of Good Hope —

ANNALS OF THE CAPE OBSERVATORY.

VOL. I., PART 2.

AN ACCOUNT

OF

TELEGRAPHIC LONGITUDE OPERATIONS CONNECTING ADEN AND THE CAPE OF GOOD HOPE

IN THE YEARS

1881 AND 1882.

BY DAVID GILL, LL.D., (ABERD. AND EDIN.,) F.R.S., &c.,

HER MAJESTY'S ASTRONOMER AT THE CAPE.

C.

PUBLISHED BY ORDER OF THE BOARD OF ADMIRALTY IN OBEDIENCE TO HER MAJESTY'S COMMAND.

1893, June 6.
Astronom. Observ.

ANNALS OF THE CAPE OBSERVATORY, Vol. I., Part 2.

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ERRATA.

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Page.	
[15]	Line 31. *For* Submarine signals *read* Submarine lines.
[26]	Heading. *For* Cape Hut Clock *read* Cape Clocks.
[38]	Line 7. *For* $-\frac{M_r - M_s}{2}$ *read* $+\frac{M_r - M_s}{2}$.
[42]	Line 3. *For* F *read* F_r.
[43]	Last line. *For* F *read* F_m.
[48]	Last two lines. *Transpose* the names Finlay and Pett.
[50]	Finlay sending from Sidereal Clock. *Insert* Pett recording.
[51]	Maclear sending from Sidereal Clock. *Insert* Finlay recording, and Pett recording.
[51]	Pett sending from Sidereal Clock. *Insert* Finlay recording, and Maclear recording.
[52]	Heading of first Table, column 4. *For* P *read* P_s.
[52]	Line 8 from bottom. *For* F_r *read* P_r.
[52]	Line 6 from bottom. *For* minor *read* mirror.
[55]	Table 1. *For* Jan. *read* June.
[58]	Note (2.) *Dele* at $\pm$ 0·35.
[64]	Line 11. *For* Graff Rienet *read* Graaff Reinet.
[66]	Line 4. *For* into *read* placed in.
2	No. 34. Prec. *For* 3^s·054 *read* 2^s·845.
4	No. 116. Prec. *For* 3^s·161 *read* 3^s·081.
5	No. 233. *For* $17^h\ 0^m\ 42^s$·37 *read* $17^h\ 0^m\ 42^s$·71; *for* 3^s·336 *read* 3^s·106; *for* 101° 29′ *read* 91° 29′.
36	Heading of Table 1. *For* Diurnal observation *read* Diurnal aberration.

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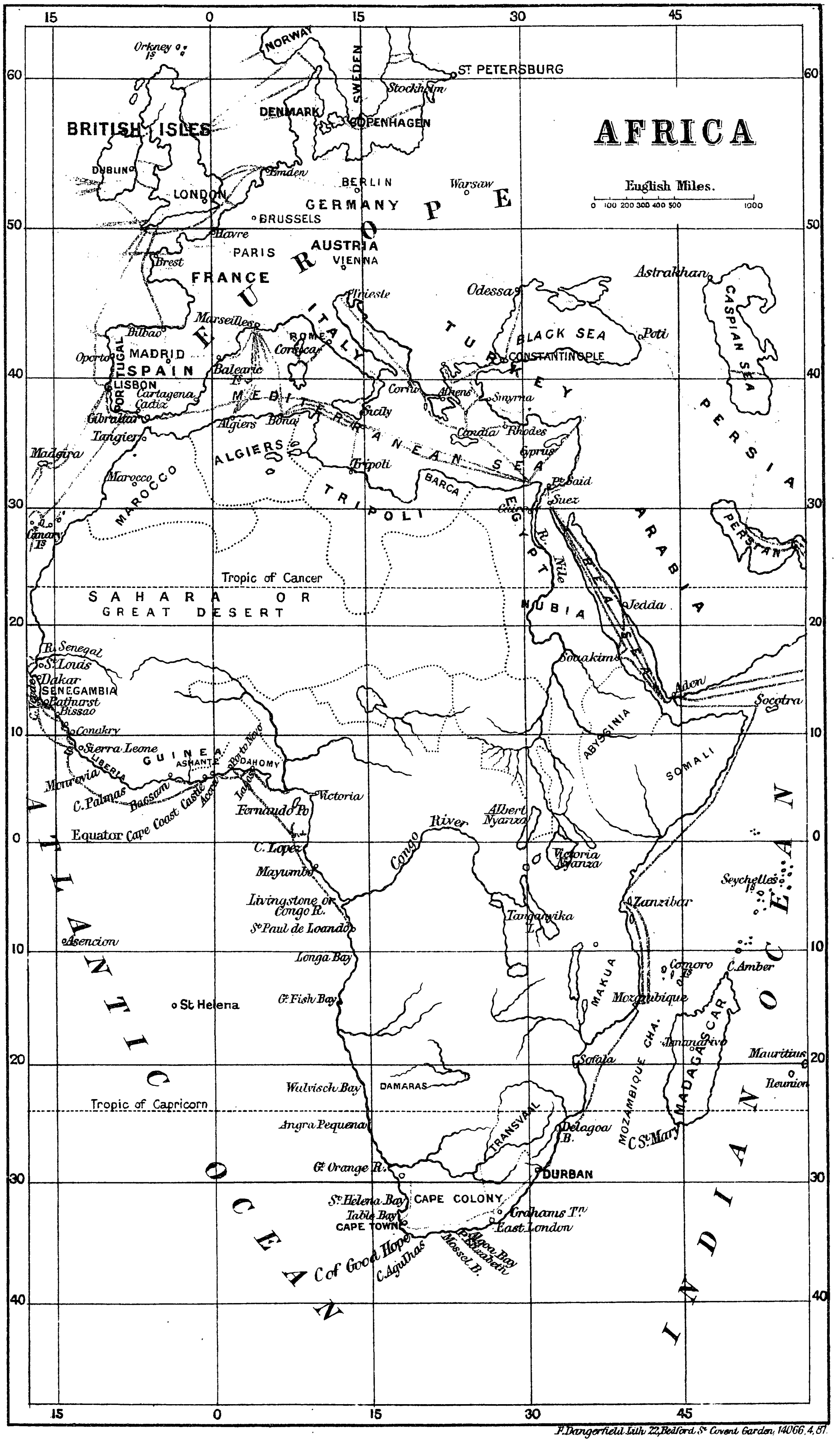
13 Reduction to Meridian. *For* 0′ 36″·9 *read* 1′ 6″·1; *for* 63′ 26″·4 *read* 63′ 16″·4. Tabular Apparent Declination of Star, *for* 38° 41′ 18″·1 *read* 38° 40′ 39″·3.


AFRICA
English Miles.
BRITISH ISLES
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LONDON
NORWAY
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COPENHAGEN
ST PETERSBURG
Stockholm
Emden
BERLIN
GERMANY
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Trieste
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CASPIAN SEA
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Poti
CONSTANTINOPLE
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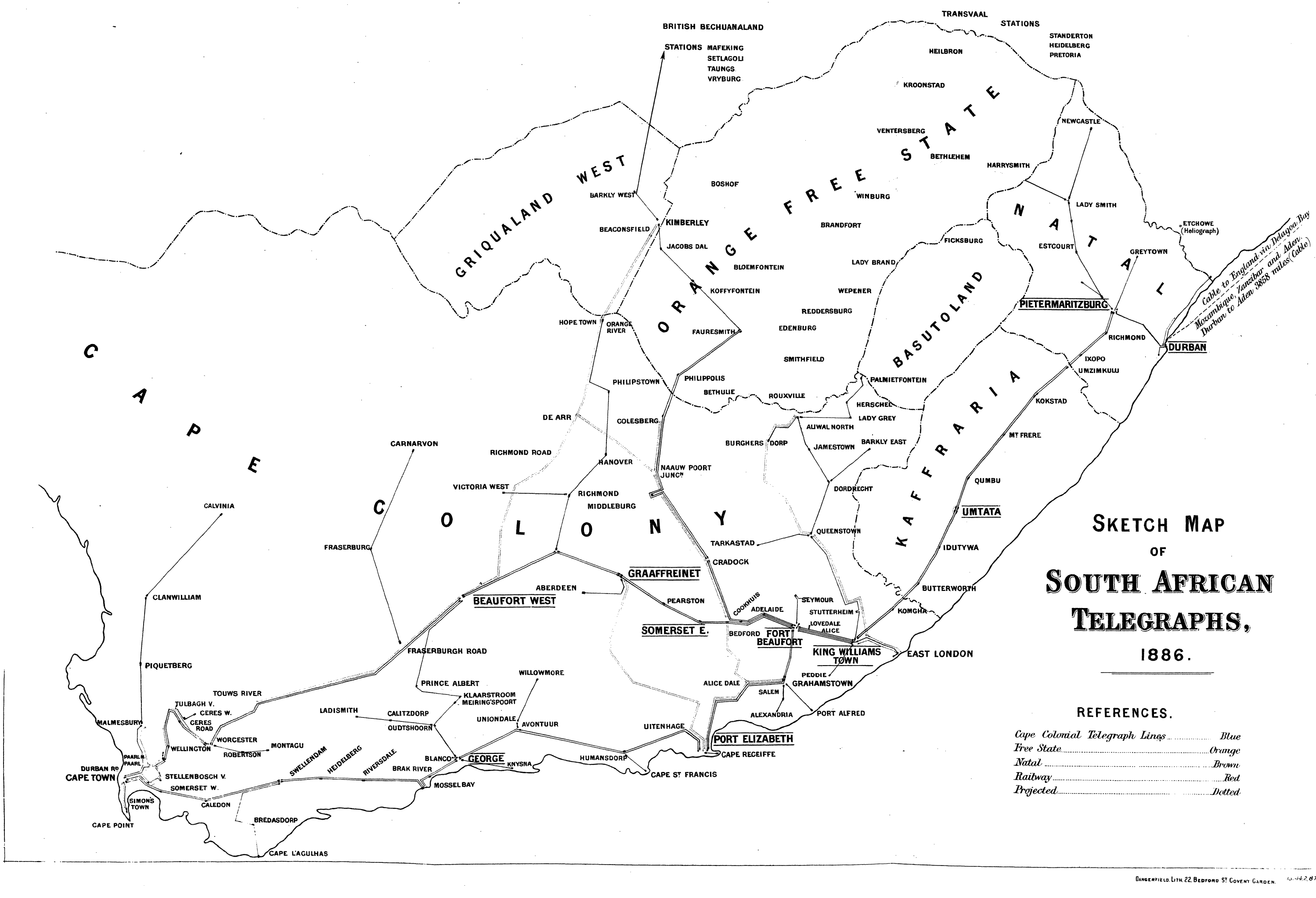
BARCA
Pt Said
Suez
Cairo
Marocco
MAROCCO
TRIPOLI
PERSIAN G.
ARABIA
Canary Is
EGYPT
R. Nile
Tropic of Cancer
SAHARA OR GREAT DESERT
NUBIA
Jedda
RED SEA
R. Senegal
St Louis
Dakar
SENEGAMBIA
Bathurst
Bissao
Souakim
Aden
Socotra
Conakry
Sierra Leone
LIBERIA
GUINEA
ASHANTI
Porto Novo
DAHOMY
ABYSSINIA
SOMALI
Monrovia
C. Palmas
Bassam
Cape Coast Castle
Accra
Lagos
Victoria
Fernando Po
Albert Nyanza
Equator
Congo River
C. Lopez
Mayumba
Victoria Nyanza
Seychelles Is
Livingstone or Congo R.
Zanzibar
St Paul de Loando
Tanganyika L.
Asencion
Longa Bay
Comoro Is
C. Amber
MAKUA
St Helena
Gt Fish Bay
Mozambique
MADAGASCAR
Tananarivo
Mauritius
Reunion
Sofala
MOZAMBIQUE CHA.
Walvisch Bay
DAMARAS
Tropic of Capricorn
Angra Pequena
TRANSVAAL
Delagoa B.
C. St Mary
Gt Orange R.
DURBAN
ATLANTIC OCEAN
St Helena Bay
CAPE COLONY
Table Bay
CAPE TOWN
Grahams Tn
East London
C of Good Hope
C. Agulhas
Mossel B.
Pt Elizabeth
Algoa Bay
INDIAN OCEAN
F. Dangerfield Lith. 22, Bedford St Covent Garden, 14066.4.81.


SKETCH MAP
OF
SOUTH AFRICAN
TELEGRAPHS,
1886.
REFERENCES.
Cape Colonial Telegraph Lines .... Blue
Free State .... Orange
Natal .... Brown
Railway .... Red
Projected .... Dotted
TRANSVAAL
STATIONS
STANDERTON
HEIDELBERG
PRETORIA
BRITISH BECHUANALAND
STATIONS MAFEKING
SETLAGOLI
TAUNGS
VRYBURG
HEILBRON
KROONSTAD
VENTERSBERG
BETHLEHEM
HARRYSMITH
NEWCASTLE
LADY SMITH
ESTCOURT
GREYTOWN
ETCHOWE (Heliograph)
Cable to England via Delagoa Bay
Mozambique, Zanzibar and Aden.
Durban to Aden 3858 miles (Cable)
PIETERMARITZBURG
RICHMOND
DURBAN
IXOPO
UMZIMKULU
KOKSTAD
MT FRERE
QUMBU
UMTATA
IDUTYWA
BUTTERWORTH
KOMGHA
EAST LONDON
GRIQUALAND WEST
ORANGE FREE STATE
NATAL
BASUTOLAND
KAFFRARIA
CAPE COLONY
BARKLY WEST
BEACONSFIELD
KIMBERLEY
JACOBS DAL
BOSHOF
WINBURG
BRANDFORT
BLOEMFONTEIN
KOFFYFONTEIN
LADY BRAND
FICKSBURG
WEPENER
REDDERSBURG
EDENBURG
FAURESMITH
SMITHFIELD
HOPE TOWN
ORANGE RIVER
PHILIPSTOWN
PHILIPPOLIS
BETHULIE
ROUXVILLE
PALMIETFONTEIN
HERSCHEL
LADY GREY
ALIWAL NORTH
BURGHERS DORP
JAMESTOWN
BARKLY EAST
DE AAR
COLESBERG
RICHMOND ROAD
HANOVER
NAAUW POORT JUNCN
CARNARVON
VICTORIA WEST
RICHMOND
MIDDLEBURG
DORDRECHT
QUEENSTOWN
TARKASTAD
CRADOCK
CALVINIA
FRASERBURG
GRAAFFREINET
ABERDEEN
BEAUFORT WEST
PEARSTON
COOKHUIS
ADELAIDE
SEYMOUR
STUTTERHEIM
LOVEDALE
ALICE
SOMERSET E.
BEDFORD
FORT BEAUFORT
KING WILLIAMS TOWN
CLANWILLIAM
PIQUETBERG
FRASERBURGH ROAD
PRINCE ALBERT
WILLOWMORE
PEDDIE
GRAHAMSTOWN
ALICE DALE
SALEM
ALEXANDRIA
PORT ALFRED
TOUWS RIVER
TULBAGH V.
CERES W.
CERES ROAD
MALMESBURY
WELLINGTON
WORCESTER
ROBERTSON
MONTAGU
LADISMITH
CALITZDORP
KLAARSTROOM
MEIRING'SPOORT
OUDTSHOORN
UNIONDALE
AVONTUUR
UITENHAGE
PORT ELIZABETH
CAPE RECEIFFE
PAARL N.
PAARL
DURBAN RD
CAPE TOWN
STELLENBOSCH V.
SOMERSET W.
SWELLENDAM
HEIDELBERG
RIVERSDALE
BRAK RIVER
BLANCO
GEORGE
KNYSNA
HUMANSDORP
CAPE ST FRANCIS
MOSSEL BAY
SIMONS TOWN
CALEDON
CAPE POINT
BREDASDORP
CAPE L'AGULHAS
DANGERFIELD. LITH. 22, BEDFORD ST COVENT GARDEN.

ANNALS OF THE CAPE OBSERVATORY.

VOL. I., PART 2

CHAPTER I.

INTRODUCTION.

THE desirability of determining the longitude of a great national Observatory with the highest accuracy need hardly be insisted upon.

In the case of the Royal Observatory at the Cape of Good Hope, many subsidiary longitudes depend upon it (especially in connexion with the Transits of Venus of 1874 and 1882), and many observations, previously made at the Cape, could not be accurately reduced till this element had been satisfactorily determined. Soon after my appointment as Her Majesty's Astronomer at the Cape of Good Hope, I received a letter from Professor Simon Newcomb, informing me that he was engaged on the completion of a new Lunar Theory, and, for the more accurate determination of the Constants of that Theory, he was anxious to secure a series of observations of occultations of Stars by the Moon at an Observatory in the Southern Hemisphere.

It gave me much pleasure, in reply, to state that not only would I undertake to make such a series of observations for several years, but that, on examining the records of the Observatory, I had found a large number of unpublished occultations made under the direction of Sir Thomas Maclear, which I would gladly reduce on a uniform system and publish with the least possible delay. To give full value to such observations, it was essential that the longitude of the Observatory should be determined with the highest possible precision, and I resolved to lose no time in arranging the necessary preliminaries.

