRICE
South Eldon River
Danube Creek
LAST HILL
Comstock Creek
MOUNT LYELL 2821'
1700'
LINDA
King River
P.R. 1420'
Bull Creek
River
P.R. = PRINCESS RIDGE
GORMANSTON
QUEENSTOWN
1400'
2800'
MOUNT OWEN 3760'
King
Princess
1160'
1030'
1015'
LYELL HIGHWAY
Nelson River
960'
1030'
THUREAU HILLS
Gorge
To Hobart
Crotty Plain
Governor River
— SCALE —
0 1 2 3 4 Miles
GLACIAL STRIATION
MORAINE
RIDGE
APPROXIMATE LIMIT OF KING VALLEY GLACIER
DIRECTION OF ICE FLOW
ROCHE MOUTONNEE
ROAD
VEHICULAR TRACK
GLACIATION OF KING RIVER VALLEY

Fig. 1.

(*d*) *The King Valley.*—The North Eldon Valley between Eldon Peak and the West Coast Range, and the South Eldon Valley on the southern side of the Eldon Range, join south-west of Eldon Peak and from there the King Valley extends south for a further eight miles as a broad (1-3 miles), flat-floored valley in which the King River pursues a meandering course. East of the Thureau Hills the river passes through a short but narrow gorge before emerging onto the Crotty Plains. The panoramic view (Plate i) shows many of these features.

The Princess River and Bull Creek are small streams in wide valleys separated from the King Valley north of the Lyell Highway by Princess Ridge (1,420 feet) and its northerly continuation. The Nelson River flows west parallel to the Lyell Highway until the latter crosses a 1,030-feet divide to the wide Princess Valley. The Nelson River, however, turns sharply south and finally joins the King River east of the Thureau Hills. In its lower part it is separated from the King by a range of hills about 1,500 feet high.

It may be stressed here that the physiographic features follow the geological structure very closely. The King, Linda, Comstock and Nelson Valleys all owe their existence primarily to the presence of relatively soft Gordon Limestone or Eldon Group sediments. Modifications of the physiography, which are due to glacial action, are present to a varying extent.

THE SOURCE OF THE KING GLACIER.

The King Glacier resulted from the junction of glaciers flowing in the North Eldon and South Eldon Valleys. The main collecting ground for the ice in the North Eldon Valley was in the Tyndall Range to the west. A substantial ice field on the east of the Tyndall Range between Mts. Tyndall and Geikie gave rise to glaciers which dominantly moved east and south-east across Lake Dora and Lake Spicer to spill over the plateau edge into the North Eldon Valley and through Lake Beatrice into the King Valley. The western wall of this valley is an abrupt but moulded and smoothed slope capped by morainal material. A tributary of the North Eldon River, rising just north-east of Lake Dora, flows eastward through a distinctly U-shaped valley and this was probably one of the principal feeders of the North Eldon Glacier.

From the north side of Mt. Tyndall, ice probably also moved northward through Lake Rolleston. The Hamilton Moraine resulted from ice originating probably on the east slopes of Mt. Geikie and flowing south-west through Lake Margaret. As pointed out by Bradley (1954) there was probably no great quantity of ice moving off the plateau in this direction, but, coming from the highest parts of the plateau and falling sharply on to the Henty Peneplain, the terminal position of the glacier stayed essentially constant over a long period of time. This period is probably represented by the many minor fluctuations recorded in the King Glacier and even perhaps lasted until after its retreat to the plateau edge. This would account for the magnitude of the Hamilton Moraine as compared to the magnitude of the moraines of the King Valley.

The area around Mt. Sedgwick is problematical as it is not known whether this acted as a separate source area or whether a portion of the main ice sheet to the north flowed past Sedgwick and spilt south into the Comstock Valley.

There are no cirques of any size on the western side of Eldon Peak but two glaciers from the north side of the peak moved north-east and have left very large lateral moraines. These glaciers meet the valley of a tributary of the North Eldon (flowing north-west here) at right angles but do not appear to have flowed down this valley but rather to have melted at its edge.

From the south-east side of Eldon Peak several glaciers fed into the South Eldon Valley. From the Eldon Range some ice moved south into the South Eldon Valley and some north into the Canning River. From Eldon Bluff a rather larger glacier moved south-east and then south-west along Danube Creek to join the South Eldon Valley. There is an ice divide running approximately from Castle Mt. to Rocky Hill. East of this, ice from High Dome moved into the Canning River and thence to the Murchison River. From the southern side of the South Eldon Valley several glaciers came from the vicinity of Last Hill to flow into the South Eldon Valley.

