

## THE DWINDLING GLACIERS OF THE UPPER RAKAIA VALLEY, CANTERBURY, NEW ZEALAND

By MAXWELL GAGE

(Department of Geology, Canterbury University College, Christchurch, N.Z.)

**ABSTRACT.** These glaciers are in a district that was seldom visited before the great expansion of recreational tramping and mountaineering in New Zealand during the past twenty years, but the record extends back for eighty-five years. During this time the chief glaciers have receded considerably but irregularly, and for one of them the records indicate a vertical downwasting and thinning. Although this glacier shows no sign yet of recovery it is fed from the same snowfield as that which supplies another glacier descending west from the main divide and which may have begun to advance. An appreciable re-advance of the Franz Josef Glacier has already been given notice in the *Journal of Glaciology*, and it may be that the steep gradients of the west-flowing glaciers of the Southern Alps enable them to respond to short-term climatic fluctuations, whereas the flatter east-flowing streams continue to shrink, in keeping with the world-wide trend.

**ZUSAMMENFASSUNG.** Diese Gletscher liegen in einer Gegend, die, vor der sich in den vergangenen 20 Jahren verbreitenden Wander- und Bergsteigerlust hierzulande, nur wenig besucht wurde, Aufzeichnungen aber reichen 85 Jahre zurück. In dieser Zeit sind die Hauptgletscher beträchtlich aber unregelmässig zurückgegangen, und für einen von ihnen ist in den Aufzeichnungen ein senkrecht Abzehren und Dünnerwerden angezeigt. Obwohl an diesem Gletscher noch kein Zeichen der Wiederherstellung festzustellen ist, wird er von demselben Schneefeld genährt, das auch einen weiteren westlich des Main Divide herunterfliessenden Gletscher versorgt, der vorzurücken begonnen haben mag. Ein bemerkenswertes Wiedervorrücken des Franz Josef Glacier ist bereits im *Journal of Glaciology* verzeichnet worden, und es mag sein, dass die steilen Gefälle der westlich fliessenden Gletscher der Southern Alps diese in stand setzen, auf kurzfristige klimatische Schwankungen zu reagieren, während die flacheren östlich fliessenden Ströme weiterhin zusammenschrumpfen, im Einklang mit der allgemeinen Neigung in dieser Richtung.

THE Lyell and Ramsay Glaciers are the northernmost valley glaciers of any magnitude in the Southern Alps,\* and are fed from an ice field on the main divide among a group of 2000–2500 metre peaks. Their combined run-off is the chief source of the Rakaia River. The glaciers are unfamiliar to tourists and much less renowned than those of the Mt. Cook region, since the best access involves a two day journey on foot for the average trumper. Although the mountains are lower, the alpine scenery is scarcely less impressive, and is well worthy of the effort in reaching this rather remote locality. The writer visited it in late December 1949 during a tramping trip from Canterbury to Westland by way of the Whitcombe Pass. Photographs and observations made on this occasion, when compared with earlier records over a span of eighty-five years, indicate marked thinning and recession of these glaciers.

### *Lyell Glacier*

Julius von Haast, one of the earliest Europeans to visit the upper reaches of the Rakaia, in 1866 published the results of topographical and geological exploration during the preceding year.<sup>1</sup> The Lyell Glacier was then about 9 km. long, reaching almost to the foot of a basal remnant of a truncated valley-side spur known as Mein's Knob and to within 800 m. of the snout of the Ramsay Glacier. A sketch of the Lyell as seen from the top of Mein's Knob does not show the freshly ice-abraded lower trough-walls below Mt. Goethe nor the relics of precariously perched lateral moraine that are noticeable to-day, yet in other respects the sketch is a remarkably detailed and faithful representation of the more permanent features. Von Haast was a keen observer, and one would not expect him to have missed these indications of ice-wasting if they had then been visible. It is inferred therefore that at least the middle and lower reaches of the glacier were about 50 m. thicker in 1865 than at present.

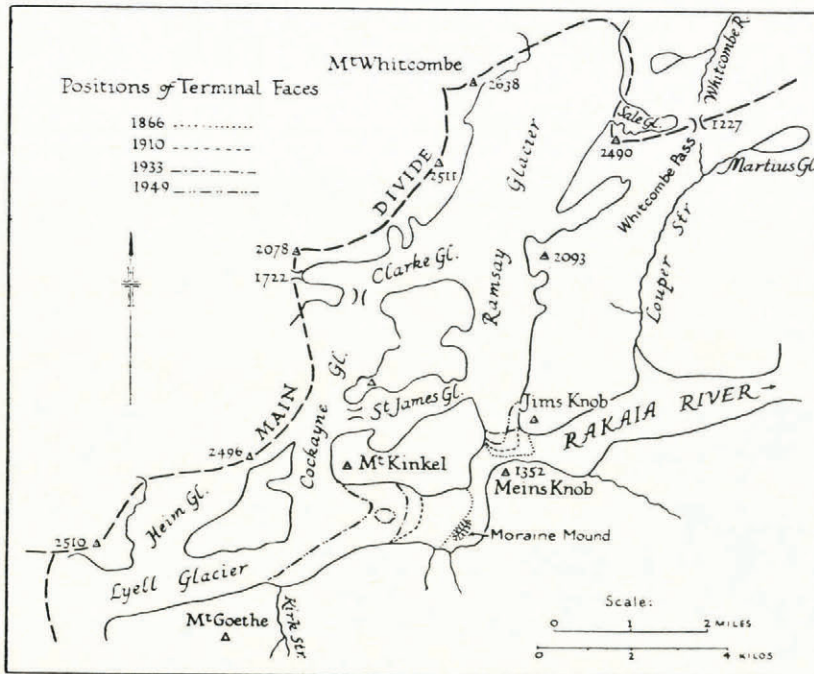
R. Speight<sup>2</sup> described the Lyell in 1911 as reaching to within 1½ miles (2.4 km.) of Mein's Knob, but this estimate is doubtful, and the correct distance was more probably 1 mile (1.6 km.),