In 1874, in conjunction with the expedition of Lord Lindsay (now Earl of Crawford and Balcarres) to Mauritius, and with Dr. Löw of the German Mauritius Transit of Venus Expedition, I had assisted in the longitude operations connecting Aden, Suez, Alexandria, Malta, and Berlin; whilst Berlin had been connected with Greenwich by several independent operations. The longitude of Aden had also been determined by the officers of the G.T. Survey of India (*Report of the G. T. Survey of India*, 1876–77), and Suez had been connected with Greenwich, viâ Mokattam (Cairo), Alexandria, and Pothcurnow, by the British Transit of Venus Expedition to Egypt in 1874 (*Account of Observations of the Transit of Venus*, 1874, by Sir George B. Airy, pp. 319–331). There was thus reasonable ground to suppose that the longitude of Aden had been determined with considerable accuracy. It therefore only remained to arrange for the telegraphic connexion of the longitudes of Aden and the Cape.

In 1879, October 6, I addressed a letter to Sir George Airy, pointing out that "before "the end of the year the Cape will probably be in telegraphic connexion with England, "and the question arises whether advantage should not be taken of this circumstance as "soon as possible, to determine the longitude of this Observatory." His encouraging reply, dated 1879, Nov. 13, was "To mention the Galvanic Determination of the longi-

" tude of the Cape of Good Hope Observatory is quite enough, the thing must be done as " soon as may be."

On 1879, December 28, the first message from England by cable to the Cape was received, and I wrote the following day to Sir George Airy, begging him to request from Sir James Anderson the use of the cable and permission to make the necessary preliminary experiments. On 1880, Feb. 12, Sir George writes, " Sir James Anderson will " be very pleased to do everything possible with the cable, Durban — Aden, and to join " up, as desired, at the intermediate stations."

It is unnecessary to follow the long subsequent correspondence, the various proposals that were discussed, and the preliminary experiments that were made. At last, having collected the necessary information, I submitted to the Admiralty (1880, June 30,) a statement of my proposed plans, together with an estimate of the probable cost of the operation.

On 1880, Sept. 20, I accepted the kind invitation of Commodore Richards, C.B. (now Admiral Sir F. Richards, K.C.B.), to accompany him, as his guest, on board H.M.S. " Boadicea " to Durban. Arrived there, I had ample opportunity of making the necessary preliminary experiments to ascertain definitively whether longitude signals could be satisfactorily exchanged between Durban and Aden without the necessity of an intermediate observer at Zanzibar. I found that this could not be done with the ordinary galvanometers in general use. In these instruments the mirror, carrying a very light magnet, is suspended in a tube filled with water. The effect of this is to make the mirror swing more slowly and steadily than if it were suspended in air, and it is found that thus the deflections, indicating letters, can be more certainly distinguished from earth currents.

But such a suspension is not favourable for longitude signals, in which the essential feature is a sharply marked commencement. This condition is best realised with Thomson's air dead-beat galvanometer. In this instrument a very light mirror is delicately suspended by a single silk fibre in an air space formed by a very short cylinder of which the ends are parallel plates of glass. The mirror is circular, of nearly the same internal diameter as the cylinder, and, being perfectly free, it deflects at first sharply, but is soon checked by the cushion of air against which it beats. Hence the name " Dead-beat Galvanometer."

It fortunately happened that there was such a galvanometer at Durban, and I found by its aid that signals sent direct from Aden could be observed with sufficient sharpness for longitude purposes. I immediately telegraphed the fact to the Admiralty.

I had also written 1880, Sept. 18, reporting my proposed visit to Durban, and pointing out that the existing contract for the Mail Service between Durban and Zanzibar expired on 1881, Feb. 9, that it would not probably be renewed, and that, unless one of H.M. gunboats was available to convey the observer from Durban to Delagoa Bay, it was essential that the operation should be sanctioned without delay.

On my return to the Cape (Oct. 15) I received authority by telegraph to proceed at once with the work. The necessary huts were built at the Observatory, a foundation at the selected site was prepared at Durban, and I only waited the arrival of the Clocks and Transit Instruments from Greenwich to begin the work.

These instruments had been the subject of considerable previous correspondence, and I did not doubt that they were now on their way to the Cape. Unfortunately this was not the case; it occurred to Sir George Airy that Alt. Azimuths might be substituted, with advantage, for Transit Instruments; this created delay. Then disturbances broke out amongst the natives of the Transkei; the land lines on the Natal border of the Cape were cut by the rebels, and on 1880, Nov. 4, Sir George Airy wrote me that he considered "the longitude enterprise was absolutely suspended for the present." I replied by return of post (1880, Nov. 27) to this letter, pointing out the extreme inconvenience of postponing the operation, or of changing methods which had been carefully considered, and for which considerable preparation had already been made in the selection and observation of stars to be employed. I urged that the Clocks, Chronometers, Transit Instruments, and Galvanometers should be placed at my disposal as soon as possible, to be tested and ready for action whenever a favourable opportunity should offer.

On 1880, Dec. 25, Sir George Airy announced, in reply, that 18 cases containing—

3 Transit Instruments,
1 Altazimuth,
3 Clocks,

had been forwarded, but, for some cause, they did not reach the Cape till 1881, March 1.

The Instruments arrived in perfect order; one Transit was erected in the Observatory grounds, a series of personal equation determinations was made, and I was about to sail for Durban on March 18, when news was received that the telegraph lines had been broken down by floods in the Transkei.

As this involved the delay of a month (because steamers only sail once a month from Durban to Delagoa Bay), I asked and obtained Admiralty permission to postpone the operation for three months, meanwhile to go to England on urgent private affairs.

When in England, I received "carte blanche" as to details, the operation to be carried out when and how I saw fit, provided only that the actual cost should not unreasonably exceed the estimated amount. The delays in starting the work had now extended nearly over the time which the whole work would have occupied, and, as I had planned for the commencement of other investigations about Midsummer, 1881, I resolved to modify the original longitude programme, and relegate to my chief assistant, Mr. Finlay, the part of chief travelling observer.

This enabled me to exercise a more efficient control over the operation as a whole, and at the same time to carry out my plans for Heliometer researches on Stellar Parallax, which would otherwise have been postponed for nearly a year. I had every confidence in the devotion and skill of Mr. Finlay, a confidence that has been amply justified by results.

In arranging the definitive programme of operations, the point I had to keep most constantly in view was the determination or elimination of personal equation. In ordinary longitude operations this is done by exchanging the observers, and such exchanges can generally be accomplished without much fear of change in the personal equation of the observers. But when, from delays and irregularities in transport, and from the great distances separating the terminal stations, the operations must extend over many months, it is by no means certain that the personal equation of the observers will remain constant, particularly when long sea voyages and great changes of climate, as well as changes in the bodily health of observers, have to be encountered. The leading idea of my plan was therefore to refer the personal equation of the travelling observers [Finlay and Maclear] to that of two stationary observers [Pett and Freeman], whose relative personal equation had remained practically constant since 1879, and which, as the event proved, remained also constant during the whole operation.

Reference to the accompanying map and the following Table will convey to the reader a clear idea of the operation as a whole. Submarine cables are shown by red lines, land wires by solid black lines.

It will be observed that the operation divided itself into two distinct parts, viz., Cape—Durban by land lines, and Durban—Aden by submarine lines.

The following Table will convey to the reader at a glance the arrangement of the observers and the plan on which the operation was actually carried out.

——	Cape.	Durban.	Aden.
1881. April and May -	Intercomparisons of personal equation by all observers.	—	
June 4–27 (1) -	Maclear - - - Pett. Freeman.	Finlay. Signals exchanged with the Cape on June 17, 21, 22, 27.	—
Aug. 6 (2)—Oct. 5	Pett - - - Freeman.	Maclear. Exchanges with Cape, Aug. 18, 19, 26, 27; Sept. 3, 19. Exchanges with Aden, Aug. 23, 26; Sept. 2, 3, 13, 18, 19, 22, 23, 26, 28.	Finlay.
Nov. 15 (1)—Dec. 7	- - - -	Finlay and Maclear. Comparison of Personal Equations, both in time determinations and in observing mirror signals.	—
1881. 1882. Dec. — Jan. -	Finlay - - - Pett. Freeman.	Maclear. Exchanges with Cape, Dec. 23; Jan. 8, 14, 20, 21, 27.	—
1882. February -	Intercomparison for personal equation by all observers.	—	—

In all the preceding observations Finlay and Maclear observed with portable Transit Instruments; Pett and Freeman with the Transit Circle.

---

(1) In the long intervals, June 27 to August 6, and October 5 to November 15, Mr. Finlay was *en route* between Durban and Aden. He availed himself of the necessary stoppages at Delagoa Bay, Quilimane, Mozambique, and Zanzibar, both going and returning from Aden, to determine the longitudes of these stations.

The reader will find an account of these operations, *Monthly Notices*, R.A.S., Vol. XLIII., p. 483. The results will also be found at the conclusion of the present work.

(2) In August I accompanied Mr. Maclear to Durban and organised the arrangements for exchange of submarine signals between Durban and Aden. So soon as all was in perfect working order, I returned to the Cape.

In the following observations both Finlay and Pett observed with portable Transits:—

1882. May -	Finlay and Pett. Comparison of Personal Equation.	—
July -	Finlay.	Pett. Exchange of signals with Cape, July 10 and 13.
December 1883. January.	Finlay and Pett. Comparison of Personal Equation.	—

The weakest point in the operation may be considered the want of exchange of observers at Aden and Durban. This was provided for in the original programme, but the cessation of regular communication between Durban and Aden, which occurred after the preparation of that programme, rendered it necessary to give up this plan, and to substitute that of determining the difference of personal equation in observing mirror signals with an additional comparison of personal equation at Durban. The result is probably not less satisfactory than if the original plan had been carried out.

CHAPTER II.

DESCRIPTION OF INSTRUMENTS AND OBSERVATORIES.

The Transits were three of five identical instruments constructed by Troughton and Simms, to the order of Sir George B. Airy, for use on the Transit of Venus Expedition of 1874; they are described in his "*Account of Observations of the Transit of Venus*, 1874, December 8, pp. 9–10.

The Transit employed at the Cape was that used at Rodriguez in 1874. It was mounted in a wooden hut 36 feet East and 373 feet South of the Cape Transit Circle, upon stone piers sent out with the instrument from England.

Time determinations at the Cape were also, as a rule, made by the fixed observers, Pett and Freeman, with the Transit Circle of the Royal Observatory (an instrument almost identical with the Greenwich Transit Circle), on nights when signals were exchanged between the Cape and Durban.

The Transit employed at Durban was that used at Honolulu in 1874. The instrument had however, at my request, been provided with a heavy cast-iron stand, to save the cost of transport and loss of time involved in the erection of heavy stone piers. This stand was bolted to a concrete pier cast *in situ* upon a wide and deep foundation of solid concrete.

The Transit employed at Aden was that used at Mokattam in 1874. It was mounted on a cast-iron stand similar to the Durban instrument, and this was bolted to a strong piece of masonry founded on the solid rock.

The methods of observation with the Cape Transit Circle are sufficiently described in the recent annual volumes of the Cape Observatory, and need not be further alluded to here.

The inclination of the axis of the portable Transits was determined throughout by means of a hanging level (furnished with a cross level) applied to the pivots. To determine the values of these levels, they were mounted on the nearly horizontal surface of the cube of the Cape Transit Circle. The inclination of this surface was then changed by a small amount in Declination, the amount of change being measured by the level and by the microscopes of the Circle. In this way the following *values of one division of the level* were obtained for each instrument:—

		div.		″	Adopted. ″
Cape Transit.—Before the Expedition,		1	=	1·280	1·300
After	,,			1·308	
Durban Transit.—Before	,,			1·400	1·400
After	,,			none	
Aden Transit.—Before	,,			0·920	0·910
After	,,			0·897	

These values do not accord very satisfactorily with the following values, determined by the makers and adopted for the reduction of the observations in connection with the Transit of Venus in 1874; viz :—

	div.	″
Cape Transit,	1 =	1·538
Durban Transit,	1 =	1·304
Aden Transit,	1 =	1·200

Still the accordance of the Cape results, and the care taken to eliminate all sources of systematic error, warrant their adoption.

The corrections for difference of diameter of the pivots were determined for each Transit. The corrections, applied to the apparent level error for inequality of pivots with Lamp West, are—

Cape Transit.	Durban Transit.	Aden Transit.
d	d	d
0·00	+ 0·22	− 0·19
	sec	sec
	(= + 0·020)	(= − 0·012)

The separate results for inclination of the axis are given in connexion with the observations at each station.

The Collimation Error at the Cape was determined by bisecting, with the Centre web, (1) cross wires in the foci of two small telescopes (mounted on piers outside the Hut), one to the North, the other to South of the Transit instrument. The Transit was then reversed, and the cross-webs of both small telescopes again bisected. The resulting reading for Geometric Collimation should be the same for reversals in front of both Collimators, the difference (apart from accidental error of observation) is due to change of azimuth in reversal, but the mean reading is free from such error.

At Durban the error of Collimation was similarly determined. A small telescope on a pier outside the Hut was used as one Collimator. A small portable Transit instrument mounted on a pier provided for carrying the Altazimuth was used by Mr. Maclear, Mr. Finlay used the telescope of the Altazimuth itself as the other Collimator.

At Aden the Altazimuth was similarly employed as a Collimator.

At Aden errors produced by change of Azimuth in reversal were guarded against by re-reversal, and if the original reading before reversal was not approximately reproduced, a second and more careful trial was made, till consistent results were obtained. It was very seldom, however, that the observation had to be repeated. The separate results of the reading for Geometric Collimation are given in connection with the observations at each station.

The values of the micrometer-screws are—

	Cape Transit.	Durban Transit.	Aden Transit.
rev.	s	s	s
1 =	3·743	3·741	3·761

derived from measures of the wire intervals in terms of the screws combined with the known wire intervals.

The Wire Intervals.—These were determined from all the complete transits of circumpolar stars observed.

(1) The transit webs of all the Transit instruments are mounted upon the slide moved by the Collimation-Micrometer-Screw.

The following are the corrections for an Equatorial Star to the centre wire "Lamp West":—

	Cape Transit.	Durban Transit.	Aden Transit.
	s	s	s
Wire I.	+ 28·604	+ 28·348	+ 28·605
II.	+ 14·257	+ 14·369	+ 14·167
III.	+ 4·764	Wanting.	Wanting.
IV.	0·000	0·000	0·000
V.	− 4·602	Wanting.	Wanting.
VI.	− 14·182	− 14·337	− 14·214
VII.	− 28·246	− 28·370	− 28·581

The corrections to the middle wire for the Durban Transit are in Mean Time, those for the Cape and Aden Transits in Sidereal Time.

The Hut Clocks.—These are all by E. Dent & Co. They are quite identical in construction, and all fitted with the well-known cylindrical zinc and steel tubular compensation pendulums constructed by that firm.

The Cape Hut Clock was bolted to a brick pillar in the observing hut. It was regulated to sidereal time.

The Durban Hut Clock was that used at Honolulu in 1874. It was mounted on a massive tripod stand of mahogany and iron which rested on three short concrete piers cast *in situ* upon the same concrete foundation on which the Transit Pier rested. This clock was regulated to Mean Time. The observer employed a pocket watch set to Sidereal Time for convenience in finding stars; but transits were observed by means of beats of the Mean Time Clock.

The Aden Hut Clock was that used at Mokattam in 1874. It was mounted similarly with the Durban Clock, the feet of its tripod resting on short piers of masonry founded on the solid rock. This clock was regulated to Sidereal Time.

The Altazimuth employed for determining the latitude of the stations at Durban and Aden is one of the three instruments of the kind made for the Transit of Venus Expedition of 1874, and described at page 18 of Sir George Airy's work above referred to. It is, in fact, the instrument employed at Honolulu; and it was afterwards employed by the Rev. Fathers Perry and Sidgreaves on the British Transit of Venus Expedition to Madagascar in 1882.

The values of the zenith-distance levels were determined as follows:—

for level *e.f.*, 1 div. = 1″·808
g.h., 1 „ = 1″·714

The Barometer employed was a mercurial travelling barometer by Negretti and Zambra. Its index error was insignificant.

The Thermometer belonged to an old set of magnetic instruments by Elliott, and required an index correction of − 0°·8.

The Huts at the Cape, Durban, and Aden were all alike built of wood on a plan furnished by Sir George Airy, which I believe was originally designed by him for the Transit instrument of Struve and Döllen erected at Greenwich in connection with the celebrated "Expédition Chronométrique" of 1843; a like model was afterwards used on the Transit of Venus Expedition of 1874. The three huts constructed at the Cape were just of sufficient size to contain the clock on its tripod, the Transit Instrument on its pier, the Altazimuth on its pier; also a shelf with the telegraph key and sounder, and at Aden and Durban an insulated pier for the dead-beat galvanometer.

The Dead-Beat Galvanometers were of the usual Thomson type. That employed at Aden was ordered from England at my request by Mr. Stacey, Telegraph Superintendent at Aden; the other was kindly lent by Mr. Carlisle, Telegraph Superintendent at Durban.

The Sounders for land-line signals were made specially at the Government Telegraph workshops in Cape Town, and each consisted of a light vertical hammer having an armature attached to its handle. A very slight current was sufficient to move the armature, and cause the hammer head to strike a metal plate with a sharp "click."

CHAPTER III.

METHODS OF OBSERVATION AND REDUCTION.

With the portable Transits a Time Determination was defined as follows :—

Step 1. Collimation Determination.
2. Level Determination with reversals and re-reversals of the level.
3. Observe Transits of 4 Time Stars; and one Circumpolar Star at upper and one at lower Transit.
4. Level—as before.

} 1st Half Determination.

5. Reverse Transit Instrument.

6. Level—as before.
7. Observe Transits of 4 Time Stars; and one Circumpolar Star at upper and one at lower Transit.
8. Level—as before.
9. Collimation Determination.

