local time was accurately determined at both by transits of Greenwich clock stars. A sidereal clock or chronometer was used at one station, a mean solar chronometer—compared with the sidereal standard before and after signalling *—at the other. At the sending station an ordinary key was used for signalling, the operator tapping his key precisely at every tenth second of his clock or chronometer with an additional tap at the fifth second of each minute as a means of identification. This was continued for seven minutes. At the receiving station the signals were sounded on a Morse instrument, and the Observer noted† and wrote down the instant of reception of each signal, to the nearest tenth of a second by his clock or chronometer. When one set had thus been sent, the direction of the signals was changed; the station which had at first received now sent. Each station of a pair thus sent and received a set of signals on each night of observation. For the determination of difference of longitude from any set of signals, the mean of all the times of transmission from the sending station (omitting the fifth-second signals), reduced to true sidereal time at place, was used, for comparison with the mean of all the times of reception of the same signals at the receiving station, reduced to true sidereal time there. The difference of these sidereal times gave one value for the difference of longitude. The signals were exchanged when practicable at about the middle time of the star observations, so that the times of transmission might coincide pretty closely with that for which the mean clock error was found by observation, thus avoiding the necessity of trusting the clock-rate for more than a very short interval.

4. The determinations of local sidereal time depend almost entirely‡ on the right ascensions of Greenwich clock-stars as derived from Greenwich Catalogues, and on the places of southern circumpolar stars furnished in Stone's and Ellery's Catalogues. Strict methods of reduction were adhered to in every case. I myself drew up the instructions and tables for use at W and A.

5. The sources of constant errors in the determinations of difference of longitude, apart from accidental errors of observation, are the following:—

(1.) Wave and armature time on the telegraph line; which, however, may be considered as eliminated by sending the signals both ways.
(2.) The personal equations of the observers in observing transit of stars; unknown.
(3.) The personal equations in tapping the key in coincidence with the clock beats; unknown.
(4.) The personal equations in receiving signals by ear; unknown.
(5.) The different qualities of the transit instruments at the several stations.
(6.) In the case of Q, the difference in the mode of recording transits and time-signals from that practised at B, Q having used a chonograph for both these purposes.

6. Signals were exchanged on four nights between B and Q; on four nights between B and W; and on three nights between B and A. The results, subject to small errors of the kinds enumerated above, are as follows:—

7. *Queenstown.*

Date.	Operators.		Resulting Diff. of Longitude.	M. S.	Time, determination by.
Nov. 25	PE at Q sends to P at B	...	Q west of B	14 32.25	D at B; PE at Q
	P at B sends to PE at Q	...	„	14 32.25	
Nov. 27	PE at Q sends to P at B	...	„	14 32.63	D at B; PE at Q
	P at B sends to PE at Q	...	„	14 32.64	
Nov. 30	PE at Q sends to P at B	...	„	14 32.81	P at B; PE at Q
	P at B sends to PE at Q	...	„	14 32.85	
Dec. 2	PE at Q sends to P at B	...	„	14 32.97	P at B; PE at Q
	P at B sends to PE at Q	...	„	14 32.94	
	Mean difference of longitude Q west of B	...	...	14 32.67	

The second result on 27th November is the mean of two sets, in which the decimals of seconds were 61s. and 67s.

8. *Wellington.*

Date.	Operators.		Resulting Diff. of Longitude.	M. S.	Time, determination by.
1874.					
Dec. 26	P at W sends to D at B	...	W east of B	9 52.96	P at W; D at B
	D at B sends to P at W	...	„	9 52.96	
Dec. 27	P at W sends to C at B	...	„	9 52.59	P at W; C at B
	C at B sends to P at W	...	„	9 52.50	
1875.					
Jan. 11	P at B sends to D at W	...	„	9 51.89	P at B; D at W
	D at W. sends to P at B	...	„	9 51.80	
Jan. 13	P at B sends to D at W	...	„	9 52.16	P at B; D at W
	D at W sends to P at B	...	„	9 52.08	
	Mean difference of longitude W east of B	...	...	9 52.37	

The discordances in this case are considerably greater than the others. I attribute this to the character of the instruments used at W. In the first place, the transit instrument had no micrometer; consequently the observations spread over a long time. I was occupied nearly two hours one night with the transit of a single circumpolar star. This necessitated a certain amount of reliance on the steadiness of rate of the chronometer employed—viz., Molyneux No. 2082; but the performance of

* Except at W, where the mean solar chronometer was itself made the standard.
† Except at Q, where the signals were recorded automatically on a chonograph.
‡ Q only used a few stars not in the list of Greenwich clock-stars, and did not directly use the Greenwich Catalogues. But the right ascensions used were in every case sensibly the same as those derivable from the Greenwich Catalogues.