The South Eldon and North Eldon glaciers seem to have been of similar size by the time they joined to form the King Glacier but the glacier flowing through Lake Beatrice was probably somewhat smaller.

THE GLACIER IN THE KING VALLEY.

Carey (1955) reported a striated pavement near the road bridge over the King River at the base of the eastern slopes of Mt. Lyell. The valley floor is here at 700 feet. West of this point erratics and till occur to a height of 1,700 feet. Benches occur in this slope at 1,700, 1,660, 1,560, 1,220, and 1,120 feet. These benches are apparently of morainal material and are probably small lateral moraines, having depressions, now filled with gravel, behind them. The presence of erratics 1,000 feet above the valley floor indicates an ice thickness here of at least this magnitude. This conclusion is supported by the presence of erratics further east on the summit of the 1,420 feet Princess Ridge which was probably crossed by about 280 feet of ice moving towards the Nelson Valley.

It seems unlikely that ice ever passed between Thureau Hills and Mt. Owen, as the northern entrance to this valley is barred by a solid rock ridge (1,000 feet) which has till on its north face but none on the crest or southern face.

Two miles south of the mouth of Linda Valley a rounded ridge of Eldon Group (Silurian and Devonian) quartzite bears erratics to a height of at least 950 feet but none could be found beyond this to the summit at 960 feet. Thus the upper limit of the ice was probably very close to the top of the ridge.

The height of the plain on the western side of the hill is 800 feet and, estimating 100 feet as the thickness of glacial deposits on the valley floor, this gives an ice thickness here of at least 250 feet.

This ridge is flanked at its northern end by a very low morainal ridge rising about five feet above the flat plain and apparently extending right across the valley. This is most probably a small end moraine of the King Glacier. The plain extending south of this morainal ridge to the quartzite barrier ridge 3½ miles south of the Linda Valley is probably an outwash plain formed between the retreating glacier and the ridge. There is a fine example of a *roche moutonnée* on this plain just north of the ridge (Plate ii.).

This barrier ridge has a surface veneer of till to a height of 940 feet at its western end. Since the valley floor is at 830 feet at the northern end of the ridge, an ice thickness of not less than 170 feet to 220 feet is indicated if 50 feet to 100 feet be allowed as the thickness of deposits. There is no evidence of an extensive end moraine in the area and a moraine-like ridge immediately south of the point at which the vehicle track cuts through a gap in the ridge is probably solid with only a thin cover of moraine. Lateral moraine occurs on the adjacent slopes of the Thureau Hills. Several terraces to the north-east of the ridge were probably cut by earlier courses of the King River and its tributaries. The dry U-shaped valley cutting through the centre of the ridge has a fan-like deposit at its southern end—this seems to be outwash material.

The small plain between the barrier ridge and the gorge just north of the Crotty Plain is dominantly of outwash material. One section showed sand and clayey sand with some boulders and pebbles resting on basement rock. A section by the vehicle track showed sandy varves. Generally, the character of the plain deposits was that of glacial outwash with little actual till. It is considered that these deposits formed in a shallow lake between the ridge to the north and the moraine-dammed gorge north of the Crotty Plain. The glacier lay behind the ridge to the north during a long retreat stage.

In the side of this gorge the upper limit of till at 740 feet above a rock basement of 650 feet indicates an ice thickness here of about 100 feet. Till and outwash occur on the northern part of the Crotty Plain (620 feet) showing that at the maximum glaciation, probably for only a very short time, the ice passed beyond the gorge.

The ice then retreated from this brief maximum, probably remaining behind the gorge above the Crotty Plain for some time. However, it is thought that for the greater part of its history the glacier remained behind the quartzite barrier ridge 3½ miles south of Linda Valley entrance, sending small tongues of ice through the lower parts and depositing outwash material south of the ridge. From this position—probably corresponding with the period of deposition of the Gormanston Moraine and the higher Nelson Moraine—the ice retreated, irregularly depositing a small recessional moraine two miles south of the Linda Valley entrance, and forming a broad outwash plain north of the barrier ridge. No attempt has been made to correlate these later retreat stages with those represented by the lower levels of the Gormanston Moraine, the moraine at the entrance to Linda Valley, the several lateral moraines on Mt. Lyell and the lower Nelson moraine.

The Nelson Valley.