} 2nd Half Determination.

All Transits were observed by "*eye and ear*."

As the effect of collimation was eliminated by reversal in *every* complete observation, the observers did not always perform Step 9.

A complete determination of longitude was supposed to consist of such a time-determination at both stations before and after the exchange of signals, but it was found necessary to relax this condition somewhat, because of the interruptions by cloudy weather which would have unduly prolonged the operation if this condition had been invariably insisted upon.

I have, therefore, accepted all results in which there is a complete time-determination at both ends within 2 or 3 hours before or after exchange of signals. I have also accepted those cases where the stars were observed Lamp West before the signals and Lamp East after the signals, or *vice versâ*, but in such cases the clock rate has not been deduced from the observations of the same night, but from other independent sources. But in no case has any time-determination been accepted in which observations have not been made in reversed positions of the instrument.

In order that the observer should lose no opportunity of observing, the following lists of stars were prepared:—

I. A list of 389 Time Stars situated between Declination $+12°$ and $-29°$, that is, between the Zenith of Aden and Durban respectively [1], and all as far as possible about 6th magnitude.

From this list an observer could always find suitable Time Stars at every 3 or 4 minutes of R.A., so that no opportunity for observing need be lost. The places of these stars were determined by the Cape Transit Circle with, as a rule, a minimum of 6 observations of each in R.A. The resulting mean places are given in Section I., pp. 2–7.

(1) The reason for this will become evident in the discussion of the Personal Equation Determination.

II. A list of 87 Southern Circumpolar Stars was prepared, conveniently selected for the determination of Azimuth, so that the observer could find an Azimuth Star either at upper or lower culmination every 7 or 8 minutes. These stars were also observed with the Cape Transit Circle. The resulting mean places are given in Section II., pp. 10–13.

III. A list of the most suitable Northern Circumpolar Stars was also prepared for use at Aden.

The mean places of those actually employed in the operation, with the authorities on which they depend, are given in Section III., p. 16.

The *Collimation Error* (c) has been determined from the special observations for the purpose made each night. In the Tables of "Adopted Collimation" the correction for diurnal aberration has been combined with the correction for Collimation.

The *Level Error* (b) has been adopted from the observations of level before and after each half-time determination, that is, from Steps 2 and 4 or 6 and 8.

When the determinations of level before and after star observations agree closely, the mean of the two determinations corrected for difference of diameter of the pivots is adopted as the true inclination of the axis for all the stars of that half-time determination. When the difference of such determinations exceeds $1''$ of arc, the level error is interpolated for each star. In the Table of Level Errors an asterisk (*), placed between two values, denotes that the level errors applied to the observations have been interpolated, according to the time between these values.

The *Azimuth* (a) has been deduced at the Cape and Durban from the difference between the computed apparent Right Ascension of two pole stars (one in upper, one in lower transit), compared with the difference of their observed Right Ascensions when corrected only for Collimation, level, and clock rate.

It is assumed, in all cases, that the Azimuth may shift by the act of reversing the Transit; thus each half time-determination is reduced quite independently of any other.

At Aden it was not always possible, from the low altitude of the pole, to observe stars in lower transit. The Azimuth was in such cases deduced by combining the observations of pole stars with those of time stars in the usual way.

The *Clock Errors* have been deduced by application of the corresponding corrections for Collimation, Level, and Azimuth to the Transit of each star.

The clock correction Δt is then—

$\Delta t =$ Star's Tabular Apparent R.A. (1)—Clock Time of Meridian Transit.

The separate results so obtained will be found—

For the Cape Transit Circle,	Pett's	Observations,	Section IV.,	pp.	24–29.
,, ,, ,,	Freeman's	,,	,,	,,	30–33.
For the Cape Hut Clock	Finlay's	,,	Section V.	,,	36–43.
,, ,, ,,	Maclear's	,,	,,	,,	44–51.
,, ,, ,,	Pett's	,,	,,	,,	51–53.
For the Durban Hut Clock	Finlay's	,,	Section VI.	,,	56–59.
,, ,, ,,	Maclear's	,,	,,	,,	60–71.
,, ,, ,,	Pett's	,,	,,	,,	72–73.
For the Aden Hut Clock	Finlay's	,,	Section VII.	,,	76–83.

(1) At Durban a Mean Time Clock was employed, therefore, instead of "Star's Tabular Apparent R.A.," the "Tabular Mean Time of Star's Culmination" has been substituted in the expression for Δt.

To deduce the definitive value of $\triangle t$ for each half determination, the means of these separate results of the clock stars and their epochs has been separately taken for Lamp East and Lamp West. The mean of the two half determinations (without regard to the number of observations in each) has been adopted as the epoch and value of $\triangle t$ in each determination.

The clock rate is derived from observations of the previous and following day, corrected, if necessary, for systematic difference of rate by night and by day.

I have in no case employed the method of least squares. The Azimuth errors are all so strongly determined by the adopted methods, and the Azimuth factors of the Time stars so comparatively small, that no result differing more than $0^s \cdot 01$ or $0^s \cdot 02$ from the adopted values would be arrived at. Such quantities are insignificant compared with the unavoidable changes of personal equation, and would quite disappear from the mean results.

The *Sending of Signals* in coincidence with the beat of a clock is an art that is soon acquired by any experienced observer, and is capable of being performed with great accuracy, as will afterwards be proved by the results of personal equation determinations of this kind.

Signals on land lines were sent according to the following programme.

Programme.

When both ends were ready and through communication was established, the Cape observer sent a rattle at 40^s by his clock, omitted 50^s, and began sending regularly at intervals of 10^s at the even minute. This was continued for 8 minutes, and ended with a rattle a few *seconds* after the last signal. The Durban observer then sent similar signals for 15 minutes, and finally the Cape observer again for 8 minutes. The times of the first and last signals were communicated by the sending station to the other.

Signals on land lines were received according to the following programme. The reader will bear in mind that the clock in Durban (the middle station) was regulated to mean time, the clocks at the Cape and Aden to Sidereal Time.

Programme.

The time at which the click of the sounder was heard was noted (to $0^s \cdot 1$) for every signal, but special attention was paid to the signals received when nearly and quite in coincidence with the beat of the clock. When the coincidence was quite passed, the observer made a mark among his records where he judged the coincidence really to have taken place. The following is an example how this was done:—

1881, June 22nd.—Observatory sending, Durban receiving. The following observations appear in the Durban observer's book near the time of coincidence :—

h	m	s	
10	48	38·1	
		48·1	
		58·05	
	49	8·	scarcely up
		18·	up and exact
		28·	up
		38·	past, I think
		48·	past
		57·95	
	50	7·95	
		17·9	

These coincidences, marked with an arrow-head, have alone been made use of in the reductions. (1)

By this method coincidences could be estimated with very considerable accuracy.

Signals on submarine lines were sent in the same manner as those on land lines, excepting that the key was longer pressed and the cable was discharged by a reverse current, and that signals were sent at longer intervals to allow time for the mirror to become steady.

The programme of sending was as follows :—

When Aden and Durban were ready, Zanzibar joined through for 3 min. and trial signals were exchanged. This was found necessary as Aden could not talk direct to Durban. Then, if all was satisfactory, Zanzibar joined through for an hour and five minutes. Durban commenced with rapid warning signals at the following 40th sec. by Durban clock, and the first signal was sent at the following even minute. The signals were sent at intervals of 20 seconds for 15 minutes, two signals being omitted, one near the beginning, the other near the end. Aden then sent for 30 minutes, 3 signals being omitted, and Durban again sent for 15 minutes.

When Zanzibar broke in, the clock times of omitted signals were mutually communicated.

Mirror signals on Submarine signals were received according to the following programme :—

The first sensible start of the spot of light was observed in every case. The times at which this start was observed were entered for every signal, and special attention paid to those near coincidence. When the coincidence was quite passed, the observer drew an arrow among his records where he judged the coincidence to have been, as in the case of the land line signals.

(1) The arrow-head being placed between the signals $10^h\ 49^m\ 18^s$ and $10^h\ 49^m\ 28^s$, the mean of these signals is taken as the time of coincidence. When the observer places the arrow-head opposite a particular signal, that signal is adopted as the time of coincidence.

In the reductions which follow I find it convenient for future discussion to denote the effects of personal equations by symbols.

In observations for Clock Error with small Transits put—

True value of Δt = Finlay's observed value + F′
= Maclear's + M′
= Pett's + P′

In observations with the Transit Circle put—

True value of Δt = Pett's observed value + P.
= Freeman's + I.

In sending signals in coincidence with a clock-beat, put—

True Clock Time of Signals = Finlay's nominal time + F_s
= Maclear's + M_s
= Pett's + P_s

In receiving land line signals, put—

True Clock Time at which the signal arrived } = Finlay's recorded time + F_r
= Maclear's + M_r
= Pett's + P_r

In receiving mirror signals on submarine lines, put—

True Clock Time at which mirror signal arrived } = Finlay's recorded time + F_m
= Maclear's + M_m

In comparing the two sidereal clocks at the Cape by Mean Time Chronometers, put—

True value of Hut Clock Slow of Transit Clock } = Finlay's result + F_c
= Maclear's + M_c
= Pett's + P_c

CHAPTER IV.

THE RESULTS OF TIME DETERMINATIONS.

The following Tables exhibit the results of all complete Time-Determinations which enter into the Longitude Operations.

TABLE A.—TIME-DETERMINATIONS WITH THE CAPE TRANSIT CIRCLE.

Date.	1st Time Determination.		2nd Time Determination.		Mean.	
1881.	h m	s	h m	s	h m	s
April 9 - -	10 2	−89·216	12 21	−89·332	11 11	−89·274 + P.
	10 50	·005	11 53	·023	11 21	·014 + I.
April 13 - -	10 7	−92·362	10 54	−92·440	10 30	−92·401 + I.
April 14 - -	10 2	−93·462	12 23	−93·610	11 13	−93·536 + P.
	10 46	·184	11 52	·253	11 19	·219 + I.
May 12 - -	11 54	−57·550	14 18	−57·677	13 6	−57·614 + P.
	12 24	·265	13 46	·363	13 5	·314 + I.
May 20 - -	11 53	−65·463	12 59	−65·533	12 26	−65·498 + P.
May 23 - -	13 4	−68·727	13 56	−68·743	13 30	−68·735 + P.
	12 16	·410	14 55	·580	13 36	·495 + I.
June 16 - -	12 59	−32·045	18 11	−32·340	15 35	−32·193 + P.
	13 46	−31·835	18 13	·145	16 0	−31·990 + I.
June 17 - -	12 59	−32·955	18 15	−33·198	15 37	−33·077 + P.
	13 46	·843	17 17	−32·900	15 32	−32·872 + I.
June 20 - -	13 37	−35·673	18 12	−35·740	15 55	−35·707 + P.
	14 11	·535	17 18	·543	15 45	·539 + I.
June 21 - -	13 40	−36·400	20 18	−36·563	16 59	−36·482 + P.
	14 11	·253	19 15	·353	16 43	·303 + I.
June 22 - -	13 37	−37·120	18 13	−37·393	15 55	−37·257 + P.
	14 11	·005	17 18	·193	15 45	·099 + I.
June 27 - -	13 58	−42·303	18 35	−42·538	16 17	−42·421 + P.
	14 51	·118	18 12	·305	16 32	·212 + I.
August 18 - -	16 26	−32·453	21 26	−32·578	18 56	−32·516 + P.
	17 23	·240	20 19	·405	18 51	·323 + I.
August 19 - -	16 39	−33·388	22 6	−33·527	19 23	−33·458 + P.
	17 14	·205	21 29	·343	19 22	·274 + I.
August 25 - -	16 51	−38·963	20 58	−39·073	18 55	−39·018 + P.
	17 42	·736	20 43	·833	19 13	38·785 + I.
August 26 - -	16 49	−39·778	21 40	−39·973	19 15	−39·876 + P.
	17 42	·638	20 44	·793	19 14	·716 + I.
August 27 - -	17 1	−40·920	21 30	−41·115	19 16	−41·018 + P.
	17 42	·745	20 38	·900	19 10	−40·823 + I.

Date.	1st Time Determination.		2nd Time Determination.		Mean.	
1881.	h m	s	h m	s	h m	s
August 28 - -	16 35 18 10	−42·120 41·938	21 29 20 43	−42·313 ·110	19 2 19 27	−42·217 + P. ·024 + I.
September 3 -	17 36	−47·848	21 57	−48·045	19 47	−47·947 + P.
September 19 -	18 25 19 30	−63·683 ·473	23 14 21 41	−63·868 ·518	20 50 20 36	−63·776 + P. ·496 + I.
December 23 -	2 4 3 16	−40·832 ·465	7 47 7 8	−40·678 ·280	4 56 5 12	−40·755 + P. ·373 + I.
December 29 -	— —	— —	— —	— —	2 48 3 24	−38·085 + P. −37·743 + I.
December 30 -	3 45	−37·623	6 32	−37·523	5 9	−37·573 + P.
1882.						
January 8 - -	—	—	—	—	4 58	−33·918 + P.
January 9 - -	— —	— —	— —	— —	3 50 3 45	−33·496 + P. ·315 + I.
January 14 - -	—	—	—	—	3 32	−31·700 + P.
January 17 - -	3 45	−30·703	6 39	−30·668	5 12	−30·685 + P.
January 20 - -	4 13	−29·675	6 50	−29·688	5 32	−29·682 + P.
January 21 - -	4 34 5 3	−29·340 ·143	7 10 6 15	−29·314 ·138	5 52 5 39	−29·327 + P. ·141 + I.
January 26 - -	—	—	—	—	4 44	−27·696 + P.
January 27 - -	—	—	—	—	4 40	−27·510 + P.
January 28 - -	—	—	—	—	4 50	−27·108 + P.
February 13 - -	5 33 6 27	−21·948 ·720	8 30 7 30	−21·848 ·726	7 2 6 58	−21·898 + P. ·723 + I.
February 14 -	5 32 6 27	−21·598 ·315	8 30 7 33	−21·502 ·353	7 1 7 0	−21·550 + P. ·334 + I.
February 15 - -	6 27 5 33	−21·155 ·012	7 30 8 30	−21·152 ·034	6 59 7 1	−21·154 + P. ·023 + I.
February 17 -	6 27 5 33	−20·415 ·206	7 29 8 33	−20·364 ·090	6 58 7 3	−20·390 + P. ·148 + I.

TABLE B.—TIME-DETERMINATIONS with the CAPE HUT TRANSIT.

Date.	1st Time Determination.		2nd Time Determination.		Mean.	
1881.	h m	s	h m	s	h m	s
April 9 - -	—	—	—	—	11 12 11 21	−31·605 + F′. ·475 + M′.
April 13 - - -	—	—	—	—	10 30	−37·045 + M′.
April 14 - -	—	—	—	—	11 17 11 12	−37·422 + F′. ·255 + M′.

Date.	1st Time Determination.		2nd Time Determination.		Mean.	
	h m	s	h m	s	h m	s
1881.						
May 12 - -	—	—	—	—	13 5 13 5	−35·145 + F′. ·005 + M′.
May 20 - - -	—	—	—	—	12 26	−33·825 + M′.
May 23 - -	—	—	—	—	13 30 13 36	−32·825 + F′. ·730 + M′.
June 16 - - -	13 31	−23·145	18 54	−23·090	16 12	−23·118 + M′.
June 17 - -	13 39	−23·130	17 52	−23·145	15 46	−23·138 + M′.
June 20 - - -	13 54	−22·725	17 35	−22·745	15 45	−22·735 + M′.
June 21 - -	13 48	−22·575	20 28	−22·595	17 8	−22·585 + M′.
June 22 - - -	13 51	−22·305	17 43	−22·390	15 47	−22·348 + M′.
June 27 - -	—	—	—	—	13 58	−20·065 + M′.
December 23 - -	3 11	−36·110	7 48	−36·295	5 30	−36·203 + F′.
December 30 -	—	—	—	—	5 12	−42·865 + F′.
1882.						
January 17 - -	—	—	—	—	5 19	−66·430 + F′.
January 20 - -	—	—	—	—	5 38	−71·255 + F′.
January 26 - -	—	—	—	—	5 8	−22·695 + F′.
January 27 - -	—	—	—	—	5 22	−24·975 + F′.
January 28 - -	—	—	—	—	4 57	−27·135 + F′.
February 13 - -	—	—	—	—	6 58 7 2	−59·945 + F′. ·910 + M′.
February 14 -	—	—	—	—	7 2 7 0	−60·265 + F′. ·345 + M′.
February 15 - -	—	—	—	—	7 2 6 58	−62·465 + F′. ·375 + M′.
February 17 -	—	—	—	—	6 58 7 2	−66·450 + F′. ·355 + M′.
May 22 - -	—	—	—	—	12 45 12 44	−67·098 + F′. ·188 + P′.
May 27 - -	—	—	—	—	12 42 12 31	−14·364 + F′. ·274 + P′.
July 10 - - -	15 51	−78·682	19 21	−78·785	17 36	−78·734 + F′.
July 13 - -	15 44	−82·442	19 9	−82·582	17 27	−82·512 + F′.

TABLE C.—TIME DETERMINATIONS AT DURBAN.

