APPENDIX.

SOUTH AUSTRALIA.

REPORT ON THE DETERMINATION OF THE BOUNDARY LINE OF THE COLONIES OF SOUTH AUSTRALIA AND NEW SOUTH WALES, BY CHARLES TODD, F.R.A.S., OBSERVER AND SUPERINTENDENT OF TELEGRAPHS, SOUTH AUSTRALIA.

Observatory and Telegraph Department, Office of Superintendent,
Adelaide, 14th December 1868.

SIR,

Having, in compliance with the instructions of the Government, completed the necessary astronomical observations, in conjunction with the Government Astronomer at Sydney, Mr. Smalley, for fixing the position of the common boundary line of South Australia and New South Wales, I have now the honor, herewith, to furnish a joint declaration of the same, signed by Mr. G. R. Smalley on behalf of the Government of New South Wales, and by myself on behalf of the Government of South Australia, together with the following detailed report, and map showing the exact position of the said boundary line, and the relative position, at its northern extremity, of the present boundary line of South Australia and Victoria.

By Imperial legislation the eastern boundary line of South Australia is defined to be the 141st meridian of east longitude.

The existing boundary line between South Australia and Victoria was fixed from observations made by Mr. C. J. Tyers, in 1839.

First. By triangulation with Melbourne.

Second. By chronometric measurement from Sydney.

Third. By lunar observations with sextant near the assumed boundary.

Mr. Tyers made the longitude of the Sandhill on the coast, from which the line starts, to be 141° 2′ 54″ east, or about $1\frac{1}{2}$ miles to the west of the mouth of the river Glenelg.

The observations were subsequently checked by Mr. Owen Stanley, F.R.A.S., Commander of H.M.S. *Britomart*, who made the longitude of the same Sandhill 141° 2′ 21″ east, by triangulation, and 141° 2′ 50″ by chronometer.

The line, taking the Sandhill before referred to as an initial point, was run from the coast (38° 4′ 3″ S. lat. of high water mark) to the Tatiara, or to about 36° S., in 1846–7, and continued to the Murray in 1849–50, a conical pile of stones, eight feet high, being built about $2\frac{1}{4}$ miles south of where the line strikes the river, and another pile twelve feet high, on the most elevated ground, forty-seven chains fifty links south of the river, (*vide* map appended to this report). This line was proclaimed in the *Government Gazette* of 23rd December 1847.

In the month of March last, by direction of the Government, I visited Sydney to confer with Mr. Smalley, the Government Astronomer of New South Wales, as to the best plan of giving effect to the wishes of the two Governments for defining the boundary line north of the Murray, it having been decided not to accept the line south of the river without first verifying its accuracy, inasmuch as the electric telegraph connecting the observatories of the three colonies afforded a means of determining the 141st degree of east longitude with greater accuracy than was possible when the boundary of South Australia and Victoria was adopted in 1847.

After consultation we agreed—

First. To make, with the co-operation of Mr. Ellery, the Government Astronomer of Victoria, a careful determination of the difference of longitude between the observatories at Sydney and Melbourne by means of the electric telegraph.

Second. To adopt as a basis a certain assumed longitude of the Sydney Observatory from which the boundary line should be measured, viz., the arithmetical mean of the longitude deduced from the present assumed longitude of Melbourne, the difference of longitudes having been ascertained, and that adduced by Mr. E. J. Stone, First Assistant Astronomer at the Royal Observatory, Greenwich, from observations of the moon at Sydney in 1859–60.

Third. That the personal equations between the different observers should be determined, Mr. Todd observing, for that purpose, with Messrs. Smalley and Russell, at Sydney, and with Messrs. Ellery and White, at Melbourne.