\* A general sketch-map of the Southern Alps is shown on page 423 (Vol. 1, No. 8) of this Journal; a more detailed map of the district described is reproduced on p. 505 of the present issue. Photographs of the Lyell and Ramsay Glaciers will be found on p. 494.

which would tally with his further statement, supported by a published photograph, that the snout then stood level with a side stream entering from the south half a mile up-stream from a high morainic mound. This would mean a retreat of about 800 m. in the preceding 45 years. Speight was uncertain whether the glacier was then retreating, but he noted symptoms of collapse on the south side, and the absence of terminal moraine.

A map of the upper Rakaia region drawn in 1933 by L. Boot<sup>3</sup> shows little change in the position of the terminal face of the Lyell compared with 1911.

In 1949 the glacier terminal was irregular and ill-defined, the ice having withdrawn from both valley sides, as well as having receded several hundred metres farther up the valley. It now occupies the full width of the trough only as far down as the junction with the Cockayne tributary glacier



Plan of the upper Rakaia glaciers. (Adapted from part of a map drawn by L. Boot.) (Altitudes are indicated in metres.)

on the north and the mouth of the ice-free valley of Kirk Stream on the south. A tongue of crevassed ice extends down the centre of the valley for a few hundred metres, and at one place may be seen to rest on compacted ground moraine. Beyond lie hummocky masses of ablation moraine showing here and there faces of dirty ice that is probably separated from the glacier, protruding into a small crescentic lake enclosed within the innermost of a series of small fragmentary recessional moraine arcs. Collapse of subglacial tunnels has resulted in important recent changes in the courses of lateral melt water streams. The glacier has receded nearly two kilometres since 1865.

#### Ramsay Glacier

The Ramsay Glacier extends for 8 km. down a side valley which joins the main Rakaia trough almost at right angles, three kilometres down-stream from the present position of the Lyell terminal. Its main source is practically continuous with the Bracken Snowfield, the most northerly

extensive permanent snowfield in the Southern Alps, supplying also the Wilkinson and Evans Glaciers which descend to the west of the main divide. The lower part of the Ramsay is deeply covered in superglacial debris. In 1865 von Haast observed that its snout was thrust across the Rakaia trough to the foot of Mein's Knob, leaving a narrow gorge between opposing walls of ice and rock through which flowed the Lyell melt water. A sketch again fails to show stranded moraines, although these are conspicuous in later photographs.

Photographs taken by Speight in 1910 indicate that the terminal face had receded unevenly to distances of up to about 200 m. from the foot of Mein's Knob. Very fresh-looking stranded lateral moraines mark a lowering of the ice surface of about 20 m., and Speight was prompted to comment upon the obvious shrinkage of the lower part of the glacier. Lateral moraine on the west side up-stream from the junction of the Clarke tributary glacier was however still almost level with the glacier surface.

More recent photographs taken by W. F. Heinz show that in 1932 the downwasting was still confined to the lower half of the glacier, and that the position of the terminal face had changed little since 1910.

The snout of the Ramsay in 1949 exposed only a few square yards of dirty ice from beneath a great field of hummocky moraine. The chief melt water stream issues from an embayment in the moraine front at a distance estimated at 600 m. from the base of Mein's Knob. Perched lateral moraines overhanging the snout that were conspicuous in the 1910 photographs are now much less distinct owing to avalanche erosion and burial beneath scree, and their elevation above the general level of the glacier is increased to about 60 m. The lateral moraine up-stream from the Clarke junction is now stranded, and the glacier surface in that vicinity is lower by an amount estimated at 60 m. by comparison of 1949 with 1932 and 1910 photographs, using the height of the steep face of Mt. Whitcombe as a standard.

#### *Small Glaciers near Whitcombe Pass*

The Martius and Sale Glaciers have receded considerably since the early sixties, when von Haast described them as almost meeting on the summit of Whitcombe Pass. Mapping by Morgan<sup>4</sup> showed that they had already retreated some distance before 1906.