Date.	1st Time Determination.			2nd Time Determination.			Mean.		
	h	m	s	h	m	s	h	m	s
1881. June 17	—		—	—		—	13	50	−44·243 + F′.
June 21	8	12	−35·575	14	31	−36·050	11	22	−35·813 + F′.
June 22	7	47	−38·165	12	39	−37·490	10	13	−37·828 + F′.
June 27	—		—	—		—	8	53	−32·005 + F′.
August 18	8	0	−29·135	12	7	−28·770	10	4	−28·953 + M′.
August 19	7	47	−27·725	12	44	−27·485	10	16	−27·605 + M′.
August 20	7	20	−26·485	12	25	−26·275	9	52	−26·380 + M′.
August 23	7	2	−23·360	12	25	−22·990	9	44	−23·175 + M′.
August 29	7	19	−13·400	11	31	−13·160	9	25	−13·280 + M′.
September 2	—		—	—		—	7	8	− 9·153 + M′.
September 13	—		—	—		—	7	26	−58·085 + M′.
September 18	—		—	—		—	7	18	−51·630 + M′.
September 19	7	6	−50·810	13	38	−50·540	10	22	−50·675 + M′.
September 22	7	0	−46·895	13	26	−46·437	10	13	−46·666 + M′.
September 23	7	23	−45·420	11	56	−45·337	9	39	−45·379 + M′.
September 26	7	44	−41·527	12	57	−41·315	10	21	−41·421 + M′.
September 28	—		—	—		—	7	12	−39·355 + M′.
November 20	—		—	—		—	11	50	−49·510 + F′.
	—		—	—		—	10	38	−49·318 + M′.
November 21	—		—	—		—	13	34	−49·043 + F′.
	—		—	—		—	13	24	−48·748 + M′.
November 26 (1)	—		—	—		—	12	18	−43·485 + F′.
	—		—	—		—	12	2	−43·012 + M′.
November 27 (1)	—		—	—		—	10	51	−42·333 + F′.
	—		—	—		—	10	40	−42·510 + M′.
December 23	9	23	−21·740	14	18	−21·580	11	50	−21·660 + M′.
1882. January 8	—		—	—		—	16	27	−13·595 + M′.
January 14	—		—	—		—	10	32	−10·410 + M′.
January 20	—		—	—		—	16	37	− 6·940 + M′.
January 21	—		—	—		—	10	29	− 6·712 + M′.
January 27	9	20	− 5·945	13	0	− 5·865	11	10	− 5·905 + M′.
July 10	8	19	−45·655	12	24	−45·458	10	22	−45·557 + P′.
July 13	8	25	−41·500	12	12	−41·364	10	19	−41·432 + P′.

(1) On November 26th both F. and M. observed all the stars Lamp E., and on November 27th all the stars Lamp W. It is necessary to combine these results, as, for some reason which I cannot explain, both observers appear to make systematic errors in opposite directions in the two positions of this Instrument.

TABLE D.—TIME-DETERMINATIONS AT ADEN.

Date.	1st Time Determination.		2nd Time Determination.		Mean.	
1881.	h m	s	h m	s	h m	s
August 20 - -	—	—	—	—	18 27·5	− 4·710 + F′.
August 21 - -	—	—	—	—	19 31	−20·900 + F′.
August 23 - -	—	—	—	—	19 31	−51·750 + F′.
August 26 - -	19 22	−36·860	0 45	−37·240	22 4	−37·050 + F′.
	Lamp West.		Lamp East.			
August 27 - -	18 8	−38·630	22 6	−39·030	20 7	−38·830 + F′.
August 29 - -	19 16	−42·510	23 20	−42·800	21 18	−42·655 + F′.
September 2 -	—	—	—	—	22 20	−50·035 + F′.
	Lamp East.		Lamp West.			
September 3 -	22 19	−51·86	1 31	−52·19	23 55	−52·025 + F′.
September 13 -	—	—	—	—	20 32	−46·345 + F′.
September 15 -	—	—	—	—	22 30	−45·930 + F′.
September 18 -	21 20	−45·355	2 8	−45·210	23 44	−45·283 + F′.
September 19 -	21 20	−45·075	3 3	−45·010	0 12	−45·043 + F′.
September 22 -	—	—	—	—	21 18	−44·670 + F′.
September 23 -	21 44	−44·380	1 50	−44·335	23 47	−44·358 + F′.
September 24 -	—	—	—	—	22 5	−44·155 + F′.
September 25 -	—	—	—	—	22 35	−44·065 + F′.
September 26 -	—	—	—	—	21 42	−43·850 + F′.
September 27 -	—	—	—	—	21 47	−43·670 + F′.
September 28 -	22 16	−43·470	3 15	−43·420	0 46	−43·445 + F′.

Observations for time were made at the Cape with two clocks, the Transit Clock and the Hut Clock, but all the signals were sent by and received with the Hut Clock.

The two clocks in question were therefore compared through mean time chronometers by coincident beats. Each observer, before work, compared his chronometer by coincidence with his clock, then carried the chronometer to the other clock and made two comparisons by coincidence, finally making a second comparison by his chronometer with his own clock.

These two symmetrically arranged coincidences of the chronometer with each clock by each observer were considered to give a complete comparison; a like complete comparison of the clocks was also made by each observer after the observations and exchanges.

The result of each complete comparison is given in the following Table E.

TABLE E.—RESULTS of COMPARISONS of the CAPE HUT CLOCK with the CAPE TRANSIT CLOCK by Coincident Beats of Mean Time Chronometers transported between the Clocks.

Date.	1st Comparison.		2nd Comparison.		Mean.	
	Sidereal Time.	Hut Clock Slow of Transit Clock.	Sidereal Time.	Hut Clock Slow of Transit Clock.	Sidereal Time.	Hut Clock Slow of Transit Clock.
1881.	h m	s	h m	s	h m	s
April 9 - - -	8 51	+57·845	13 42	+57·720	11 17	+57·783 + F_c
	8 53	·905	13 36	·710	11 15	·808 + M_c
	8 53	·915	13 10	·815	11 2	·865 + P_c
April 22 - -	9 56	+54·750	12 59	+54·830	11 28	+54·790 + M_c
		·805	12 35	·890	11 17	·848 + P_c
April 13 - -	—	—	—	—	9 16	+55·520 + F_c
					9 18	·490 + M_c
					8 44	·470 + P_c
April 14 - -	8 50	+56·160	12 59	+56·245	10 55	+56·203 + F_c
	9 18	·135	13 16	·200	11 17	·168 + M_c
	8 57	·125	13 10	·265	11 4	·195 + P_c
May 12 - - -	11 12	+22·395	15 19	+22·545	13 16	+22·470 + F_c
	10 35	·410	14 59	·585	12 47	·498 + M_c
	10 54	·390	14 56	·580	12 55	·485 + P_c
May 20 - - -	11 3	+31·640	13 28	+31·740	12 16	+31·690 + M_c
	10 49	·590	13 20	·765	12 5	·678 + P_c
May 23 - - -	11 40	+35·750	15 55	+36·080	13 48	+35·915 + M_c
	11 29	·785	15 36	·085	13 33	·935 + P_c
June 16 - - -	12 5	+ 8·830	19 51	+ 9·155	15 58	+ 8·993 + M_c
	12 5	·870	18 56	·163	15 31	9·017 + P_c
June 17 - - -	12 13	+ 9·695	19 47	+ 9·895	16 0	+ 9·795 + M_c
	12 3	·765	19 22	·985	15 42	·875 + P_c
June 20 - - -	12 58	+12·635	19 4	+12·975	16 1	+12·805 + M_c.
	12 41	·645	18 40	·950	15 41	·798 + P_c
June 21 - - -	12 22	+13·685	21 14	+14·065	16 48	+13·875 + M_c
	12 36	·735	20 43	·040	16 40	·888 + P_c
June 22 - - -	12 30	+14·710	19 2	+15·070	15 46	+14·890 + M_c
	12 30	·730	18 36	·025	15 33	·878 + P_c
June 27 - - -	12 35	+22·040	19 43	+22·450	16 9	+22·245 + M_c
	12 48	·085	19 28	·490	16 8	·288 + P_c
July 13 - - -	16 47	− 4·185	19 36	− 4·000	18 12	− 4·093 + M_c
	16 46	·170	19 55	− 3·930	18 21	·050 + P_c
August 18 - -	15 50	+17·335	17 50	+17·480	16 50	+17·408 + P_c
	20 11	·650	22 20	+17·785	21 16	·718 + P_c
August 19 - -	15 45	+18·965	22 18	+19·305	19 2	+19·135 + P_c
August 25 - -	15 58	+30·445	17 20	+30·565	16 39	+30·505 + P_c
August 26 - -	16 25	+32·850	17 17	+32·940	16 51	+32·895 + P_c
	18 47	33·090	22 15	33·420	20 31	+33·255 + P_c
August 27 - -	16 44	+35·320	18 44	+35·515	17 44	+35·418 + P_c
	20 58	·770	21 59	+35·820	21 29	·795 + P_c
August 28 - -	16 25	+37·580	17 42	+37·690	17 4	+37·635 + P_c
	19 34	·850	22 20	38·065	20 57	·958 + P_c

Date.	1st Comparison.		2nd Comparison.		Mean.	
	Sidereal Time.	Hut Clock Slow of Transit Clock.	Sidereal Time.	Hut Clock Slow of Transit Clock.	Sidereal Time.	Hut Clock Slow of Transit Clock.
	h m	s	h m	s	h m	s
1881. September 3	17 17	−11·800	21 58	−11·580	19 38	$-11{\cdot}690+P_c$
September 19	18 19 22 10	+ 6·745 ·920	20 24 23 45	+ 6·835 6·960	19 21 22 58	$+6{\cdot}790+P_c$ $\cdot940+P_c$
December 23	1 52 2 43	+ 4·805 ·740	8 53 8 30	+ 4·415 ·455	5 23 5 37	$+4{\cdot}610+F_c$ $\cdot598+P_c$
December 29	—	—	—	—	2 8 2 9	$-3{\cdot}485+F_c$ $\cdot500+P_c$
December 30	3 23 3 9	− 5·205 ·230	7 0 7 0	− 5·455 ·440	5 12 5 5	$-5{\cdot}330+F_c$ $\cdot335+P_c$
1882. January 8	4 39	−20·075	6 5	−20·195	5 22	$-20{\cdot}135+P_c$
January 14	2 50 2 49	−29·510 ·510	6 56 6 55	−29·795 ·825	4 53 4 52	$-29{\cdot}653+F_c$ $\cdot668+P_c$
January 17	3 59	−35·605	7 7	−35·915	5 33	$-35{\cdot}760+P_c$
January 20	3 32 3 13	−41·370 ·340	7 17 7 29	−41·650 ·665	5 25 5 21	$-41{\cdot}510+F_c$ $\cdot503+P_c$
January 21	3 56	+16·575	6 49	+16·295	5 23	$+16{\cdot}435+P_c$
January 26	3 53 4 29	+ 5·210 ·180	6 30 7 28	+ 4·930 ·845	5 12 5 59	$+5{\cdot}070+F_c$ $\cdot013+P_c$
January 27	3 57 5 3	+ 2·635 ·520	8 4 7 13	+ 2·205 ·280	6 1 6 8	$+2{\cdot}420+F_c$ $\cdot400+P_c$
February 13	5 8 5 4 4 49	−35·800 ·780 ·780	9 1 9 31 8 58	−36·280 ·265 ·225	7 5 7 18 6 54	$-36{\cdot}040+F_c$ $\cdot023+M_c$ $\cdot003+P_c$
February 14	5 2 4 56 4 45	−38·455 ·455 ·455	9 5 8 56 9 6	−38·980 ·975 ·950	7 3 6 56 6 56	$-38{\cdot}718+F_c$ $\cdot715+M_c$ $\cdot703+P_c$
February 15	4 59 4 52 4 50	−40·970 ·980 ·975	8 59 8 51 8 52	−41·380 ·415 ·390	6 59 6 52 6 51	$-41{\cdot}175+F_c$ $\cdot198+M_c$ $\cdot183+P_c$
February 17	5 14 5 0	−45·855 ·825	9 19 8 55	−46·225 ·180	7 17 6 58	$-46{\cdot}040+M_c$ $\cdot003+P_c$

From the results of Table E. we obtain the relative hourly rates of the Hut Clock to the Transit Clock during the observations. *See* Table F.

With these rates the comparisons of the different observers have been reduced to the same epoch, and we obtain the personal equation of the different observers in comparing the clocks in question as follows:—

Taking Mr. Pett as standard, that is, putting $P_c = 0$, we get—

$F_c = +0{\cdot}003$ sec., with a probable error of $\pm\cdot004$ sec. from 15 comparisons.
$M_c = +\cdot021$, „ „ $\pm\cdot005$ „ 18 „

The probable error of a single complete comparison is with—

$$F_c \pm 0{\cdot}016 \text{ sec.}$$
$$M_c \pm \cdot020.$$

Now *à priori* one would suppose it impossible that personal equation could exist in comparing two sidereal clocks with the intervention of a mean time chronometer, because, if the observer acquired a systematic habit of waiting too long for the coincidence, or *vice versâ*, that habit would probably be the same for both clocks. But it happens, in the present case, that the clocks under comparison have very different beats, that of the Transit Clock being very loud, and that of the Hut Clock quiet but sharp, and the observations give pretty certain proof that this circumstance has produced real personality. Between Finlay and Pett there is, as I should have expected, no sign of relative personal equation; of their 15 comparisons eight give a positive and seven a negative value for F_c. In the case of Maclear 13 comparisons give positive values and five negative values (the latter all very small) of M_c. We must, therefore, regard the difference in Maclear's case as real, and due to the fact that his sense of hearing is by no means so acute as that of Finlay and Pett, and I can conceive that the very marked difference in the character of the beats of the two clocks may have thus systematically affected Maclear's comparisons. I, therefore, regard Finlay and Pett as normal observers, unaffected by personality in such comparisons, but that Maclear's determinations of "Hut Clock slow on Transit Clock" require the correction $+ 0^s\cdot020$. That is, for the combinations which occur in Table E, the corrections to "Hut Clock slow of Transit Clock" will be—

$$\frac{F_c + M_c + P_c}{3} = +\overset{\text{sec.}}{0\cdot007}.$$

$$\frac{F_c + P_c}{2} = \quad \cdot000.$$

$$\frac{M_c + P_c}{2} = \quad \cdot010.$$

$$P_c = \quad \cdot000.$$

Applying these corrections to the mean results of Table E., we get the following errors of the Cape Hut Clock on the Transit Clock at the mean epoch of the comparisons:—

TABLE F.—DEFINITIVE ERRORS of the CAPE HUT CLOCK relative to the TRANSIT CLOCK.

	Date.	Sidereal Time.	Hut Clock slow of Transit Clock.	Relative Hourly Rates of Hut Clock slow on Transit Clock from Comparisons on same Night.	
	1881.	h m	s	s	
	April 9 - -	11 11	+57·826	−·030	
	12 - -	11 22·5	+54·829	+·030	
	13 - -	9 6	+55·500	[+·027]	
	14 - -	11 5	+56·196	+·024	
	May 12 - -	12 59	+22·491	+·041	
	20 - -	12 10·5	+31·694	+·055	
	23 - -	13 40·5	+35·935	+·076	
	June 16 - -	15 44·5	+ 9·015	+·043	
	17 - -	15 51	+ 9·845	+·029	

Date.	Sidereal Time.	Hut Clock slow of Transit Clock.	Relative Hourly Rates of Hut Clock slow on Transit Clock from Comparisons on same Night.
1881.	h m	s	s
June 20 - -	15 51	+12·812	+·054
21 - -	16 44	+13·892	+·041
22 - -	15 39·5	+14·894	+·052
27 - -	16 8·5	+22·277	+·060
July 13 - -	18 16·5	− 4·082	+·071
Aug. 18 - -	19 3	+17·563	+·069
19 - -	19 2	+19·135	+·053
25 - -	16 39	+30·505	+·088
26 - -	18 41	+33·075	+·096
27 - -	19 36·5	+35·607	+·100
28 - -	19 0·5	+37·797	+·083
Sept. 3 - -	19 38	−11·690	+·047
19 - -	21 9·5	+ 6·865	+·041
Dec. 23 - -	5 30	+ 4·604	−·053
29 - -	2 8·5	− 3·493	[−·059]
30 - -	5 8·5	− 5·333	−·062
1882.			
Jan. 8 - -	5 22	−20·135	[−·068]
14 - -	4 52·5	−29·661	−·073
17 - -	5 33	−35·760	−·098
20 - -	5 23	−41·507	−·074
21 - -	5 23	+16·435	−·096
26 - -	5 35·5	+ 5·042	−·111
27 - -	6 4·5	+ 2·410	−·107
Feb. 13 - -	7 6	−36·029	−·114
14 - -	6 58	−38·719	−·125
15 - -	6 54	−41·192	−·105
17 - -	7 7·5	−46·032	−·092

CHAPTER V.

FORMATION OF DEFINITIVE CLOCK ERRORS AND RATES.

The Cape Hut Clock.

To determine definitively the rate of the Cape Transit Clock at the various times of observation, the following table has been prepared.

The column marked R_d is the hourly rate as it is usually deduced, viz., by taking for a particular night the mean hourly rate derived from observations on the preceding and following night. In deducing these rates, the personal equation of the observers has been taken into account, and when observations have not been secured for purposes of the longitude on successive days the rates of column R_d are taken from the Observatory Clock Book as deduced from the routine observations.

Columns R_p and R_i give the hourly rate derived from observations of the same night by the observers P and I respectively.

Column R_n gives the definitive rate deduced by combining the observations of P and I, weight being given to the separate results in proportion to the square of the interval between the first and second time determinations of each observer.

Column ϵ_n gives the *mean error* of the determination of the clock rate on each night.