Fourth. That Mr. Todd should then proceed to the boundary and erect a transit instrument on the north of the river, near to the line of electric telegraph connecting Adelaide and Sydney, the wires being brought into the temporary observatory, and that its longitude should be determined—

a By voltaic signals exchanged with Sydney on two or more clear nights. The signals to be transits over the meridian, or rather over the several wires of the telescope, of certain stars, previously selected, observed at both places, and recorded on the Sydney chronograph.

b By voltaic signals exchanged in the same way with the Melbourne Observatory on two or more clear nights. The transits being recorded on the Melbourne chronograph.*

Fifth. That the geographical latitude of the transit instrument should then be ascertained by transits of stars over the prime vertical.

Sixth. That the longitude and latitude of the transit instrument having been determined and its distance, east or west, from the 141st meridian mutually agreed to, that distance to be carefully chained, and the boundary line so ascertained to be properly marked and run for a short length for the guidance of the surveyors. A post to be set up on the site of the transit instrument for future reference.

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* There being no convenient means of fitting up a chronograph at the boundary, the signals could be sent only one way.

With regard to articles 1 and 2, it may be well to explain that a discrepancy of about three-quarters of a mile was known to exist in the assumed longitudes of the Sydney and Melbourne observatories, and that the position of the 141st meridian would therefore differ by that much according as one or the other were taken as a basis. The agreement arrived at by Mr. Smalley and myself was to divide this difference, but before finally adopting this course we separately recommended and obtained the official concurrence of our respective Governments in the arrangement proposed.

The longitude of the Sydney Observatory, as calculated by Mr. Stone (Royal Astronomical Society's Monthly Notice for June 1867, No. 8, vol. xxvii.), viz., 10h. 4m. 47·32s., is deduced from twenty-four transits of the moon in 1859, and twenty-four in 1860, using only those observations when a transit of the moon was observed at Greenwich not differing more than 40 mins. in right ascension, and where each observation was accompanied by at least one moon culminating star common to both Sydney and Greenwich.

The resulting longitude may be considered free, therefore, from the errors in Burckhardt's lunar tables, which were somewhat large in 1859 and 1860.

Taking each limb separately, the longitude obtained was as follows :—

					h. m. s.	Weight.
1859.	From 16 observations of	1st limb	...	...	10 4 45·05	58
„	„ 8 „	2nd „	...	...	10 4 48·08	27
1860.	„ 13 „	1st „	...	...	10 4 45·81	47
„	„ 11 „	2nd „	...	...	10 4 50·05	40

Combining the two years we have—

h. m. s.		
10 4 45·39	from 29 observations of	1st limb
10 4 49·26	„ 19 „	2nd „

And the resulting longitude is 10h. 4m. 47·32s.

A rough comparison by voltaic signals with the observatory at Williamstown, in 1861, made it 10h. 4m. 50·19s., adopting the assumed longitude of Williamstown, 9h. 39m. 38·81s.

The longitude of the observatory at Williamstown, from which that of the new observatory at Melbourne was obtained by a very good triangulation, was deduced from 142 meridian transits of the moon compared with corresponding transits at Greenwich and the Cape of Good Hope, as follows :—

		h. m. s.
From 80 observations of Moon's 1st limb	... ...	9 39 38·86
„ 62 „ 2nd „	... ...	38·74

Giving weights corresponding to the number of observations, we have as the resulting longitude, 9h. 39m. 38·81s. ± 0·19s.

The difference of longitude between the old observatory at Williamstown and the new one at Melbourne was found by a careful triangulation to be 16·0 secs. ; the longitude of the latter is therefore assumed to be 9h. 39m. 54·8s.

Mr. Ellery having kindly promised his cordial co-operation, arrangements were made with Messrs. Cracknell and McGowan for the use of the telegraph wires, and on 3rd April, the night being clear at Sydney, but partially clouded at times at Melbourne, the two observatories were connected in direct circuit, and transits of fifteen stars, previously selected, were observed on both meridians and recorded on the Melbourne chronograph, Messrs. Smalley, Todd, and Russell, observing, in turn, at Sydney, and Mr. E. J. White, the Assistant Astronomer, at Melbourne.