As mentioned previously, Princess Ridge was probably crossed by about 280 feet of ice moving towards the Nelson Valley. Ice would also possibly have crossed the divide from the South Eldon-King Valley into the basin of Princess River at points further north. The net result was that ice moved towards and into the Nelson Valley.

Dolerite erratics occur to a height of 1,160 feet north of the mouth of the Nelson Valley. Since the valley floor is at about 900 feet, the thickness of ice here would have been somewhat over 260 feet. At the Princess River Bridge the valley floor is at 705 feet so the ice thickness here during maximum glaciation would have been over 455 feet. It would, however, probably be less than the thickness of 1,000 feet in the main King Valley since it represents the thickness of ice crossing the slightly lower northerly extension of Princess Ridge.

At the entrance to Nelson Valley the Lyell Highway crosses two end moraines. The more easterly of these is at 1,030 feet and is concave towards the Princess flats. Till does occur a little further up the Nelson Valley (height 1,015 feet) but no distinct end moraine exists.

A second and later end moraine occurs parallel to and slightly west of the above-mentioned moraine. It is at a height of 965 feet and consists of till (dominantly Jurassic dolerite) interbedded with current bedded sand, gravel and some clay beds. These moraines represent two relatively long-lived retreat stages of the glacier following a short-lived maximum phase.

The Nelson River, prior to the glaciation, probably flowed westward, approximately following the present Lyell Highway, to join the Princess River before the latter joined the King River. This easterly distributary of the King Glacier and the moraines it built up caused the diversion of the Nelson River to the south so that it is now separated from the King River by a range of hills for a distance of four miles, and finally joins the King before this river enters the Crotty Plains.

Comstock Valley.

This valley was not studied in detail; however, till and glacial outwash similar to that in Linda Valley occur at its western end. Erratics of dolerite, Eldon Group (Silurian and Devonian) rocks, and the haematitic silicious breccia capping the Comstock ore body, occur on the north-western slopes of Mt. Lyell, at an elevation of 1,844 feet, 400 yards due west of the Comstock open cut (M. L. Wade, pers. comm.). These indicate that Comstock Valley was filled with ice that had moved from the north-east. However, it need not have entered from the King Valley. It may have been derived from ice spilling over Mt. Sedgwick from the north.

Linda Valley.

As has been pointed out, erratics occur to a height of 1,700 feet on the eastern slopes of Mt. Lyell at the entrance to Linda Valley. In Linda Valley, till occurs to a height of 1,400 feet on Owen Spur, near Gormanston, and varves and till lie on basement rock at 900 feet near Linda Township. Between these two there is a continuous series of till, outwash and varves. A typical part of the section exposed in a gully near the Lyell Highway above Linda is as follows:—

1,090 feet to 1,080 feet—Till.
1,080 feet to 1,050 feet—Bedded till—outwash.
1,050 feet to 1,020 feet—Varves.
1,020 feet to 1,015 feet—Till.
1,015 feet to 960 feet—Varves.
960 feet to ? —Till.

The interbedding of till and varves seems to represent successive advances and retreats of the ice. The deposition of till and varves from a height of 1,400 feet down to 900 feet, with a maximum thickness of 100 to 200 feet at any one point, indicates an overall retreat downhill of the glacier so that successively lower and north-eastward (downhill) deposits were formed during periods of less intense glaciation.

As recorded by Gregory (1904), the tills contain representatives of practically all the rock types occurring in the surrounding districts. Of particular interest is the presence of Jurassic dolerite (diabase of the older workers) and highly fossiliferous Eldon Group quartzites and slates (see also Carey, 1955). Outcrops of similar Eldon Group rocks occur on the floor of the King Valley, while the nearest outcrops of dolerite are on the summits of Mt. Sedgwick and Eldon Peak. The only conceivable route by which these dolerite boulders could have reached Gormanston is by way of the King and Linda Valleys.

The floor of the Linda Valley rises from 800 feet at the mouth of the valley to 900 feet near Linda and 1,360 feet at Gormanston Gap. The thickness of ice would have been over 1,000 feet at the valley entrance, over 500 feet above Linda, and over 40 feet just east of Gormanston Gap. This supports the conclusion of Gregory, based on the presence in the till of "diabase," that the Linda Glacier was a distributary of the King Glacier. The difference in levels would have provided the hydrostatic head for the flow into the Linda Valley.