Column $R_n - R_d$ gives the correction which the results for clock hourly rates reckoned from day to day require to reduce them to the hourly rate during the night.

The values of ϵ_n may be deduced by various methods.

(1.) From the discordance of the clock errors determined by the two observers on the same night, allowance being made for their difference of personal equation.

(2.) From the discordance of the separate clock errors derived from the different time stars observed by the same observer.

(3.) From the discordance of the clock rates determined by the two observers.

The *first* of these methods is liable to the objection that, although the personal equation remains pretty constant during one night, it somewhat varies from night to night, and we should probably arrive at too small a value of ϵ_n. By the *second* method we should probably arrive at too small a value of ϵ, because a sensible part of the error of determination of Azimuth, Level and Collimation will remain common to all the stars. The *third* method, though more troublesome, is free from these objections; I have, therefore, employed it as follows. Put—

ϵ = the *mean error* of a normal time determination (*i.e.*, from four time stars with independent determinations of Azimuth, Level and Collimation).

t = the number of hours between the epochs of first and second time determination of the same observer on the same night.

m = the discordance between the clock rates determined by two observers.

Then the *mean error* of the hourly rate of a clock derived from two such time determinations, an hour apart, by one observer is—

$$\pm \sqrt{2}\, \epsilon,$$

or, if the interval between the observations is t hours, the *mean error* of the rate is—

$$\pm \frac{\sqrt{2}\, \epsilon}{t}.$$

Hence, if there are two observers whose mean errors for a time determination are $\epsilon_{,}$ and $\epsilon_{,,}$, and if they have both determined the rate of the same clock for the same epoch, each by two time determinations, separated by $t_{,}$ and $t_{,,}$ hours, we have in the mean—

$$\frac{2\epsilon_{,}^2}{t_{,}^2} + \frac{2\epsilon_{,,}^2}{t_{,,}^2} = m^2,$$

and if we put $\epsilon_{,}^2 = \epsilon_{,,}^2$, which is practically true for Pett and Freeman, we have—

$$\epsilon^2 = \frac{1}{2} m^2 \frac{t_{,}^2\, t_{,,}^2}{t_{,}^2 + t_{,,}^2},$$

of which the weight of each equation is $(t_{,}^2 + t_{,,}^2)$; whence in the usual notation of least squares—

$$\left[(t_{,}^2 + t_{,,}^2)\, \epsilon^2\right] = \left[\frac{1}{2} m^2 \,.\, t_{,}^2\, t_{,,}^2\right] \quad \text{- - - - - - - - -} \quad (1),$$

and the theoretical *mean error* of each observed clock rate is for two observers—

$$\left.\begin{aligned} \epsilon_n &= \frac{\epsilon}{t_0}, \\ \text{where } t_0 &= \sqrt{t_{,}^2 + t_{,,}^2}, \end{aligned}\right\} \quad \text{- - - - - - - - - - - -} \quad (2).$$

By application of Equation (1) to the data of Table A., I find—

$$\epsilon = \pm \overset{\text{sec.}}{0{\cdot}031},$$

or, taking the table in four separate groups, we have—

For Group I.	ϵ	$= \pm$ ·030. (sec.)
„ II.		$= \pm$ ·029.
„ III.		$= \pm$ ·030.
„ IV.		$= \pm$ ·034.

These quantities are practically identical, and show the constancy of the quality of the observers' work; and also that the *probable error* of a time determination by four stars with the Cape Transit Circle, including also the error of the star places and the errors of the determination of the instrumental constants, is for Pett and Freeman $= \pm 0^s{\cdot}021$.

Rates of the Cape Transit Clock.

Note.—(The length of the pendulum was altered in October.)

	——	R_d.	R_p.	R_i.	R_n.	$R_n - R_d$.	ϵ_n.
	1881.	s	s	s	s	s	s
Group I.	April 9	−·039	−·050	−·017	−·044	−·005	±·017
	April 12	−·034					
	April 13	−·033	−·100		−·100	−·067	·056
	April 14	−·036	−·063	−·063	−·063	−·027	·016
	May 12	−·042	−·053	−·072	−·058	−·016	·016
	May 20	−·044	−·063		−·063	−·019	·040
	May 23	−·046	−·018	−·064	−·060	−·014	·016
Group II.	June 16	−·036	−·057	−·069	−·062	−·026	·007
	June 17	−·037	−·046	−·016	−·037	·000	·007
	June 20	−·034	−·015	−·004	−·011	+·023	·008
	June 21	−·033	−·025	−·020	−·023	+·010	·005
	June 22	−·032	−·060	−·060	−·060	−·028	·008
	June 27	−·038	−·051	−·056	−·053	−·015	·008
Group III.	August 18	−·038	−·025	−·056	−·033	+·003	·008
	August 19	−·040	−·026	−·032	−·028	+·012	·006
	August 25	−·037	−·027	−·032	−·029	+·008	·009
	August 26	−·042	−·040	−·051	−·043	−·001	·008
	August 27	−·049	−·044	−·053	−·046	+·003	·008
	August 28	−·044	−·040	−·067	−·045	−·001	·007
	September 3	−·046	−·045		−·045	+·001	·008
	September 19	−·035	−·038	−·021	−·035	·000	·008
Group IV.	December 23	+·023	+·027	+·048	+·033	+·010	·006
	December 29	+·018					
	December 30	+·018	+·036		+·036	+·018	·016
	1882.						
	January 8	+·017					
	January 9	+0·17					
	January 14	+0·15					
	January 17	+·013	+·012		−·012	+·001	·013
	January 20	+·015	−·015		−·015	−·030	·017
	January 21	+·011	+·010	+·003	+·009	−·002	·016
	January 26	+·011					

Rates of the Cape Transit Clock—*cont.*

NOTE.—(The length of the pendulum was altered in October.)

—		R_d.	R_p.	R_i.	R_n.	$R_n - R_d$.	ϵ_n.
	1882.	s	s	s	s	s	s
Group IV.—*cont.*	January 27	+·013					
	January 28	+·015					
	February 13	+·015	+·034	−·006	+·030	+·015	±·015
	February 14	+·015	+·032	−·035	+·024	+·009	·014
	February 15	+·016	+·002	−·007	−·006	−·022	·014
	February 17	+·017	+·048	+·039	+·040	+·023	·015

Giving to the separate values of $R_n - R_d$ the weights $\frac{1}{\epsilon_n^2}$ from the above table, we find that the correction of the rate reckoned from day to day to reduce it to the rate determined from the observations at night amounts in the mean to—

$$+ \overset{\text{sec.}}{0{\cdot}0016},$$

a quantity totally insignificant.

If we divide the results into four groups, we obtain the like corrections as in Column I. of the following Table :—

—	I. Correction of Daily Rate.	II. Mean Value of $(R_n - R_d)^2$.	III. Mean Value of ϵ_n^2.	IV. Mean Daily Range of Temperature.	V. Correction of Temperature at 10^h to Mean Daily Temperature.
	s			°	°
Group I.	−·016	·001026	·000966	8·6 F.	+2·2 F.
Group II.	·000	386	53	8·2	+1·1
Group III.	+·004	29	61	8·0	+1·5
Group IV.	+·005	294	205	10·3	+2·8

We have now to consider, with the evidence of Columns II. and III., and also having regard to the temperature conditions given in Columns IV. and V., whether the corrections given in Column I. are real or apparent.

If the quantities of Column II. were systematically greater than those of Column III., we should have evidence that the rates determined from the observations at night are systematically more reliable than those from the daily rate; but in Groups II. and III., which have by far the greatest weight, the evidence is contradictory, nor is it by any means pronounced in Groups I. and IV. We also see from the comparison of the apparent systematic corrections with the temperature conditions that there is no cause to account for the discordant values of Column I.; those corrections may therefore be considered as due merely to accidental errors of observation.

The conclusion is that the rate of the Cape Transit Circle clock is not sensibly affected by change of temperature, and we shall therefore derive a more accurate value of its rate by adopting that obtained from the observations of one day and the next than by employing that derived from observations of the same night.

The definitive rate of the Transit Clock by night or day is therefore to be taken from the column R_d of the preceding Table.

The relative rate of the Hut Clock to the Transit Clock given in Table F., applied to the rate R_d, gives the hourly rate of the Hut Clock. See Column V. of the Table G.

Column II. of Table G. gives the errors of the Cape Hut Clock from observations with the Transit Circle combined with Chronometer Comparisons of the clocks (*i.e.*, combining the results of Table A. and Table F.).

Column III. gives the errors of the same clock, derived from observations with the Hut Transit, the results being corrected by $-^{s}{\cdot}028$ to reduce to the longitude of the Transit Circle.

The mean hourly rate from day to day given in Column IV. has been obtained by combining the determinations by both instruments with equal weight, and correcting for the personal equation of the observers by approximately known values of F′, M′, P, and I.

The rates of Column V. have been adopted as definitive.

TABLE G.—DEFINITIVE ERRORS and HOURLY RATES of the CAPE HUT CLOCK.

Date.	I. Sidereal Time.	II. Clock Slow from Observations with the Transit Circle. Δt	III. Clock Slow from Observations with the Hut Transit. Δt	IV. Hourly Rates. Day to Day.	V. Hourly Rates. From the Chronometer Comparisons.
1881.	h m	s	s	s	s
April 9	11 16	$-31{\cdot}321 + \frac{P}{2} + \frac{I}{2}$	$-31{\cdot}568 + \frac{F'}{2} + \frac{M'}{2}$		$-{\cdot}069$
„ 13	10 30	$-36{\cdot}863 + I$	$-37{\cdot}073 + M'$		$-{\cdot}006$
„ 14	11 14	$-37{\cdot}178 + \frac{P}{2} + \frac{I}{2}$	$-37{\cdot}367 + \frac{F'}{2} + \frac{M'}{2}$		$-{\cdot}012$
May 12	13 5	$-34{\cdot}968 + \frac{P}{2} + \frac{I}{2}$	$-35{\cdot}103 + \frac{F'}{2} + \frac{M'}{2}$		$-{\cdot}001$
„ 20	12 26	$-33{\cdot}790 + P$	$-33{\cdot}853 + M'$	$+{\cdot}007$	$+{\cdot}011$
„ 23	13 33	$-32{\cdot}689 + \frac{P}{2} + \frac{I}{2}$	$-32{\cdot}806 + \frac{F'}{2} + \frac{M'}{2}$	$+{\cdot}014$	$+{\cdot}030$
June 16	16 12	$-23{\cdot}071 + \frac{P}{2} + \frac{I}{2}$	$-23{\cdot}146 + M'$		$+{\cdot}007$
				$-{\cdot}002$	
„ 17	15 36	$-23{\cdot}140 + \frac{P}{2} + \frac{I}{2}$	$-23{\cdot}166 + M'$		$-{\cdot}008$
				$+{\cdot}005$	
„ 20	15 45	$-22{\cdot}814 + \frac{P}{2} + \frac{I}{2}$	$-22{\cdot}763 + M'$		$+{\cdot}020$
				$+{\cdot}009$	

Date.	I. Sidereal Time.	II. Clock Slow from Observations with the Transit Circle. Δt	III. Clock Slow from Observations with the Hut Transit. Δt	IV. Hourly Rates. Day to Day.	V. Hourly Rates. From the Chronometer Comparisons.
	h m	s	s	s	s
1881. June 21	17 8	$-22{\cdot}495 + \frac{P}{2} + \frac{I}{2}$	$-22{\cdot}613 + M'$		+·008
				+·010	
„ 22	15 47	$-22{\cdot}276 + \frac{P}{2} + \frac{I}{2}$	$-22{\cdot}376 + M'$		+·020
				+·019	
„ 27	15 58	$-20{\cdot}034 + \frac{P}{2} + \frac{I}{2}$	$-20{\cdot}093 + M'$		+·022
Aug. 18	18 54	$-14{\cdot}868 + \frac{P}{2} + \frac{I}{2}$			+·031
				+·027	
„ 19	19 23	$-14{\cdot}213 + \frac{P}{2} + \frac{I}{2}$			+·013
				+·035	
„ 25	19 4	$-9{\cdot}185 + \frac{P}{2} + \frac{I}{2}$			+·051
				+·104	
„ 26	19 15	$-6{\cdot}666 + \frac{P}{2} + \frac{I}{2}$			+·054
				+·055	
„ 27	19 13	$-5{\cdot}352 + \frac{P}{2} + \frac{I}{2}$			+·051
				+·044	
„ 28	19 15	$-4{\cdot}304 + \frac{P}{2} + \frac{I}{2}$			+·039
				+·032	
Sept. 3	19 47	$-59{\cdot}630 + P$			+·001
				+·007	
„ 19	20 43	$-56{\cdot}789 + \frac{P}{2} + \frac{I}{2}$			+·006
Dec. 23	5 30	$-35{\cdot}950 + \frac{P}{2} + \frac{I}{2}$	$-36{\cdot}231 + F'$		−·030
				−·039	
„ 29	3 6	$-41{\cdot}463 + \frac{P}{2} + \frac{I}{2}$			−·041
				−·011	
„ 30	5 12	$-42{\cdot}908 + P$	$-42{\cdot}893 + F'$		−·044
				−·052	
1882. Jan. 8	5 22	$-54{\cdot}053 + P$			−·051
„ 14	3 32	$-61{\cdot}264 + P$			−·058
				−·069	
„ 17	5 19	$-66{\cdot}452 + P$	$-66{\cdot}458 + F'$		−·085
				−·066	
„ 20	5 38	$-71{\cdot}184 + P$	$-71{\cdot}283 + F'$		−·059
				−·073	
„ 21	5 8	$-12{\cdot}781 + \frac{P}{2} + \frac{I}{2}$			−·085
				−·081	
„ 26	5 8	$-22{\cdot}633 + P$	$-22{\cdot}723 + F'$		−·100
				−·096	
„ 27	5 22	$-25{\cdot}015 + P$	$-25{\cdot}003 + F'$		−·094
				−·080	

Date.	I. Sidereal Time.	II. Clock Slow from Observations with the Transit Circle. Δt	III. Clock Slow from Observations with the Hut Transit. Δt	IV. Hourly Rates. Day to Day.	V. Hourly Rates. From the Chronometer Comparisons.
	h m	s	s	s	s
1882. Feb. 13	7 0	$-57.819 + \frac{P}{2} + \frac{I}{2}$	$-57.956 + \frac{F'}{2} + \frac{M'}{2}$		$-.099$
				$-.098$	
„ 14	7 0	$-60.167 + \frac{P}{2} + \frac{I}{2}$	$-60.333 + \frac{F'}{2} + \frac{M'}{2}$		$-.110$
				$-.088$	
„ 15	7 0	$-62.292 + \frac{P}{2} + \frac{I}{2}$	$-62.448 + \frac{F'}{2} + \frac{M'}{2}$		$-.089$
				$-.083$	
„ 17	7 0	$-66.290 + \frac{P}{2} + \frac{I}{2}$	$-66.431 + \frac{F'}{2} + \frac{M'}{2}$		$-.075$
July 10	17 36		$-78.734 + F'$		$-.030$ (1)
„ 13	17 27		$-82.512 + F'$		$-.037$ (1)

(1) These rates are deduced from the earlier and later sets of observations on the same night.

The Durban Clock.

The following Table H. contains the results of such time determinations at Durban as enter into the Longitude Operations.

A comparison of the rates reckoned from day to day with those derived from observations of the same night shows no systematic difference, the accidental differences being within the limits of the probable errors of their determination.

The compensation of the pendulum for the effect of temperature seems therefore to be sensibly exact.

With the mercurial compensation pendulum there is a tendency, on a sudden change of temperature, for the rod to acquire the new temperature more quickly than the large mass of mercury which forms the pendulum bob.

Thus a sudden fall of temperature causes the clock to gain until the mercury of the bob acquires the same temperature as the rod. But in Dent's pendulum in question the zinc cylinder and steel rod appear to acquire heat at the same rate, and thus the compensation is preserved even under the great changes of temperature to which a clock placed in a wooden hut under a tropical sun is subjected.

TABLE H.—ERRORS and HOURLY RATES of the DURBAN CLOCK.