The signals transmitted from Sydney were received by a repeater at Melbourne, the armature of which automatically repeated them to the chronograph. From several trials, Mr. Ellery found that the time lost in repeating was 0·027 secs., which has consequently been subtracted from the time by the Melbourne clock of each Sydney transit to obtain the true sidereal interval.

To eliminate the time occupied in the transmission of the voltaic signals between the two observatories, the Melbourne clock was made to transmit its beats automatically to the Sydney chronograph, where they were compared with the transit clock there.

The transits were all reduced to one observer—Mr. White—as a standard, the personal equations being determined in the following manner :—

From transits of clock stars observed by Messrs. Smalley, Russell, and Todd, on 3rd April, recorded on the Sydney chronograph, the clock at 11h. 12m. (*vide* Table III. in the Appendix) was 10·979s. slow by Mr. Smalley (S); 10·883s. by Mr. Todd (T); and 10·730s. by Mr. Russell (R). From which it appears that S sees a star on the the wire of the telescope, or observes earlier than T by 0·096s., and earlier than R. by 0·249s. Hence—

$$S-T=0\overset{s}{\cdot}096$$
$$S-R=0\cdot249$$
$$T-R=0\cdot153$$

Mr. Smalley observed with Mr. White (W) on 13th April 1867, the personal equation being—

$$S-W=0\overset{s}{\cdot}302$$

T observed with W in July 1866, and again on 12th and 14th April 1868, the personal equation being—

$$T-W=0\overset{s}{\cdot}255,\ \text{July, 1866}$$
$$=0\cdot234,\ \text{12th April 1868}$$
$$=0\cdot237,\ \text{14th April 1868}$$

For R—W we have—

$$T-W=0\overset{s}{\cdot}235\ \text{(adopted)}$$
$$\text{and } T-R=0\cdot153$$
$$\therefore R-W=0\cdot082$$

The personal equations adopted in the following calculations are—

$$S-W=0\overset{s}{\cdot}302$$
$$T-W=0\cdot235$$
$$R-W=0\cdot082$$

The following table shows the difference of longitude between Melbourne and Sydney, deduced from transits of the same stars over the two meridians recorded on the Melbourne chronograph.

DIFFERENCE of Longitude between Melbourne and Sydney.

Star.	Observer at Sydney.	Time by Melbourne Clock of: Sydney Transit.			Sydney Transit + P Equation with W.			Melbourne Transit, (Observer W.)			Sidereal Interval by Melbourne Clock.	
		H.	M.	S.	H.	M.	S.	H.	M.	S.	M.	S.
α Leonis	R	9	36	17·454	9	36	17·536	10	1	13·237	24	55·701
γ Leonis	S	9	47	38·267	9	47	38·569	10	12	34·275		55·706
ρ Leonis	T	10	0	48·414	10	0	48·649	10	25	44·377		55·728
l Leonis	R	10	17	16·029	10	17	16·111	10	42	11·888		55·777
B.A.C. 3822	S	10	38	30·692	10	38	30·994	11	3	26·456		55·462
δ Crateris	T	10	47	41·763	10	47	41·998	11	12	37·832		55·834
υ Leonis	R	11	5	8·621	11	5	8·703	11	30	4·577		55·874
β Leonis	S	11	17	16·247	11	17	16·549	11	42	12·577		56·028
B.A.C. 4046	T	11	27	46·483	11	27	46·718	11	52	42·290		55·572
B.A.C. 4088	R	11	36	29·956	11	36	30·038	12	1	25·741		55·703
β Corvi	T	12	2	25·119	12	2	25·354	12	27	21·100		55·746
γ Virginis	R	12	9	55·575	12	9	55·657	12	34	51·463		55·806
B.A.C. 4309	S	12	18	29·887	12	18	30·189	12	43	25·701		55·512
B.A.C. 4355	T	12	28	17·262	12	28	17·497	12	53	13·319		55·822
B.A.C. 4383	R	12	34	31·922	12	34	32·004	12	59	27·794		55·790