The fact that at a short distance east of the Gap erratics occur to a height of 40 feet above the level of the Gap suggests that it is likely that some ice spilt over the Gap and rapidly melted on the steep slope of Conglomerate Creek. The sharp V section of Conglomerate Creek favours the idea that only melt-water and not ice flowed down this creek. During the retreat of the ice from this maximum extent the large Gormanston Moraine was deposited. Till, varves and outwash at the mouth of Linda Valley indicate another retreat position of the ice.

THE AGE OF THE GLACIATION.

The authors have found no evidence to suggest more than one glacial stage in the whole of the King, Lake Dora, and Lake Margaret areas . Rather they consider that all the observed features can be explained by a single, though fluctuating, glaciation.

Lewis considered that the glaciation in Linda Valley belonged to the Malanna Stage (the oldest of his three stages) while the Hamilton Moraine belonged to the Margaret Stage (the youngest of the stages). As pointed out earlier, the Linda Glacier was a distributary of the King Glacier and the authors contend that both were contemporaneous with the Margaret Glacier (which deposited the Hamilton Moraine).

Gill (1956) has reported the result of a radiocarbon dating of wood from varves in the Gormanston Moraine as 26,480 $\pm$ 800 years. Unfortunately, the exact locality from which this wood was obtained cannot be ascertained. However, it seems possible that it came from deposits containing wood several hundred yards upstream from the Linda Hotel (see Plate iii.). The sequence of beds here suggests that a forest was flooded by a shallow lake and then covered by till during the initial advance of ice up the valley. Presumably, ice then moved over the till to reach the higher ground near Gormanston and later till and varves were deposited during the retreat of the ice.

If the wood is actually from this locality, then the dating of the initial, advancing phase of the King Glacier is 26,480 $\pm$ 800 years. This date corresponds with the beginning of the Wisconsin Glaciation of North America. The glaciation of the King Valley may then tentatively be regarded as approximately Wisconsin in age.

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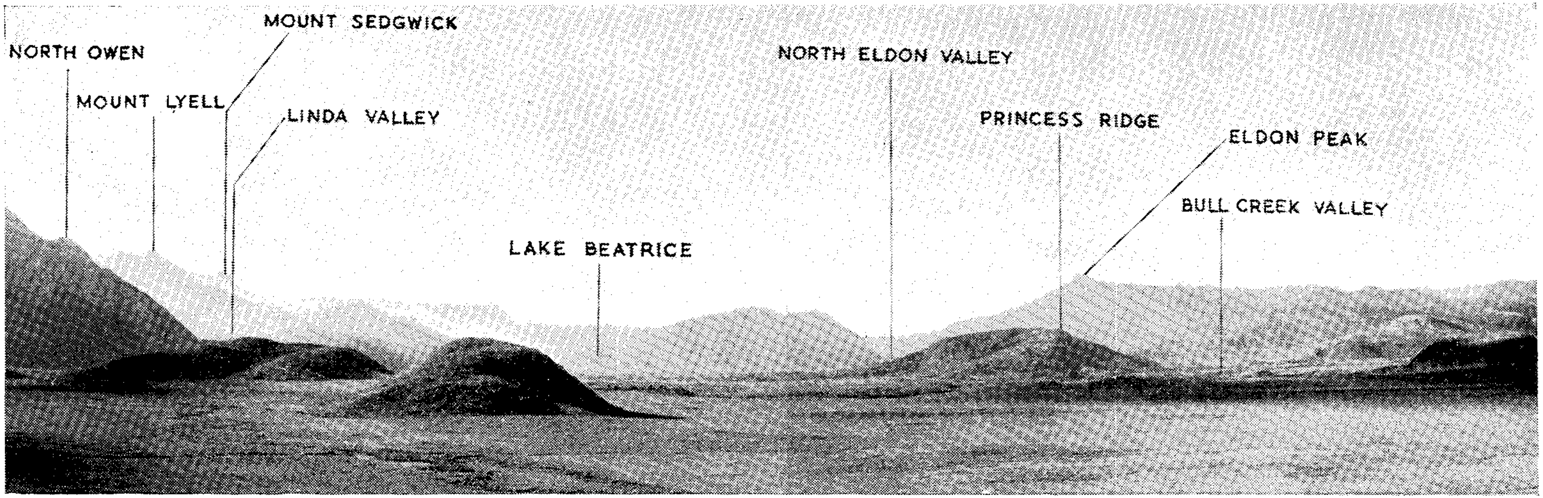
LOCALITY INDEX.