Date.		Sidereal Time.	Clock Slow.	Hourly Rates reckoned from Day to Day.	Hourly Rate from Observations of the same Night.	Adopted Hourly Rate.
		h m	s	s	s	s
June	16	9 15	$-32{\cdot}420 + F'$			
				$-{\cdot}411$		
”	17 (a)	13 50	$-32{\cdot}243 + F'$		$-{\cdot}440$ (1)	$-{\cdot}425$
”	21 (b)	11 22	$-35{\cdot}813 + F'$		$-{\cdot}075$	$-{\cdot}075$
”	22 (c)	10 13	$-37{\cdot}828 + F'$		$+{\cdot}139$	$+{\cdot}139$
”	24	8 15	$-34{\cdot}665 + F'$			$+{\cdot}036$
				$+{\cdot}036$		
”	27	8 53	$-32{\cdot}005 + F'$			
August	18	10 4	$-28{\cdot}953 + M'$		$+{\cdot}089$	$+{\cdot}060$
				$+{\cdot}056$		
”	19	10 16	$-27{\cdot}605 + M'$		$+{\cdot}048$	$+{\cdot}054$
				$+{\cdot}052$		
”	20	9 52	$-26{\cdot}380 + M'$		$+{\cdot}041$	$+{\cdot}048$
				$+{\cdot}043$		
”	23	9 44	$-23{\cdot}175 + M'$		$+{\cdot}069$	$+{\cdot}044$
				$+{\cdot}045$		
”	29	9 25	$-13{\cdot}280 + M'$		$+{\cdot}057$	$+{\cdot}045$
				$+{\cdot}044$		
September	2	7 8	$-9{\cdot}153 + M'$			$+{\cdot}045$
				$+{\cdot}045$		
”	13	7 26	$-58{\cdot}085 + M'$			$+{\cdot}050$
				$+{\cdot}054$		
”	18	7 18	$-51{\cdot}630 + M'$			$+{\cdot}044$
				$+{\cdot}035$		
”	19	10 22	$-50{\cdot}675 + M'$		$+{\cdot}041$	$+{\cdot}045$
				$+{\cdot}056$		
”	22	10 13	$-46{\cdot}666 + M'$		$+{\cdot}071$	$+{\cdot}056$
				$+{\cdot}055$		
”	23	9 39	$-45{\cdot}379 + M'$		$+{\cdot}018$	$+{\cdot}055$
				$+{\cdot}054$		
”	26	10 21	$-41{\cdot}421 + M'$		$+{\cdot}041$	$+{\cdot}050$
				$+{\cdot}046$		
”	28	7 12	$-39{\cdot}355 + M'$			$+{\cdot}046$
November	20	11 14	$-49{\cdot}414 + \frac{F'}{2} + \frac{M'}{2}$			$+{\cdot}035$
”	21	13 29	$-48{\cdot}896 + \frac{F'}{2} + \frac{M'}{2}$	$+{\cdot}020$		$+{\cdot}030$
”	26 (2)	12 10	$-43{\cdot}249 + \frac{F'}{2} + \frac{M'}{2}$	$+{\cdot}046$		$+{\cdot}045$
”	27 (2)	10 46	$-42{\cdot}422 + \frac{F'}{2} + \frac{M'}{2}$			$+{\cdot}045$
December	23	11 50	$-21{\cdot}660 + M'$		$+{\cdot}032$	$+{\cdot}030$
				$+{\cdot}022$		

(1) From Obs. Lamp E. only before Sigs. combined with the Obs. Lamp E. after Sigs. (interval 5^h 25^m).

(2) On Nov. 26 both F. and M. observed all the Stars with Lamp East, and on Nov. 27 all Stars Lamp W. It is necessary to combine these results, as, for some reason which I cannot explain, both observers appear to make systematic errors in opposite directions in the two positions of this instrument.

(a) Pendulum lengthened $12\frac{1}{2}$ divisions on June 17.
(b) ” ” $5\frac{1}{2}$ ” ” 21.
(c) ” shortened 3 ” ” 23.

Date.	Sidereal Time.	Clock Slow.	Hourly Rates reckoned from Day to Day.	Hourly Rate from Observations of the same Night.	Adopted Hourly Rate.
1882.	h m	s	s	s	s
January 8	16 27	−13·595 + M′			+·022
			+·023		
„ 14	10 32	−10·410 + M′			+·023
			+·023		
„ 20	16 37	− 6·940 + M′			+·018
			+·013		
„ 21	10 29	− 6·712 + M′			+·010
			+·006		
„ 27	11 10	− 5·905 + M′		+·022	+·010
July 10	10 22	−45·557 + P′		+·048	+·052
			+·057		
„ 13	10 19	−41·432 + P′		+·036	+·050

The Aden Clock.

This clock is in every respect similar with the Durban Clock.

The following Table I. contains the results of such time determinations at Aden as enter into the Longitude operations.

A comparison of the hourly rates, reckoned from day to day, with those derived from observations of the same night shows a systematic difference of + $0^s{\cdot}007$, by which amount the rates reckoned from day to day have to be corrected.

In other words, the pendulum is very slightly over-compensated, and for the change of temperature by day and night which obtains at Aden in the month of September the hourly rate of the clock is slower by $0^s{\cdot}007$ during the observations at night than is the rate for the day.

The adopted hourly rates have therefore been obtained by applying a correction of $+0^s{\cdot}007$ to the hourly rates obtained from the observations of one day and the next.

TABLE I.—ERRORS and HOURLY RATES of the ADEN CLOCK.

Date.	Sidereal Time.	Clock Slow.	Hourly Rate from Day to Day.	Hourly Rates from Observations of the Same Night.	Adopted Hourly Rate.
	h m	s	s	s	s
August 20 - -	18 27·5	− 4·710+F′			−·638
			−·645		
21 - -	19 31	−20·900+F′			−·636
			−·643		
23 - -	19 31	−51·750+F′			−·636
	Altered length of the pendulum.				
26 - -	22 4	−37·050+F′		−·071	−·074
			−·081		
27 - -	20 7	−38·830+F′			−·073
			−·078		
29 - -	21 18	−42·655+F′		−·071	−·070
			−·076		
September 2 -	22 20	−50·035+F′			−·070
			−·078		
3 -	23 55	−52·025−F′			−·071
	Lengthened pendulum 2 divisions of screw-head.				
13 -	20 32	−46·345+F′	+·008		+·015
15 -	22 30	−45·930+F′			+·016
			+·009		
18 -	23 44	−45·283+F′		+·030	+·017
			+·010		
19 -	0 12	−45·043+F′		+·011	+·015
			+·005		
22 -	21 18	−44·670+F′			+·016
			+·012		
23 -	23 47	−44·358+F′		+·011	+·017
			+·009		
24 -	22 5	−44·155+F′			+·013
			+·004		
25 -	22 35	−44·065+F′			+·014
			+·009		
26 -	21 42	−43·850+F′			+·015
			+·008		
27 -	21 47	−43·670+F′			+·015
			+·008		
28 -	0 46	−43·442+F′		+·010	+·015

CHAPTER VI.

EXCHANGE OF SIGNALS.

Two kinds of signals have been employed; those exchanged between the Cape and Durban being audible signals, sent on land lines, those between Aden and Durban being mirror signals, sent through submarine cables.

A description of the instruments and methods employed in sending and receiving these signals is given in Chapter III. From that description it is evidently not necessary to tabulate all the signals exchanged, but only to give the clock times at which the clock beats at both stations were *apparently* in coincidence.

Thus in the following Table I., which gives these clock times of *apparent* coincidence of the clock beats at the Cape and Durban, Maclear is supposed to send signals in exact coincidence with each tenth beat of the Cape Hut Clock. These beats are repeated by the "Sounder" at Durban, and at $10^h\ 38^m\ 17^s$ the beat of this Sounder is found by Finlay to coincide with the beat of his clock at Durban. On after-comparison of the records of both stations, giving the times of first and last signals and of the omitted signal, the corresponding signal ($15^h\ 32^m\ 40^s$) is easily identified. But the beat of the Sounder at Durban does not represent the beat of the Cape Clock, but the time of this beat, *plus* the time of transmission of the signal, which we shall call θ; therefore, in estimating the true clock times of true coincidence of the clock beats, we have to write, when signals are sent from the Cape,—

$$\text{Cape Clock time} + \theta = \text{Durban Clock time.}$$

To reduce these to corresponding local times, we apply to the Cape Clock the correction $(\Delta t + \frac{P}{2} + \frac{I}{2} + \textit{correction for rate})$ from Columns II. and V. of Table G., or of $(\Delta t + M' + \textit{correction for rate})$ from Columns III. and V. of the same Table, and convert from Sidereal into Cape Mean Time. We must also apply the symbolical correction $+ M_s$ for the personal error of Maclear in sending signals. The Durban clock time must receive the correction $(\Delta t + F')$ from Table H., and the further symbolical correction F_r for the personal equation of Finlay in receiving audible signals. The observed difference of Longitude, $\Delta\lambda$, (taking the Cape as origin,) will therefore be—

$$\Delta\lambda = T_w + \theta + \frac{P}{2} + \frac{I}{2} + M_s - (T_e + F' + F_r),$$

where the errors of the Cape Hut Clock have been determined from the data of Table G., Column II., and where T_w and T_e are the numerically corrected clock mean times at the Western and Eastern Stations respectively.

Similarly, when signals are sent from Durban to the Cape, we have

$$\Delta\lambda = T_w + \frac{P}{2} + \frac{I}{2} + M_r - (T_e + \theta + F' + F_s),$$

or putting

$\Delta T_w = T_w - T_e$ when signals are sent from the Western and received at the Eastern station,

$\Delta T_e = T_w - T_e$ „ „ „ Eastern „ „ Western station,

we get

$$\Delta\lambda - \theta = \Delta T_w - F' + \frac{P}{2} + \frac{I}{2} - F_r + M_s,$$

$$\Delta\lambda + \theta = \Delta T_e - F + \frac{P}{2} + \frac{I}{2} - F_s + M_r\,;$$

whence

$$\Delta\lambda = \frac{\Delta T_w + \Delta T_e}{2} - F' + \frac{P}{2} + \frac{I}{2} - \frac{F_r + F_s}{2} + \frac{M_r + M_s}{2},$$

$$\theta = \frac{\Delta T_e - \Delta T_w}{2} + \frac{F_r - F_s}{2} + \frac{M_r - M_s}{2}\,;$$

or, if we take the clock errors at the Cape from the determinations of clock error with the Hut Transit; that is, use Column III. of Table G. instead of Column II. of same Table, we have

$$\Delta\lambda = \frac{\Delta T_w + \Delta T_e}{2} - F' + M' - \frac{F_r + F_s}{2} + \frac{M_r + M_s}{2}.$$

In the following Table I. the values of ΔT_w and ΔT_e have been computed with the errors of the Hut Clock as determined by the Transit Circle and chronometer comparison of the two clocks.

To find the numerical values of ΔT_w and ΔT_e in the case where the clock error at the Cape is determined with the Hut Transit, it is only necessary to apply to each a correction ($= \Delta t_{III} - \Delta t_{II}$) where these expressions represent the values of Δt taken from Columns III. and II. respectively of Table G.

TABLE I.—CLOCK TIMES of *apparent* coincidence of BEATS of the CLOCKS at the CAPE and DURBAN, from SIGNALS exchanged between FINLAY at DURBAN and MACLEAR at the CAPE.

Date.	Cape Sending.		ΔT_w.	Durban Sending.		ΔT_e.
	Cape Hut Sid. Clock.	Durban M.T. Clock.		Cape Hut Sid. Clock.	Durban M.T. Clock.	
	h m s	h m s	m s	h m s	h m s	m s
June 17 - -	15 32 40 =	10 38 17	−50 12·17	15 43 25 =	10 49 0	−50 11·85
	16 4 30 =	11 10 2	12·15	49 51 =	10 55 25	11·86
				56 17 =	11 1 50	11·88
June 21 - -	17 28 30 =	12 17 58	−50 12·14	17 38 29 =	12 27 55	−50 11·77
	53 50 =	12 43 14	12·27	44 25 =	12 33 50	11·73
	59 35 =	12 48 58	12·20	50 26 =	12 39 50	11·71
June 22 - -	15 39 10 =	10 25 2	−50 12·00	15 49 40 =	10 35 30	−50 11·75
	16 3 35 =	10 49 23	12·06	55 26 =	10 41 15	11·70
	16 9 25 =	10 55 12	11·98			
June 27 - -	15 32 30 =	9 58 40	−50 12·05	15 37 1 =	10 3 10	−50 11·82
	16 21 0 =	10 47 2	12·04	15 43 22 =	10 9 30	11·86
				16 7 36 =	10 33 40	11·83
				16 13 47 =	10 39 50	11·85

In the following Table II. are similarly given the results of signals exchanged between Maclear at Durban and Pett at the Cape. The time determinations at the Cape depend entirely on the Transit Circle (Table G.), those at Durban on the results of Table F. The separate results for $\Delta\lambda$ will therefore be computed from this Table by the expression—

$$\Delta\lambda = \frac{\Delta T_w + \Delta T_e}{2} + \frac{P}{2} + \frac{I}{2} - M' + \frac{P_r + P_s}{2} - \frac{M_r + M_s}{2},$$

$$\text{and } \theta = \frac{\Delta T_e - \Delta T_w}{2} + \frac{P_r - P_s}{2} - \frac{M_r - M_s}{2}.$$

TABLE II.—CLOCK TIMES of *apparent* coincidence of BEATS of the CLOCKS at the CAPE and DURBAN from SIGNALS exchanged between MACLEAR at DURBAN and PETT at the CAPE.

Date.	Cape Sending.		ΔT_w.	Durban Sending.		ΔT_e.
	Cape Hut Sid. Clock.	Durban M.T. Clock.		Cape Hut Sid. Clock.	Durban M.T. Clock.	
	h m s	h m s	m s	h m s	h m s	m s
August 18 -	19 30 40 =	10 31 46	−50 12·31	10 23 55 =	19 22 48	−50 12·01
	19 36 50 =	10 37 55	12·31	10 48 15 =	19 47 12	12·01
August 19 -	20 9 25 =	11 6 28	−50 12·27	10 58 5 =	20 1 1	−50 11·88
	20 15 20 =	11 12 22	12·24	11 22 30 =	20 25 30	11·93
	20 21 30 =	11 18 31	12·26	11 28 30 =	20 31 31	11·91
September 19 -	21 26 50 =	10 21 28	−50 12·43	10 11 40 =	21 17 1	−50 11·83
	21 33 10 =	10 27 47	12·47	10 47 50 =	21 53 17	11·78

The following Table III. gives similar results of signals exchanged between Finlay at the Cape and Maclear at Durban. The error of the Cape Hut Clock on each of the six nights has been determined by observations with the Transit Circle and chronometer comparisons of that Clock with the Hut Clock; the values of ΔT_w and ΔT_e, given in Table III., have been computed with these results.

On December 23, January 20, and January 27, the error of the Hut Clock was also determined by Finlay with the Hut Transit, but the effects of a recurring fever which had attacked Mr. Finlay during his absence on the East Coast of Africa rendered him physically unfit to observe on the other three nights in question.

The values of ΔT_w and ΔT_e resulting from Finlay's observations may be obtained, as before, by application of the correction $(\Delta t_{III} - \Delta t_{II})$ to the corresponding values of Δt in Table G.

The symbolical corrections for personal equation applicable to these results will be evident from what has been previously said, and they are afterwards given in Table .

Table III.—Clock Times of *apparent* Coincidence of Beats of the Clocks at the Cape and Durban from Signals exchanged between Maclear at Durban and Finlay at the Cape.

Date.	Cape Sending.		ΔT_w.	Durban Sending.		ΔT_e.
	Cape Hut Sid. Clock.	Durban M.T. Clock.		Cape Hut Sid. Clock.	Durban M.T. Clock.	
	h m s	h m s	m s	h m s	h m s	m s
1881.						
December 23 -	6 5 50 =	12 45 23	−50 12·11	6 15 24 =	12 54 55	−50 11·68
	6 30 20 =	13 9 49	12·14	6 21 45 =	13 1 15	11·73
1882.						
January 8 -	4 58 15 =	10 34 39	−50 12·54	5 7 48 =	10 44 10	−50 12·12
	5 22 25 =	10 58 45	12·52	5 13 44 =	10 50 5	12·09
January 14 -	4 49 45 =	10 2 24	−50 12·21	4 59 33 =	10 12 10	−50 11·83
	5 14 5 =	10 26 40	12·23	5 5 39 =	10 18 15	11·84
January 20 -	5 35 20 =	10 24 3	−50 12·33	5 51 20 =	10 40 0	−50 11·97
	5 41 45 =	10 30 27	12·39	5 57 31 =	10 46 10	11·99
	6 11 50 =	11 0 27	12·36	6 3 22 =	10 52 0	11·96
January 21 -	5 40 25 =	10 26 9	−50 12·22	5 50 28 =	10 36 10	−50 11·87
	6 4 30 =	10 50 10	12·19	5 56 24 =	10 42 5	11·85
January 27 -	6 15 45 =	10 37 35	−50 12·49	6 25 27 =	10 47 15	−50 12·11
	6 21 40 =	10 43 29	12·48	6 31 33 =	10 53 20	12·12
	6 45 50 =	11 7 35	12·48	6 37 34 =	10 59 20	12·12

The following signals were exchanged between Pett at Durban and Finlay at the Cape. The time was determined at both stations with the Hut Transits.

Table IV.—Clock Times of *apparent* Coincidence of Beats of the Clocks at the Cape and Durban from Signals exchanged between Pett at Durban and Finlay at the Cape.

Date.	Cape Sending.		ΔT_w.	Durban Sending.		ΔT_e.
	Cape Hut Sid. Clock.	Durban M.T. Clock.		Cape Hut Sid. Clock.	Durban M.T. Clock.	
	h m s	h m s	m s	h m s	h m s	m s
1882.						
July 10 - -	17 14 45 =	10 49 44	−50 12·35	17 24 33 =	10 59 30	−50 11·98
	17 20 40 =	10 55 38	12·34	17 30 29 =	11 5 25	11·96
	17 44 30 =	11 19 24	12·28	17 36 20 =	11 11 15	11·92
July 13 - -	16 46 45 =	10 9 53	−50 12·37	10 37 45 =	17 14 42	−50 11·95
	16 59 0 =	22 6	12·37	10 55 35 =	17 32 55	11·93
	17 23 0 =	46 2	12·34	—	—	—

TABLE V.—CLOCK TIMES of *apparent* COINCIDENCE of BEATS of the CLOCKS at DURBAN and ADEN from MIRROR-SIGNALS exchanged between FINLAY at ADEN and MACLEAR at DURBAN by SUBMARINE CABLE.