	M.	S.
	15)	11·063
Mean	24	55·738
Add for losing rate (0·71s. in 24 hours) of clock	+	·012
Add for time lost by repeating register	+	·027
Difference of longitude, less time occupied by voltaic current	24	55·777

By comparison of clocks—beats of Melbourne clock transmitted to Sydney chronograph—

	1st Comparison. H.	M.	S.	2nd Comparison. H.	M.	S.
Time by Sydney clock	9	48	53·33	11	18	53·50
Time by Melbourne clock	9	24	0·00	10	54	0·00

Each comparison being derived from the mean of several beats of the two clocks as recorded on the chronograph.

For the error of the Sydney clock by W, at these times, we have—

Time. H.	M.	Clock slow. S.	Observer.	Personal Equation with W. S.	Clock slow by W. S.
9	38	11·05	S	0·302	10·748
9	53	10·98	T	0·235	10·745
10	1	10·75	R	0·082	10·668
10	13	10·99	S	0·302	10·688
10	26	10·98	T	0·235	10·745
10	42	10·82	R	0·082	10·738
11	7	10·95	S	0·302	10·648
11	12	10·85	T	0·235	10·615
11	30	10·71	R	0·082	10·628
11	42	11·09	S	0·302	10·788
12	35	10·64	R	0·082	10·558
Mean ... 10	49	Sydney clock slow by W			10·688

The daily gaining rate of the clock was 1·50 sec. The Sydney clock was therefore slow at 1st comparison (9h. 49m.) by W 10·694 secs., and 10·685 secs. at 2nd comparison. The Melbourne clock was slow by W at the same times 8·21s. and 8·25s. respectively.

1st COMPARISON.

	H.	M.	S.	H.	M.	S.
1st Time by Sydney clock	9	48	53·330			
Clock slow by W		+	10·694			
Sidereal time at Sydney				10	49	4·024
2nd Time by Melbourne clock	9	24	0·00			
Clock slow by W...		+	8·21			
Corresponding sidereal time at Melbourne				9	24	8·210
Difference of time					24	55·814

2nd Comparison.

	H.	M.	S.	H.	M.	S.
1st Time by Sydney clock	11	18	53·50			
Clock slow by W		+	10.685			
Sidereal time at Sydney				11	19	4·185
	H.	M.	S.			
2nd Time by Melbourne clock	10	54	0·00			
Clock slow by W		+	8·25			
Corresponding sidereal time at Melbourne				10	54	8·25
Difference of time					24	55·935
Ditto (1st Comparison)					24	55·814
Mean					24	55·874

Hence—

Difference of longitude (signals transmitted from Sydney to Melbourne)	24	55·777
Ditto ditto (signals transmitted from Melbourne to Sydney)	24	55·874
Difference = twice time occupied by current		0·097

The voltaic current appears, therefore, to have taken 0·048 sec. to pass from one observatory to the other, a distance of about 540 miles, or to have had a velocity of 11,250 miles a second.

Giving twice the weight to the former of the two measurements, we have as the resulting difference of longitude between the two observatories, 24 min. 55·81 sec.

	H.	M.	S.
Difference of longitude		24	55.81
Assumed longitude of Melbourne	9	39	54·80
Longitude of Sydney referred to Melbourne	10	4	50·61
Longitude of Sydney by Mr. Stone, Royal Astronomical Society's Notices, No. 8, vol. xxvii.	10	4	47·32
Mean = adopted longitude of Sydney	10	4	48·97

I left Sydney for Adelaide on 7th April, spending a few days at Melbourne to observe with Mr. Ellery and Mr. White, and after a week's stay in Adelaide, I proceeded up the river by the steamer *Prince Alfred* from Blanchetown, accompanied by Mr. A. B. Cooper, Deputy Surveyor-General, taking with me an excellent 4-feet transit instrument, having an aperture of $2\frac{3}{4}$ inches, three chronometers, &c., and arrived at Chowilla on the evening of Friday the 1st of May.