#### *The Wilkinson Glacier*

The Wilkinson descends west of the main divide into the Whitcombe valley, dropping 1200 m. over a horizontal distance of about 2000 m. Its upper half is virtually an ice fall. Persistent bad weather and swollen rivers encountered during the writer's visit were particularly unfortunate in that they prevented a close examination of this glacier to verify an impression that it is advancing, although fed by the same snow field that supplies the shrinking Ramsay. As seen from the junction of the Whitcombe and Wilkinson Rivers, 2.2 km. distant, a face showing a good deal of clean white ice is threatening to override an old terminal moraine which appears to stand high above the ice in earlier photographs.

#### CONCLUSIONS

The Lyell Glacier has dwindled to about three-quarters of its length in 1865, and probably has thinned throughout its length. With relatively little recession, but spectacular downwasting, the behaviour of the Ramsay resembles more closely that of the larger eastern glaciers of the Mt. Cook region (Speight<sup>6</sup>). Neither of the Rakaia glaciers suffered much nett loss or gain between 1910 and 1933, and thinning of the upper reaches of the Ramsay has been noticeable only since 1933.

The nearest weather station with records extending over a long period is at Hokitika, nearly forty miles distant. Speight<sup>7</sup> could come to no conclusion as to the cause of changes in the Franz Josef, Fox and Tasman Glaciers, but using weather information from Hokitika and Ross, R. P. Suggate<sup>8</sup> found evidence that the Franz Josef advanced and retreated in response to cumulative departures from average rainfall, combined with accumulated temperature and total annual sunshine variations, with a lag of about five years. The failure of the Ramsay to respond to the increased precipitation between 1941 and 1946, and its slight recession compared with down-wasting both point to greater importance of factors encouraging ablation at lower altitudes. If the Wilkinson, fed from the same area of alimentation as the Ramsay, is actually advancing, the difference would probably be due to its steeper gradient and more rapid flow, which would allow it to respond more readily to short-term climate fluctuations than the flatter, slower glaciers on the Canterbury side, and at the same time would make it less sensitive to changes promoting ablation.

## ACKNOWLEDGEMENT

I wish to thank Mr. J. A. Hayward for redrawing the sketch-map on page 505.

## REFERENCES

1. Haast, J. von. *Report on the headwaters of the River Rakaia*. Christchurch, N.Z., 1866.
2. Speight, R. *et al.* The Mount Arrowsmith District. *Transactions of the New Zealand Institute*, Vol. 43, 1910, p. 315-78.
3. Boot, L. Map of part of the Southern Alps. *The Canterbury Mountaineer*, Vol. 2, 1933. Frontispiece.
4. Morgan, P. G. The Geology of the Mikonui Subdivision, North Westland. *New Zealand Geological Survey, Bulletin* 6, 1908, p. 59.
5. Speight, R. The Rakaia Valley. *Transactions of the New Zealand Institute*, Vol. 63, Pt. 4, 1934, p. 457-96.
6. ——— Ice wasting and glacier retreat in New Zealand. *Journal of Geomorphology*, Vol. 3, Pt. 2, 1940, p. 131-43.
7. ——— Note on the Franz Josef Glacier. December, 1940. *Transactions of the Royal Society of New Zealand*, Vol. 71, Pt. 2, 1941, p. 131-33.
8. Suggate, R. P. Franz Josef and other glaciers of the Southern Alps. *Journal of Glaciology*, Vol. 1, No. 8, p. 422-29.

## GLACIER FLUCTUATION IN THE ITALIAN ALPS, 1949

FLUCTUATIONS in the Italian glaciers were published in the last issue of this Journal (p. 421) in an article by Professor A. Desio. Sr. M. Vanni, in the current issue of the *Bolletino del Comitato Glaciologico Italiano* (Ser. 2, No. 1, 1950, p. 103-13), gives results observed in a somewhat larger number of glaciers. These show that in 1949 out of a total of 118 glaciers 93 had receded, 28 were stationary and 2 had advanced. Professor Desio had indicated an advance in 3 glaciers—the two mentioned by Sr. Vanni and the western glacier of Monte Canin. Sr. Vanni attributes the recessions principally to light winter precipitations.

## GLACIER FLUCTUATION IN THE SWISS ALPS, 1949

GLACIER recession proceeded at an increased rate during 1949, the figures for 1948 and 1949 being :

			Advance	Stationary	Retreat
1948	..	..	13%	10%	77%
1949	..	..	5%	2%	93%

Dr. P-L. Mercanton in his able review of the subject \* points out that in the few cases of advance the glaciers were small cirque glaciers.

\* *Die Alpen*, Jahrg. 26, No. 6, 1950, p. 201-09.



*Lyell Glacier from Mein's Knob in 1949. Note recessional moraines and lake, and prominent moraine mound at left. Peaks are, from left to right: Mt. Goethe, Mt. Nicholson and Malcolm Peak (2510 m.) (see text, p. 504 et seq.)*

*Photograph by M. Gage*



*Ramsay Glacier from Mein's Knob in 1910, showing stranded lateral moraine on east side, and eastern end of terminal face in contact with Jim's Knob. Mt. Whitcombe at left*

*Photograph by R. Speight*



*Ramsay Glacier, 1949, showing further lowering of glacier surface since 1910*

*Photograph by M. Gage*