Date.	Durban Sending.		ΔT_w.	Aden Sending.		ΔT_e.
	Durban Hut M.T. Clock.	Aden Sid. Clock.		Durban M.T. Clock.	Aden Sid. Clock.	
1881.	h m s	h m s	m s	h m s	h m s	m s
August 20	11 51 30 =	22 44 28	−55 50·25	12 9 42 =	23 2 40	−55 47·06
	11 57 50 =	22 50 49	50·14	12 13 41 =	23 6 40	47·36
				12 20 20 =	23 13 20	47·19
				12 24 59 =	23 18 0	47·38
				12 30 58 =	23 24 0	47·32
August 23	10 3 20 =	21 8 38	−55 49·88	10 17 32 =	21 22 50	−55 47·39
	10 9 0 =	21 14 19	49·89	10 24 1 =	21 29 20	47·26
	10 48 50 =	21 54 16	49·89	10 29 20 =	21 34 40	47·33
				10 35 19 =	21 40 40	47·28
				10 40 18 =	21 45 40	47·39
August 29	9 2 40 =	20 31 27	−55 49·83	9 24 2 =	20 52 50	−55 47·28
	9 9 0 =	20 37 48	49·78	9 30 1 =	20 58 50	47·29
	9 51 0 =	21 19 55	49·79	9 36 20 =	21 5 10	47·23
	9 56 50 =	21 25 46	49·82	9 42 9 =	21 11 0	47·26
	10 2 40 =	21 31 37	49·84			
September 2	12 11 10 =	23 56 26	−55 49·71	12 27 14 =	0 12 30	−55 47·08
	12 17 10 =	0 2 27	49·72	12 33 3 =	0 18 20	47·10
	12 53 50 =	0 39 13	49·62	12 39 32 =	0 24 50	47·01
	13 0 0 =	0 45 24	49·61	12 45 11 =	0 30 30	47·06
September 13	9 43 50 =	22 11 11	−55 49·85	9 59 39 =	22 27 0	−55 47·25
	9 50 10 =	22 17 32	49·81	10 5 48 =	22 33 10	47·24
	10 33 0 =	23 0 29	49·73	10 11 47 =	22 39 10	47·24
	10 38 20 =	23 5 50	49·85	10 17 26 =	22 44 50	47·31
				10 24 15 =	22 51 40	47·20
September 18	10 19 40 =	23 6 55	−55 49·75	10 36 25 =	23 23 40	−55 46·98
	10 26 10 =	23 13 26	49·67	10 42 34 =	23 29 50	46·97
	11 8 40 =	23 56 3	49·67	10 49 3 =	23 36 20	46·91
	11 14 40 =	0 2 4	49·68	10 55 12 =	23 42 30	46·89
				11 1 1 =	23 48 20	46·93
September 19	11 42 50 =	0 34 16	−55 49·89	11 58 34 =	0 50 0	−55 47·29
	11 49 10 =	0 40 37	49·84	12 4 33 =	0 56 0	47·32
	12 31 30 =	1 23 4	49·87	12 10 42 =	1 2 10	47·31
	12 38 0 =	1 29 35	49·79	12 16 41 =	1 8 10	47·32
				12 23 10 =	1 14 40	47·24
September 22	11 23 30 =	0 26 46	−55 49·80	11 33 15 =	0 36 30	−55 47·19
	12 6 10 =	1 9 33	49·76	11 39 34 =	0 42 50	47·15
	12 18 40 =	1 22 5	49·69	11 45 23 =	0 48 40	47·21
	12 48 40 =	1 52 10	49·75	11 51 32 =	0 54 50	47·18
				11 57 1 =	1 0 20	47·28
September 23	9 48 20 =	22 55 18	−55 49·89	10 10 41 =	23 17 40	−55 47·22
	9 54 40 =	23 1 39	49·85	10 16 10 =	23 23 10	47·31
	10 0 40 =	23 7 40	49·86	10 21 39 =	23 28 40	47·41
	10 43 10 =	23 50 17	49·85	10 27 58 =	23 35 0	47·36
	10 48 50 =	23 55 58	49·92	10 34 7 =	23 41 10	47·35
September 26	11 7 30 =	0 26 34	−55 49·79	11 23 26 =	0 42 30	−55 47·18
	11 13 40 =	0 32 45	49·79	11 29 15 =	0 48 20	47·22
	11 56 10 =	1 15 22	49·77	11 35 4 =	0 54 10	47·25
	12 1 50 =	1 21 3	49·84	11 41 3 =	1 0 10	47·27
				11 47 32 =	1 6 40	47·21
September 28	10 19 30 =	23 46 21	−55 49·75	10 29 30 =	23 56 20	−55 47·11
	10 26 0 =	23 52 52	49·69	10 35 39 =	0 2 30	47·10
	11 8 30 =	0 35 29	49·67	10 40 38 =	0 7 30	47·28
	11 15 0 =	0 42 0	49·60	10 46 27 =	0 13 20	47·32
				10 52 56 =	0 19 50	47·25
				10 59 5 =	0 26 0	47·23

The following signals were also exchanged between Maclear at Durban and Pett at the Cape upon nights when no Time Determinations were obtained at Durban, but on which signals were also exchanged between Durban and Aden.

These signals, therefore, serve to determine the Error of the Durban Clock on Cape time, and hence to give a direct determination of the difference of longitude between Aden and the Cape.

TIMES OF COINCIDENCE.

Date.	Cape Sending.			Durban Sending.		
	Cape Hut. Sid. Clock.	Durban Hut M. T. Clock.	Durban Clock Slow on C.M.T.	Cape Hut Sid. Clock.	Durban Hut M. T. Clock.	Durban Clock Slow on C.M.T.
1881.	h m s	h m s	$-\theta$	h m s	h m s	$+\theta$
August 26	19 15 40 =	9 45 19	−0 50 30·88	19 7 25 =	9 37 5	−0 50 30·52
	19 21 40 =	9 51 18	30·85	19 31 34 =	10 1 10	30·46
August 27	20 6 5 =	10 31 39	−0 50 28·69	19 51 34 =	10 17 10	−0 50 28·30
	20 11 50 =	10 37 23	28·62	20 21 49 =	10 47 20	28·24
September 3	20 10 20 =	10 7 20	−0 50 20·91	20 1 39 =	9 58 40	−0 50 20·49
	20 16 35 =	10 13 34	20·93	20 26 13 =	10 23 10	20·51

The following are the mirror signals that were exchanged between Finlay at Aden and Maclear at Durban on the above nights.

TIMES OF COINCIDENCE.

Date.	Durban Sending.			Aden Sending.		
	Durban M. T. Clock.	Aden Sid. Clock.	$\Delta\lambda - \theta^1$.	Durban M. T. Clock.	Aden Sid. Clock.	$\Delta\lambda + \theta'$.
1881.	h m s	h m s	h m s	h m s	h m s	h m s
August 26	10 49 0 =	22 6 4	−1 46 1·91	10 59 57 =	22 17 0	−1 45 59·10
	10 55 10 =	12 15	1·89	11 5 16 =	23 20	59·22
	11 30 40 =	47 51	1·99	11 9 25 =	26 30	59·53
	11 37 0 =	54 12	1·94	11 16 34 =	33 40	59·53
				11 21 13 =	38 20	59·67
				11 27 52 =	45 0	59·46
*August 27	8 51 0 =	20 11 45	−1 46 1·87	9 13 14 =	20 34 0	−1 45 59·18
	8 57 10 =	17 56	1·85	9 20 3 =	40 50	59·05
	9 38 50 =	59 43	1·92	9 24 52 =	45 40	59·24
September 3	11 27 50 =	23 16 58	−1 46 2·17	11 49 51 =	23 39 0	−1 45 59·51
	11 33 50 =	23 22 59	2·17	11 55 50 =	45 0	59·50
	12 16 10 =	0 5 26	2·14	12 1 29 =	50 40	59·59
	12 22 0 =	0 11 17	2·17			

* Earth Currents very troublesome at Durban.

TABLE K.—SUMMARY of RESULTS of EXCHANGE of SIGNALS on LAND LINES for determining the DIFFERENCE of LONGITUDE of the CAPE and DURBAN.

	m sec.			
I.—June 17	$-$ 50 12·01 $- F'$	$+\frac{P}{2}+\frac{I}{2}$	$-\frac{F+F_s}{2}$	$+\frac{M_r+M_s}{2}$.
21	11·96 $- F'$	$+\frac{P}{2}+\frac{I}{2}$	"	"
22	11·87 $- F'$	$+\frac{P}{2}+\frac{I}{2}$	"	"
27	11·95 $- F'$	$+\frac{P}{2}+\frac{I}{2}$	"	"

or the following values if the time determinations with the Hut Transit at the Cape are adopted :—

June 17	$-$ 50 12·04 $- F' + M'$	- -	$-\frac{F_r+F_s}{2}$	$+\frac{M_r+M_s}{2}$.
21	12·08 $- F' + M'$	- -	"	"
22	11·97 $- F' + M'$	- -	"	"
27	12·00 $- F' + M'$	- -	"	"
II.—Aug. 18	$-$ 50 12·16	$-M'+\frac{P}{2}+\frac{I}{2}$ - - -	$-\frac{M_r+M_s}{2}$	$+\frac{P_r+P_s}{2}$.
19	12·08	" " " - -	"	"
Sept. 19	12·13	" " " - -	"	"
1881.				
III.—Dec. 23	$-$ 50 11·91	$-M'+\frac{P}{2}+\frac{I}{2}$	$+\frac{F_r+F_s}{2}$	$-\frac{M_r+M_s}{2}$.
1882.				
Jan. 8	12·32	$-M'+P$ - -	"	"
14	12·03	$-M'+P$ - -	"	"
20	12·16	$-M'+P$ - -	"	"
21	12·03	$-M'+\frac{P}{2}+\frac{I}{2}$	"	"
27	12·30	$-M'+P$ - -	"	"

or the following values if the time determinations with the Hut Transit at the Cape are adopted :—

1881.				
Dec. 23	$-$ 50 12·19 $+ F' - M'$	- - -	$+\frac{F_r+F_s}{2}$	$-\frac{M_r+M_s}{2}$.
1882.				
Jan. 20	12·26 $+ F' - M'$	- - -	"	"
27	12·29 $+ F' - M'$	- - -	"	"
1882.				
IV.—July 10	$-$ 50 12·14 $+ (F' - P')$	- - -	$+\frac{F_r+F_s}{2}$ - -	$-\frac{P_r+P_s}{2}$.
13	12·15 $+ (F' - P')$	- - -	" - -	"

TABLE L.—RESULTS of EXCHANGE of MIRROR SIGNALS by SUBMARINE CABLE for determining the DIFFERENCE of LONGITUDE, DURBAN *minus* ADEN.

1881.	m. sec.				
Aug. 20 (1)	− 55 (48·73)	$- F'$	$+ M'$	$- \frac{F_m + F_s}{2}$	$+ \frac{M_m + M_s}{2}$.
23	48·61	„	„	„	„
29	48·54	„	„	„	„
Sept. 2	48·36	„	„	„	„
13	48·53	„	„	„	„
18	48·32	„	„	„	„
19	48·57	„	„	„	„
22	48·48	„	„	„	„
23	48·60	„	„	„	„
26	48·51	„	„	„	„
28	48·45	„	„	„	„

TABLE M.—RESULTS of EXCHANGES of SIGNALS on the CABLE and LAND LINE (on nights when no time determinations were secured at Durban) for determining the DIFFERENCE of LONGITUDE, CAPE *minus* ADEN.

1881.	h m sec.	
Aug. 26	− 1 46 0·68	$- (F' + \Delta F_n') + \frac{P}{2} + \frac{I}{2} - \frac{F_m + F_s}{2} + \frac{M_m - M_r}{2} + \frac{P_r + P_s}{2}$.
27	0·52	$- (F' + \Delta F_n') + \frac{P}{2} + \frac{I}{2} - \frac{F_m + F_s}{2} + \frac{M_m - M_r}{2} + \frac{P_r + P_s}{2}$.
Sept. 3	0·85	$- (F' + \Delta F_n') + P - \frac{F_m + F_s}{2} + \frac{M_m - M_r}{2} + \frac{P_r + P_s}{2}$.

(1) The observations of August 20 must be rejected on account of the unsatisfactory nature of the signals received at Aden. The motion of the spot of light was so small and uncertain, that after attempting to estimate two coincidences, Mr. Finlay was unable to observe any more. A fault was afterwards discovered and corrected in the Hut-connections with the Telegraph Office, when the signals after August 22 became quite sharp and satisfactory. A glance at column ΔT_W of Table V. p. [40] is sufficient to prove the sluggishness of the signals in question, for the value of ΔT_W is nearly $0^{sec}\cdot4$ above the mean, whilst the value of ΔT_e (the signals observed at Aden) is near the mean of other nights.

CHAPTER VII.

RESULTS OF OBSERVATIONS FOR PERSONAL EQUATION.

From Table A., Chapter IV., with the rates of the Transit Clock R_3 as determined in Chapter V., we obtain directly the following results for the relative personal equation of Pett and Freeman :—

I. 1881.	P−I. sec.	II. 1881.	sec.	III. 1881.	sec.
April 9	+·267	Aug. 18	+·190	Dec. 23	+·376
April 14	·221	Aug. 19	·184	Dec. 29	·331 ½ weight.
May 12	·300	Aug. 25	·244	1882.	
May 23	·245	Aug. 26	·160	Jan. 9	·182 ½ weight.
June 16	·218	Aug. 27	·200	Jan. 21	·188
June 17	·202	Aug. 28	·211	Feb. 13	·176
June 20	·162	Sept. 19	·272	Feb. 14	·216
June 21	·170			Feb. 15	·131
June 22	·153			Feb. 17	·241
June 27	·218				

Whence from—

	P−I. sec.	No. of Obs.	Mean Error. sec.
Group I.	+0·216	10	±0·015
Group II.	·209	7	± ·015
Group III.	·226	7	± ·022
Mean	+ 0·217	24	±0·010

and the probable error of one comparison $= \pm 0^s{\cdot}035$.

We found, from the discussion in Chapter V., that the probable error of a time determination by Pett or Freeman is $\pm\, 0^s{\cdot}021$, and each of the above determinations of full weight depends on two such determinations by each observer. If, therefore, the personal error remained quite constant, the probable error of each of the above results should be $\pm\, 0^s{\cdot}021$, but we find it $= \pm 0^s{\cdot}035$, which shows that this relative personal equation has a probability of changing $\pm 0^s{\cdot}028$ from night to night, although it appears to be very constant in the long run. This latter is confirmed by the fact that in 1879 their relative personal equation for stars of like Declination was found from determinations on eight nights to be—

$$P - I = +\, 0^s{\cdot}204.$$

It is, therefore, reasonable to assume that these observers may be accepted as a reliable standard, and their personal equations may be conveniently adopted as follows :—

$$\frac{P + I}{2} = \pm\, \overset{\text{sec.}}{0{\cdot}000}.$$

$$P = +\ {\cdot}109.$$

$$I = -\ {\cdot}109.$$

The substitution of these values in Table G. in conjunction with the results of Table B. leads to the following values of F′ and M′:—

1881.		F′.
		sec.
April 9	-	+0·32
April 14	-	+ ·27
May 12	-	+ ·21
May 23	-	+ ·16
Mean	-	+0·24 ±·035

1881.		M′.
		sec.
April 9	-	+0·18
April 13	-	+ ·10
April 14	-	+ ·11
May 12	-	+ ·07
May 20	-	+ ·17
May 23	-	+ ·07
		+0·12 ±·020

1881.		
		sec.
Dec. 23	-	+0·28
Dec. 30	-	+ ·09
1882.		
Jan. 17	-	+ ·12
Jan. 20	-	+ ·21
Jan. 26	-	+ ·20
Jan. 27	-	+ ·10
Mean	-	+0·17 ±·030

1881.		
		sec.
June 16	-	+0·07
June 17	-	+ ·03
June 20	-	− ·05
June 21	-	+ ·12
June 22	-	+ ·10
June 27	-	+ ·06
Mean	-	+0·06 ±·024

1882.		
		sec.
Feb. 13	-	+0·16
Feb. 14	-	+ ·12
Feb. 15	-	+ ·30
Feb. 17	-	+ ·19
Mean	-	+ 0·19 ±·038

1882.		
		sec.
Feb. 13	-	+0·12
Feb. 14	-	+ ·21
Feb. 15	-	+ ·21
Feb. 17	-	+ ·09
Mean	-	+0·16 ±·030

We have also, from the observations at Durban, Table C., the following values of the difference of personal equation of Finlay and Maclear:—

1881.		F′ − M′.
		sec.
November 20	- -	+ 0·23
November 21	- -	+ ·30
November 26, November 27 (1)	-	+ ·16 weight 2
		+ 0·21 ±·033

(1) *See* footnote in Table C. p. [20].

It does not appear that the personal equation of the observers follows any law depending on the time, nor do the separate mean values of F′ and M′ appear to differ much more than one would expect from the *mean errors* attached to each result. But the independent result for F′ — M′ obtained at Durban differs by about three times its mean error from that which is derived for F′ — M′ by comparisons at the Cape. It is, therefore, not improbable that the personal equations of Finlay and Maclear are *really* different at this time, and it will be desirable to discuss the results, *first* assuming that the personal equation of Finlay and Maclear is really constant, and *second*, that there was a real change in Finlay and Maclear's personal equation about the time in question.