The following day and Monday were occupied in carting instruments and camp to the boundary. A suitable site for the transit instrument was found at a distance of 25 chains 56·68 links to the west of the present boundary between South Australia and Victoria, produced north of the river, and about one-third of a mile from the line of electric telegraph, from which a short line of that length was temporarily run up to bring the wires into the observatory.

The weather being favorable, I was able to get the transit into good adjustment and everything ready for signalling by the following Saturday. And on the nights of 9th and 10th May, the sky being splendidly clear, longitude signals were exchanged with the Sydney Observatory. The circuit (about 900 miles long) was not very good, and many of the boundary transits could not be recorded on the Sydney chronograph, the adjustment being difficult, especially on Sunday night.

The following table shows the resulting difference of longitude corrected for personal equation of observers, Messrs. Smalley and Todd.

Table showing the Time by the Transit Clock at Sydney, of Transit of Stars over the meridians of the Sydney Observatory and of Station near the Boundary recorded on the Sydney Chronograph, and the observed Sidereal Interval corrected for person equation.

Date.	Star observed.	Observer at Sydney.	Observer at Boundary.	Time by Sydney Clock of— Sydney Transit.			Boundary Transit.			Sidereal Interval by Clock.	
1868.				H.	M.	S.	H.	M.	S.	M.	S.
May 9	ρ Leonis	S	T	10	25	48·98	11	6	48·99	41	0·01
„	B.A.C. 3638	„	„	10	31	0·41	11	11	59·85	40	59·44
„	B.A.C. 3926	„	„	11	26	21·03	12	7	20·77	40	59·74
„	β Leonis	„	„	11	42	17·31	12	23	17·23	40	59·92
„	B.A.C. 4015	„	„	11	46	13·38	12	27	13·01	40	59·63
„	B.A.C. 4037	„	„	11	50	20·38	12	31	20 05	40	59·67
May 10	β Leonis	„	„	11	42	15·86	12	23	15·86	41	0·00
„	B.A.C. 4015	„	„	11	46	12·21	12	27	11·70	40	59·49
„	B.A.C. 4037	„	„	11	50	19·15	12	31	18·91	40	59·76
„	θ Virginis	„	„	13	3	3·89	13	44	3·98	41	0·09
										10)	7·75
	Mean									40	59·775
	Clock's loss in 41 min.									+	·039
	Personal equation, T — S									−	·096
	Difference of longitude									40	59·718

On 13th and 14th May, signals were successfully exchanged between the boundary and Melbourne, Messrs. Cracknell and McGowan having kindly arranged to give me direct circuit with the Melbourne Observatory, *viâ* Deniliquin and Echuca, all intermediate telegraph offices being cut out. The nights were brilliantly clear at both places, and the circuit splendid.

Zenith stars were selected, nine stars being observed on 13th May and twelve on 14th May. On the second night the transit at the boundary was reversed in the middle of the series, six stars being taken with lamp east, and six with lamp west. B.A.C. 655 S. P. and B.A.C. 4790 were observed for azimuth error at the boundary on both nights, the transits being recorded on the Melbourne chronograph.

The following two tables show the resulting difference of longitude between the Melbourne Observatory and Boundary Transit, corrected for personal equation of observers (T − W = 0·235 seconds).

1868.—13th May.

Name of Star.	Time by Melbourne Clock of Transit at— Melbourne. (W)			Boundary. (T)			Difference.	
	H.	M.	S.	H.	M.	S.	M.	S.
B.A.C. 4095	12	2	41·202	12	18	45·130	16	3·928
κ' Centauri	12	16	6·755	12	32	10·495	16	3·740
B.A.C. 4253	12	30	9·946	12	46	13·538	16	3·592
B.A.C. 4309	12	42	59·341	12	59	2·893	16	3·552
B.A.C. 4355	12	52	46·975	13	8	50·580	16	3·605
B.A.C. 4417	13	4	9·745	13	20	13·283	16	3·538
ι Centauri	13	12	38·892	13	28	42·363	16	3·471
B.A.C. 4507	13	22	51·825	13	38	55·453	16	3·628
i Centauri	13	37	39·411	13	53	42·736	16	3·325
Mean							16	3·598
Personal equation, T − W							+	·235
Transmission time							−	·026
Correction for repeater							−	·027
Difference of longitude from nine stars on 13th May							16	3·780

14th May.

