ignored by the Geological Survey under Dr. Bell and Mr. Greville in 1909, who set up their own pegs to check the terminal advance only, and nothing to check lateral variation. This neglect of previous records has left an important gap in the observations, because our cairns for lateral measurement, which were in existence up to about 1914, had disappeared by 1926.

In addition to the 1893 and 1909 observations, Professor Speight and I have made independent examinations between 1914 and 1932. These indicate a marked retreat after 1893; a rapid advance almost recovering lost ground in 1908–9; and a further retreat, which amounted to 170 ft. by 1914, increasing to about 230 yards by 1926. In thickness the ice had shrunk about 150 ft. in the centre to nearly 200 ft. at the sides between 1893 and 1926, but a big "wave" was seen coming down the glacier, which reached the terminal in 1928–29 and pushed it forward past the 1914 line and almost recovered the shrinkage in thickness. No other glacier in our alps has shown such variations.

The Fox Glacier, its close neighbour, which descends to the same low altitude as the Franz Josef, has not materially altered since 1894. Thus the variations on the latter can hardly be due to a general change in the climatic conditions. The problem presented by these two glaciers remains to be solved.

Rate of Ice-flow.—The two main factors which influence the speed by which a glacier moves down the valley are the fall per mile and the nature of the trough. The Tasman Glacier, for instance, has a fall of about 187·7 ft. to the mile from *névé* to terminal and has a shattered rock-lining to the valley, while the Franz Josef falls about 1,064 ft. to the mile in a trough of hard rockfor mation, which cannot retard its flow very seriously. The result is an enormous difference in speed. The Tasman was most carefully tested by the theodolite observations of Mr. T. N. Brodrick in 1891, and his figures show a summer movement up to 18 in. a day opposite the Ball Glacier, and up to 13·3 in. opposite Mount De la Beche the side motion varied from 2 in. to 9 in. The Murchison, Hooker, and Mueller were even less.

In 1893 Douglas and I made as careful measurements as possible across two different sections of the Franz Josef, but as these were checked by prismatic compass we can only claim them to be approximate. The results were startling. On the line 30 chains above Cape Defiance we got a maximum summer daily rate of 200 in. in the centre of the glacier. No actual side measurement was possible, owing to crevassed ice, on a line below Roberts Point 132 in. in the centre down to 5 in. on the eastern side.

These figures showed so much greater movement than is usual that we put them forward with some hesitation, but subsequent conditions on the glacier seem to indicate that they are fairly approximate. In 1909 Dr. Bell and Mr. Greville observed a line across the ice 56 chains nearer the terminal face than our No. 2 line, showing a maximum of 2 ft. in the centre; no side motion was checked. This result, when I saw it, gave me more confidence in our figures on the two lines above quoted, because Bell's figures were practically the same as we obtained at about the same point.

The great difference between our two lines and Dr. Bell's can be explained by the fact that we checked the speed at two points where the speed is obviously exceptional, whereas Dr. Bell's line was at a point where the ice has lost its fall, and its speed is undoubtedly checked by the "roches moutonnees" which extend across the valley just below.

It is difficult to believe that in thirty-seven years which have elapsed since Douglas and I explored it no attempt has been made to check our figures. One thing is clear—namely, that in such a climate the ice must of necessity travel abnormally fast to reach so low an altitude—for the terminal face of a glacier is at the point where the forward motion is counteracted by its rate of melting.

Conclusion.

The above is really a very inadequate description of the various matters of great interest to be found in these reserves. To lovers of Nature they afford an infinite variety of beauty and grandeur, for climbers there are numbers of expeditions available to suit every inclination, scientific men will find work for many years to solve such problems as the relation of *névé* to trunk in the Douglas and Balfour Glaciers, also ice-movement and its effects in the Fox and Franz Josef, and the study of past glacial action in every valley, while Dr. Cockayne has already shown what a wonderful field is here for botanists. Finally, ski-enthusiasts will find here the best snow-fields in New Zealand for their sport, whether in winter or summer.

The wisdom of setting aside this great area will be more and more realized as time goes on, and I hope I shall yet see the day when they are extended to include the whole chain from Arthur's Pass to the Sounds.

Bibliography.

The following publications deal with one or other parts of the above areas and the scientific points of interest:—

Sir Julius Von Haast's "Geology of Canterbury and Westland"; Dr. Macintosh Bell's "Wilds of Maoriland"; sundry articles in the *N.Z. Alpine Journal;* the *Alpine Journal* (London), and the Geological Survey report of 1910; N.Z. Survey Reports from 1892 to 1896; sundry papers in the "Transactions of the New Zealand Institute." My book, "Pioneer Work in the Alps of New Zealand," 1896, deals with the whole area under these reserves from every point of view.