Name	*Zuadrangle*	*Latitude*	*Longitude*
Bull Creek	Lyell 58	42° 03′	145° 42′
Canning River	Murchison 51	41° 53′	145° 52′
Castle Mount	Murchison 51	41° 55′	145° 52′
Comstock Valley	Lyell 58	42° 03′	145° 38′
Conglomerate Creek	Lyell 58	42° 06′	145° 35′
Crotty Plain	Lyell 58	42° 10′	145° 39′
Crotty Track	Lyell 58	42° 07′	145° 39′
Danube Creek	Lyell 58	42° 02′	145° 50′
Eldon Bluff	Murchison 51	41° 58′	145° 51′
Eldon Peak	Murchison 51	41° 58′	145° 44′
Eldon Range	Murchison 51	41° 59′	145° 45′
Gormanston	Lyell 58	42° 04′	145° 35′
Gormanston Gap	Lyell 58	42° 04′	145° 35′
High Dome Hill	Murchison 51	41° 59′	145° 57′
King River	Strahan 57 Lyell 58	42° 04′	145° 38′
Lake Beatrice	Murchison 51	42° 00′	145° 40′
Lake Dora	Murchison 51	41° 57′	145° 38′
Lake Margaret	Zeehan 50	41° 59′	145° 34′
Lake Rolleston	Murchison 51	41° 55′	145° 37′
Lake Spicer	Murchison 51	41° 58′	145° 39′
Last Hill	Lyell 58	42° 02′	145° 48′
Linda	Lyell 58	42° 04′	145° 35′
Linda Valley	Lyell 58	42 °04′	145° 37′

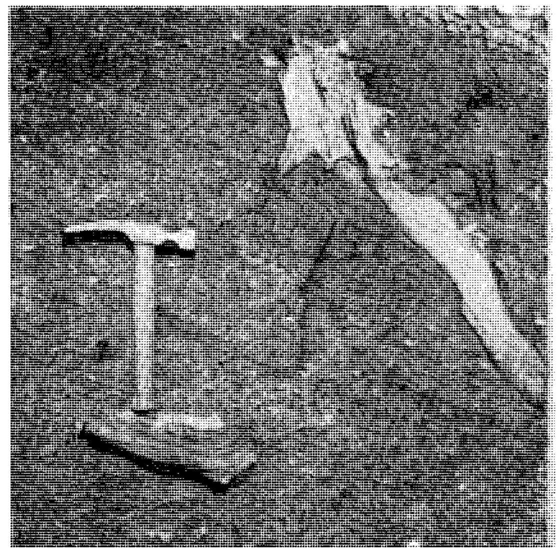
LOCALITY INDEX—*continued*

Name	*Zuadrangle*	*Latitude*	*Longitude*
Mt. Geikie	Zeehan 50	41° 58′	145° 35′
Mt. Huxley	Lyell 58	42° 07′	145° 36′
Mt. Jukes	Lyell 58	42° 11′	145° 37′
Mt. Lyell	Lyell 58	42° 03′	145° 37′
Mt. Owen	Lyell 58	42° 06′	145° 37′
Mt. Sedgwick	Lyell 58	42° 00′	145° 35′
Mt. Tyndall	Murchison 51	41° 54′	145° 33′
Murchison River	Murchison 51	41° 51′	145° 42′
Nelson River	Lyell 58	42° 07′	145° 43′
North Eldon River	Murchison 51 Lyell 58	41° 48′	145° 42′
Owen Spur	Lyell 58	42° 05′	145° 34′
Princess Ridge	Lyell 58	42° 03′	145° 42′
Princess River	Lyell 58	42° 04′	145° 41′
Princess River Bridge	Lyell 58	42° 05′	145° 40′
Princess Flats	Lyell 58	42° 05′	145° 41′
Queenstown	Lyell 58	42° 05′	145° 33′
Rocky Hill	Lyell 58	42° 03′	145° 53′
South Eldon River	Lyell 58	42° 01′	145° 43′
Thureau Hills	Lyell 58	42° 07′	145° 38′
Tyndall Range	Murchison 51	41° 57′	145° 34′
West Coast Range	Murchison 51 Lyell 58 Pillinger 65	41° 44′ 42° 18′	145° 33′ 145° 38′



(i) Northern part of King Valley, looking north from *roche moutonnée* figured in (ii).

(ii) *Roche moutonnée*, 3½ miles south of Lyell Highway along Kelly Basin Track and just north of quartzite barrier ridge. View looking east.



(iii) Wood *in situ* in soil beneath glacial outwash, bank of creek west of Linda.