Name of Star.	Time by Melbourne Clock of Transit at— Melbourne. (W)			Boundary. (T)			Difference.	
	H.	M.	S.	H.	M.	S.	M.	S.
B.A.C. 4046	11	52	49·670	12	8	53·363	16	3·693
B.A.C. 4095	12	3	15·056	12	19	18·652	16	3·596
κ' Centauri	12	16	40·714	12	32	44·202	16	3·488
B.A.C. 4202	12	21	23·358	12	37	26·859	16	3·501
B.A.C. 4253	12	30	43·787	12	46	47·379	16	3·592
B.A.C. 4309	12	43	33·270	12	59	36·855	16	3·585
B.A.C. 4355	12	53	20·935	13	9	24·377	16	3·442
B.A.C. 4417	13	4	43·653	13	20	47·263	16	3·610
ι Centauri	13	13	12·724	13	29	16·173	16	3·449
B.A.C. 4507	13	23	25·709	13	39	29·386	16	3·677
i Centauri	13	38	13·185	13	54	16·999	16	3·814
k¹ Centauri	13	44	14·662	14	0	18·126	16	3·464
Mean							16	3·576
Personal equation, T − W							+	·235
Transmission time							−	·026
Correction for repeater							−	·027
Difference of longitude from twelve stars							16	3·758

Difference on 13th May = 16 m. 3·780 s., Weight 9.
Difference on 14th May = 16 m. 3·758 s., Weight 12.

Hence the difference of longitude between the observatory at Melbourne and transit near boundary, was 16 min. 3·767 sec.; and for resulting longitude of the transit instrument we have—

1st.

	H.	M.	S.
Adopted longitude of Sydney	10	4	48·97
Difference of longitude between transit and Sydney		40	59·72
Longitude of transit by signals with Sydney	9	23	49·25

2nd.

	H.	M.	S.
Difference of longitude between transit and Melbourne		16	3·77
Difference of longitude between Sydney and Melbourne		24	55·81
Sum = difference of longitude between transit and Sydney		40	59·58
Adopted longitude of Sydney	10	4	48·97
Longitude of transit by signals with Melbourne	9	23	49·39

The mean of these is 9 hours 23 min. 49·32 secs. (140° 57′ 19·8″ E.), or, giving to each determination a weight proportionate to the number of stars observed, 9 hours 23 min. 49·34 secs.

The longitude of the transit instrument actually adopted, from calculations made on the spot, and from which the boundary line was measured, was 9 hours 23 min. 49·312 secs. (140° 57′ 19·7″), which is practically the same.

To obtain the latitude the piers were shifted on 20th May and transits of stars over the prime vertical were observed on that and the following night; care being taken to have the centre of the transit instrument exactly over the same spot as before.

Only one star, No. 4603 in the British Association's catalogue, was observed on both sides of the meridian on 20th May; but on the following night B.A.C. 4437, k² Centauri, B.A.C. 4603, and B.A.C. 4916 were taken at both transits.

The adopted latitude from these, deduced at the time of transits east and west, over the middle wire only, was 33° 55′ 8″, which may be a few seconds in error, the apparent places of the stars being calculated from the British Association's catalogue, and requiring verification.

The adopted position of the transit instrument being 140° 57′ 19·7″ east longitude, and 33° 55′ 8″ south latitude, its distance due west from the 141st meridian was therefore 2 miles 44 chains 68½ links.

Mr. Smalley, on behalf of the New South Wales Government, having telegraphed to me his acceptance of this result, the distance just mentioned was carefully chained on a line due east from the centre of the transit instrument by Mr. Cooper, and subsequently, as a check, by myself.

The 141st meridian was then carefully run south to where it intersects the upper and lower tracks to Wentworth, or for nearly two miles.

A stout post, painted white, was planted on the exact site of the transit instrument, with the following painted in large black letters and figures, viz.:—

On south face of pole:

Longitude, 140° 57′ 19·7″ East. Latitude, 33° 55′ 8″ South.

On east face:

↑ C. Todd, Observer.

On north face:

Province Boundary, 2 miles 44 chains 68 links East.

On west face:

↑

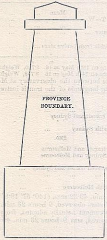
On the boundary line, where it crosses the upper and lower tracks to Wentworth, a stout white painted post was planted on each side of the two tracks, lettered on the side facing the track—

"PROVINCE BOUNDARY;"

on the east side the letters "N. S. W.;" and on the west side, "S. A."

Mr. Smalley met me, by appointment, at Wentworth last month, and proceeded with me to the boundary, where he formally accepted it, as marked on the ground, on behalf of the Government of New South Wales.

The position of the boundary thus determined from the foregoing observations, and mutually agreed to by Mr. Smalley and myself on behalf of our respective Governments, would be defined as a meridian line starting from the river Murray, 2 miles 19 chains due east of the pile of stones on the south bank of the river (mentioned in a former part of this report), marking the north end of the line at present adopted as the common boundary of South Australia and Victoria; as, however, there were no good natural landmarks we thought it better to permanently indicate the exact position of the new boundary line by a brick pyramid, 13 feet 6 inches high and 5 feet 6 inches square at the base, which we erected on the slope of the scarp (*vide* point A in accompanying map), forming the limit of the Murray floods, and immediately to the north of a circular salt lagoon (dry at the time), having the words "PROVINCE BOUNDARY" on the north and south faces; "N. S. W." "G. R. Smalley." } on the east face, and "S. A." "Charles Todd" } on the west face.



The above mark is erected a short distance up the slope of the scarp, about 77 yards from the nearest point of the line of electric telegraph, on the north side of the line. The bend of the river Murray, immediately to the east of Slaney's Island, being nearly $3\frac{1}{2}$ miles distant on an astronomical bearing of about 53° west of south; the Salt Creek public-house being 2 miles 71 chains distant, 30° east of south; and Mount Hancock bearing about $16\frac{1}{3}$° east of south.

During my stay at the boundary, Mr. Cooper assisted me in making a series of magnetic observations with a view of determining the declination of the compass, and dip.

The resulting declination at different hours of the day is shown in the following table:—

Hours of Observation.	Number of Observations.	Declination. °	′	″	
7 a.m. to 9 a.m.	6	6	31	18	east
9 „ to 11 „	7	6	34	46	„
11 „ to 12 noon	3	6	34	53	„
12 noon to 1 p.m.	3	6	37	29	„
1 p.m. to 3 „	7	6	39	32	„
3 „ to 5 „	4	6	36	3	„
5 „ to 8 „	7	6	33	15	„

Adopted mean variation, 6° 35′ 15″ east. The magnetic dip, from eleven observations between the same dates, was found to be 64° 3′ 7″.

In conclusion, I have to gratefully acknowledge the cordial manner in which Mr. Smalley, acting on behalf of the New South Wales Government, co-operated with me throughout. From both Mr. Smalley and his assistant, Mr. Russell, as well as, indeed, from Mr. Cracknell, and many other scientific friends, I received during my stay in Sydney the kindest attention. Nor should I omit to acknowledge the valuable assistance of Mr. Ellery and the Assistant Astronomer, Mr. White, whose co-operation these pages will have shown was essential to the successful completion of the work entrusted to me.

Mr. Cracknell and Mr. McGowan gave every facility for the free use of the lines of electric telegraph under their respective control. I have also to thank Mr. Cooper for his ever ready and zealous aid in the somewhat arduous labors at the boundary.

I have the honor, &c.,

CHARLES TODD,
Observer and Superintendent of Telegraphs.

The Honorable the Treasurer.

APPENDIX.

Observations for determining the Difference of Longitude between the Observatories at Sydney and Melbourne, 3rd April 1868.

Table I.—Transits observed at Sydney, and recorded on the Chronograph at the Melbourne Observatory.

Name of Star.	Concluded Transit over Seven Wires. H.	M.	S.	c. sec. δ S.	n. tan. δ S.	m. S.	Time by Melbourne Clock of true Transit at Sydney. H.	M.	S.	Observer.
ε Leonis	9	13	16·087	+ 0·893	− 0·034	+ 0·976	9	13	17·922	S
π Leonis	9	28	9·340	+ 0·823	− 0.011		9	28	11·128	T
α Leonis	9	36	15·662	+ 0·833	− 0·017		9	36	17·454	R
γ Leonis	9	47	36·450	+ 0·869	− 0·028		9	47	38·267	S
ρ Leonis	10	0	46·626	+ 0·825	− 0·013		10	0	48·414	T
l Leonis	10	17	14·239	+ 0·829	− 0·015		10	17	16·029	R
B.A.C. 3783	10	31	54·526	+ 0·951	+ 0·045		10	31	56·498	T
B.A.C. 3822	10	38	28·714	+ 0·956	+ 0·046		10	38	30·692	S
δ Leonis	10	42	0·170	+ 0·872	− 0·029		10	42	1·989	S
δ Hydræ et Crateris	10	47	39·931	+ 0·838	+ 0·018		10	47	41·763	T
υ Leonis	11	5	6·831	+ 0·813	+ 0·001		11	5	8·621	R
β Leonis	11	17	14·449	+ 0·843	− 0·021		11	17	16·247	S
B.A.C. 4046	11	27	44·467	+ 0·988	+ 0·052		11	27	46·483	T
B.A.C. 4088	11	36	27·949	+ 0·980	+ 0·051		11	36	29·956	R
β Chamæleontis	11	45	38·959	+ 4·106	+ 0·371		11	45	44·412	S
β Hydri, S.P.	11	53	37·294	− 3·910	− 0·353		11	53	34·007	S
β Corvi	12	2	23·230	+ 0·882	+ 0·031		12	2	25·119	T
γ Virginis (1st Star) ...	12	9	53·776	+ 0·813	+ 0·010		12	9	55·575	R
B.A.C. 4309	12	18	27·889	+ 0·973	+ 0·049		12	18	29·887	S
B.A.C. 4355	12	28	15·270	+ 0·968	+ 0·048		12	28	17·262	T
B.A.C. 4383	12	34	29·898	+ 0·995	+ 0·053		12	34	31·922	R

Correction to meridian $= m + c \sec. \delta + n \tan. \delta$

The collimation error $(c) = + 0·813$s. Level error $(b) = + 0·853$s.

The value of n was obtained from transits of β Chamæleontis and β Hydri S.P.

$$n = \frac{(t^1 - t) - (a^1 - a)}{\tan. \delta - \tan. \delta^1} = 0·075\text{s.}$$

Where—

t = observed time of transit of β Chamæleontis; corrected for collimation error.

t^1 = observed time of transit of β Hydri S.P.; corrected for collimation error.

a = apparent R.A. of β Chamæleontis 12h. 10m. 48·70s.*

a^1 = apparent R.A. of β Hydri 0h. 18m. 38·29s. + 12h.†

δ = apparent declination of β Chamæleontis.

δ^1 = apparent declination of β Hydri S.P.

$m = b \sec. \phi - n \tan. \phi$, where ϕ = latitude 33° 51′ 41″.

* Apparent R.A. by nautical almanac has been increased by 0·38 secs. (the Melbourne correction).

† Apparent R.A. by N.A. diminished by 0·10 secs. (the Melbourne correction).