On the first assumption we have the following equations to satisfy :—

				sec.	p	v
From Obs.	1881 April and May	F′		= +0·24	4	+·022
	1881 April and May		M′	= + ·12	6	+·032
	1881 June		M′	= + ·06	6	—·028
	1881 November at Durban	F′ —	M′	= + ·21	4	+·080
	1881 December, 1882 Jan.	F′		= + ·17	6	—·048
	1882 February	F′		= + ·19	4	—·028
	1882 February		M′	= + ·16	4	+·072

These, having regard to weight, lead to the normal equations—

$$18{\cdot}00\,F' - 4{\cdot}00\,M' = +\,3{\cdot}58^{\text{sec.}}$$
$$-\,4{\cdot}00 \qquad +20{\cdot}00 \qquad = +\,0{\cdot}88$$

and their solution, and the substitution of the resulting values of F′ and M′, to the following values of their probable errors :—

$$F' = +\,0{\cdot}218^{\text{sec.}} \text{ with the probable error } \pm\,0{\cdot}020^{\text{sec.}}$$
$$M' = +\,{\cdot}088 \text{ with the probable error } \pm\,{\cdot}019$$

and the probable error of a comparison of weight *unity* = ± 0s·084.

The consideration of the *second* assumption will be best deferred till the final discussion of the longitude.

These determinations of Personal Equation are only applicable to the results of the various observers so long as the conditions of observation remain the same.

In course of the observations for Personal Equation made at the Cape in 1879 for Stars of different Declination, it was found that there was a marked change in the relative Personal Equation of the observers at the Zenith.

Observations were made by two observers at a time in various combinations, so that each observer compared successively directly with each of the other four observers. The observations were made in zones of 15° in Declination, and the Personal Equations for each zone were deduced from a combination of the results of each zone on the assumption that the sum of the Personal Equations for that zone is Zero. One observer noted the Clock Time of Transit over the first three wires, the other over the three last wires; for the next Star the order was reversed.

The results were the following :—

Observer.	N.P.D. 90°—105°.		N.P.D. 105°—120°.		N.P.D. 120°—135°. (1)		N.P.D. 135°—150°.		N.P.D. 150°—165°.		N.P.D. 165°—175°.	
	s	s	s	s	s	s	s	s	s	s	s	s
G	−·061	±·005	−·078	±·005	−·015	±·004	+·035	±·004	+·120		+·350	
F	−·048	±·005	−·066	±·005	−·081	±·003	−·122	±·004	−·115	±·035	−·170	±·057
M	+·113	±·005	+·104	±·005	+·067	±·005	+·117	±·004	+·134	±·034	+·227	±·036
P	−·091	±·005	−·095	±·005	−·082	±·003	−·140	±·004	−·182	±·031	−·217	±·041
I	+·087	±·005	+·134	±·005	+·110	±·005	+·109	±·004	+·043	±·037	−·189	±·056

(1) Observations made "face North" are here rejected.

Remembering the results of a Paper by Captain Campbell, R.E., "On a peculiarity of Personal Equation" (*Monthly Notices*, R.A.S., Vol. XXXVII., pp. 283, 284), I instituted a series of experiments to ascertain whether this sudden change of "Personal Equation" might depend (as was the case with Captains Campbell and Heaviside) on whether the Star crossed the field of the telescope from (observer's) right to left or left to right,—that is, whether he observed a Star to South or North of the Zenith.

Accordingly a series of observations was arranged in which each observer noted the Transit of a Zenith Star over three or four wires with his feet towards the South, and then the remaining wires with his feet towards the North, or *vice versâ*, taking care to alternate the arrangement of the observations so as to eliminate the effect of errors in the adopted wire intervals. The observations in the two conditions were then separately reduced to the middle wire. When a number of stars had been thus observed by each observer on each of four nights it was found that, in the mean for every observer, the Clock Times of Transit across the middle wire were greater when the observer faced South than when he faced North. In other words, if these Stars had been used to determine the Error of the Clock, the deduced amount of "Clock Slow" would have been numerically smaller for Stars South than for Stars North of the Zenith.

The following Table exhibits the corrections to be applied to the values of Δt to Stars near the Zenith when the observer faces South, to reduce them to values of Δt when the observer faces North.

	s	s	No. of Stars.		s	s	No. of Stars.
F =	+·063	±·017	21	M =	+·145	±·025	23
	+·079	±·011	32		+·117	±·017	23
	+·111	±·025	16		+·112	±·023	20
	+·078	±·012	28		+·115	±·019	24
P =	+·056	±·020	18	I =	+·014	±·030	24
	+·009	±·019	16		+·076	±·018	11
	−·023	±·021	22		+·144	±·027	23
	+·016	±·018	24		+·029	±·022	17

The mean results are—

s
F = + ·079
M = + ·122
P = + ·015
I = + ·066

It is somewhat remarkable that all these results have the same sign :—For myself I found the same, the mean on two nights being + $0^{s}.076$.

It is, perhaps, worthy of note that Mr. Pett, whose personal equation is least changed by the apparent direction of the Star's motion, is ambidextrous; he uses his right hand in writing, but employs his left hand in the use of tools.

For Maclear, Pett, and Freeman I simply quote the above results here on account of their general interest, and for their observations there is no necessity to consider the effect of such personality on the Longitude, since all the Time Stars which they observed at the Cape and Durban were situated to the North of the Zenith.

Finlay, on the other hand, observed the same list of Time Stars at Aden as he did at the Cape and Durban; but at Aden these Stars culminate to the South of the Zenith, and therefore move across the field of view of his Transit apparently from right to left instead of from left to right.

According to the experiments just quoted, Finlay's Personal Equation at Aden would require the correction $+0^{s}.079$ to reduce to his habit of observing the same Stars at the Cape or Durban. But as his habit of observation might have changed between 1879 and 1881 it was desirable to repeat the experiments before and after the expedition.

By placing a reversing prism between the eyepiece and the observer's eye it is possible to make any Star appear to move from right to left or from left to right at pleasure, by rotating the prism 90°. In this way the correction of Finlay's Personal Equation for Stars crossing the field of view from right to left (*i.e.*, for Stars South of the Zenith as seen in a reversing telescope) to reduce to his habit of observing Stars crossing from left to right (*i.e.*, for Stars North of the Zenith) was found to be—

		sec.	sec.
From 31 transits before the expedition	+	0.060 ±	0.012.
„ 21 „ after „	+	.080 ±	.010.

For Finlay's observations at Aden the correction to the observed Clock Error to reduce to his habit of observation in the Southern Stations is—

$$\Delta F_n' + 0^{\text{sec.}}.07 \pm 0^{\text{sec.}}.008.$$

The following are the available materials for determining the Personal Equation of Mr. Pett when observing with a portable Transit (P′).

Previous to his departure for Natal observations were made at the Cape in which the error of the Hut Clock was independently determined by symmetrically arranged observations made both by Mr. Finlay and Mr. Pett with the same instrument, and so that the clock rate as well as the errors of the Star places are practically eliminated from the results of the observations on two nights. Mr. Pett was delayed for some time in Natal in connexion with the erection of the Natal Observatory and Equatorial, and the observations of *Victoria* and *Sappho*. He had thus no opportunity of meeting Mr. Finlay till he joined him at the Transit of Venus Station at Aberdeen Road in November, where the Durban Transit and Hut were erected, and signals exchanged for determining the longitude of the station. On Nov. 29 and 30 Mr. Finlay observed whilst Mr. Pett sent and received the signals, whilst on Nov. 28 and Dec. 1 the signals were sent by Mr. Pett, whilst Mr. Finlay observed.

On the return of both observers to the Cape they again compared Personal Equation on two nights. The results of the comparisons at the Cape are the following :—

BEFORE MR. PETT'S DEPARTURE FOR DURBAN.(1)

1882.		Hut Clock slow.	F′ − P′	Mean.
	h m	m sec.	sec.	sec.
May 22, at	12 45	− 1 7·098 + F′	− ·090	± 0·000.
	12 44	7·188 + P′		
May 27	12 42	− 0 14·364 + F′	+ ·090	
	12 31	14·274 + P′		

AFTER MR. PETT'S RETURN FROM DURBAN. (1)

1883.				
Jan. 20	5 25	− 1 2·663 + F′	+ ·040	+ 0·032.
	5 26	− 1 2·623 + P′		
Jan. 22	5 26	− 1 6·958 + F′	+ ·023	
		·935 + P′		

Whence $F' - P' = + 0^s\cdot016$, with a mean error $= \pm 0^s\cdot038$.

From the time determinations and exchange of signals at Aberdeen Road, the resulting longitudes were—

Aberdeen Road, west of Cape.(2)

1882.	h m sec.
Nov. 29 and 30,	$- 0\ 23\ 20\cdot807 + M' - F' - P_r - P_s$.
28 and Dec. 1,	$20\cdot843 + M' - P' - F_r - F_s$.

Whence $F' - P' + P_r + P_s - (F_r + F_s) = + 0^s\cdot036$,
and substituting the values of P_r, P_s, F_r, F_s, given in the conclusion of the present chapter we obtain—

$$F' - P' = + 0^s\cdot031.$$

Giving equal weight to each of these values, we obtain as definitive—

$$F' - P' = + 0^s\cdot021 \pm 0^s\cdot031. \quad \text{(Mean Error)}$$

(1) The details of these observations are given for Mr. Finlay at pp. 42 and 43, and for Mr. Pett at p. 53.

(2) The details of this operation will be afterwards published in connexion with other longitude determinations in South Africa.

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Personal Equation in Sending and Observing Signals.

To determine the relative personal error of the observers in sending and receiving signals, the Cape Normal Mean Time Clock was compared with the Cape Hut Sidereal Clock by means of telegraphic signals over a short line precisely as in the longitude operations connecting distant places, described pp. [14], [15], excepting that whilst one observer sent signals from one clock only, the signals were received and coincidence recorded by two observers at the other clock. The observers were so interchanged, and the times of their respective observations so symmetrically arranged that the required Personal Equations were obtained independent of clock rate. For example, 1882, Feb. 17 :—

Finlay, sending from M. T. Clock.

Maclear recording.							Pett recording.						
Sid. Clock.				M. T. Clock.			Sid. Clock.				M. T. Clock.		
h	m	s		h	m	s	h	m	s		h	m	s
20	16	43	=	22	22	40	20	16	43	=	22	22	40
	48	28	=		54	20		48	18	=		54	10

Maclear, sending from M. T. Clock.

Finlay recording.							Pett recording.						
20	23	14	=	22	29	10	20	23	4	=	22	29	0
	42	7	=		48	0		41	52	=		47	45

Pett, sending from M. T. Clock.

Finlay recording.							Maclear recording.						
20	29	30	=	22	35	25	20	29	25	=	22	35	20
	35	41	=		41	35		35	46	=		41	40

Finlay, sending from Sidereal Clock.

Maclear recording.													
h	m	s		h	m	s	h	m	s		h	m	s
20	55	0	=	23	0	51	20	54	50	=	23	0	41
21	25	20	=		31	6	21	25	15	=		31	1

MACLEAR, sending from Sidereal Clock.

21	1	0 =	23	6	50	21	1	5 =	23	6	55
	19	15 =		25	2		19	20 =		25	7

PETT, sending from Sidereal Clock.

21	7	15 =	23	13	4	21	7	15 =	23	13	4
	13	20 =		19	8		13	15 =		19	3

Assuming the M. T. Clock free from error, and that the mean of the Personal Equations is Zero, we obtain the following corrections to the Sidereal Clock, and from the difference of the separate results from the mean we obtain the desired equations which express the personal error in sending and receiving signals according to the notation on p. [16] :—

By Signals from the M. T. Clock.

	Resulting Equations.
Sid. Clock Correction $= - 0^{m}\ 7^{s}{\cdot}84$	$F_s + M_r = -\ 0^{s}{\cdot}005$
$\cdot 86$	$F_s + P_r = +\ \cdot 015$
$\cdot 83$	$M_s + F_r = -\ \cdot 015$
$\cdot 86$	$M_s + P_r = +\ \cdot 015$
$\cdot 84$	$P_s + F_r = -\ \cdot 005$
$\cdot 84$	$P_s + M_r = -\ \cdot 005$

Then by subtraction we obtain—

$$F_s - M_s = 0^{s}{\cdot}00 \qquad F_r - M_r = 0^{s}{\cdot}00$$
$$F_s - P_s = \cdot 00 \qquad F_r - P_r = - \cdot 03$$
$$M_s - P_s = - \cdot 01 \qquad M_r - P_r = - \cdot 02$$

Similarly by signals from the Sidereal Clock we obtain—

$$F_s - M_s = + 0{\cdot}03 \qquad F_r - M_r = 0{\cdot}00$$
$$F_s - P_s = + \cdot 01 \qquad F_r - P_r = + \cdot 01$$
$$M_s - P_s = - \cdot 02 \qquad M_r - P_r = - \cdot 02$$

It is unnecessary to give similar details of all the observations; the results are summarised in the following tables :—

COMPARISONS made before the LONGITUDE OPERATIONS.

M. T. Clock sending.

1881.		$F_s - M_s$	$F_s - P_s$	$M_s - P_s$	$F_r - M_r$	$F_r - P_r$	$M_r - P_r$
		s	s	s	s	s	s
March	11	+ ·02	+ ·04	·00	+ ·01	− ·01	·00
	16	·00	− ·02	+ ·01	− ·03	+ ·02	·00
	24	·00	+ ·02	+ ·02	·00	− ·01	− ·01
	25	·01	+ ·02	+ ·02	− ·01	− ·01	·00
May	19	·00	− ·03	+ ·01	·00	+ ·01	− ·01

COMPARISONS made after the LONGITUDE OPERATIONS.

M. T. Clock sending.

1882.		$F_s - M_s$	$F_s - P_s$	$M_s - P_s$	$F_r - M_r$	$F_r - P_r$	$M_r - P_r$
Feb.	17	·00	·00	− ·01	·00	− ·03	− ·02
	18	− ·03	− ·03	− ·03	− ·01	− ·06	− ·02
	19	+ ·04	+ ·02	+ ·01	− ·01	·00	− ·02
	20	− ·01	− ·03	+ ·01	− ·03	·00	·00

Sid. Clock sending.

Feb.	17	+ ·03	+ ·01	− ·02	·00	+ ·01	− ·02
	18	·00	+ ·01	+ ·02	− ·02	+ ·01	·00
	19	+ ·04	+ ·01	+ ·01	− ·02	·00	− ·02
	20	·00	+ ·03	+ ·02	·00	·00	+ ·01

and we have in the mean—

Before the operations	+ ·006	+ ·006	+ ·010	− ·006	·000	− ·004
After the operations	+ ·009	+ ·002	+ ·002	− ·012	− ·009	− ·012

Taking the means and putting the sum of the unknowns = Zero, we have—

$$F_s - M_s = +\overset{s}{\cdot}0075 \qquad F_r - M_r = -\overset{s}{\cdot}009$$
$$F_s - P_s = +\cdot004 \qquad F_r - P_r = -\cdot0045$$
$$M_s - P_s = +\cdot006 \qquad M_r - P_r = -\cdot008$$
$$F_s + M_s + P_s = \cdot000 \qquad F_r + M_r + P_r = \cdot000$$

and the solution of the equations gives—

$$F_s = +\overset{s}{\cdot}0054 \qquad F_r = -\overset{s}{\cdot}0066$$
$$M_s = -\cdot0021 \qquad M_r = +\cdot0024$$
$$P_s = -\cdot0013 \qquad F_r = +\cdot0042$$

For comparing the Personal Equations of Mr. Finlay and Mr. Maclear in observing signals through submarine lines by means of minor galvanometers, I arranged the following plan, which was well carried out. I instructed Mr. Finlay to leave his clock at Aden, and to train a member of the telegraph staff there in the art of sending time signals. The duty was cordially undertaken by Mr. A. W. Prosser, of the telegraph staff there, and he acquired great skill in sending signals with uniformity and precision. Mr. Finlay brought with him the Thomson dead-beat galvanometer, which he had used at Aden, and mounted it in the hut at Durban, where the galvanometer used by Mr. Maclear was also mounted. Both galvanometers were then put in the Aden circuit, and signals sent by Mr. Prosser at Aden were observed simultaneously by Mr. Finlay and Mr. Maclear at Durban, *each observer using his own galvanometer, but recording the same signal at the same place by the beats of the same clock.*

Any difference in the recorded times for coincidence between the first movement of the spot of light and the beat of the clock was therefore due either to Personal Equation or to a different degree of sensibility in the two galvanometers. For longitude purposes it is obviously unnecessary to separate the observer's personality from the difference of the instruments, and therefore no observations were made with an exchange of galvanometers.

The following are the results of the experiments in question, taking Finlay as standard, that is, putting $F_m = 0$.

FINLAY'S galvanometer first on line.

1881	Number of observed coincidence.	Deduced value of M_m. (s)
Nov. 19	6	− 0·305
20	8	·342
21	11	·273
29	9	·178
Dec. 2	7	·292
3	6	·220

MACLEAR'S galvanometer first on line.

1881	Number of observed coincidence.	Deduced value of M_m. (s)
Nov. 20	13	− 0·306
21	5	·186
29	11	·221
Dec. 2	9	·254
3	9	·261

Giving equal weight to the observations of each day, we obtain—

	M_m.	Mean Error.
From observations with Finlay's galvanometer first	−·268	± ·024.
" " " Maclear's " "	−·246	± ·021.

And from the mean of these results,

$$M_m = -\overset{s}{0{\cdot}257} \text{ with a mean error of } \pm \overset{s}{0{\cdot}016}.$$

Collecting finally the mean values of the various determinations of Personal Equation contained in the present chapter, we have—

In time determination.

	s	Mean error.
$F' =$	$+\ 0{\cdot}218$	$\pm\ {\cdot}020$
$M' =$	$+\ {\cdot}088$	$\pm\ {\cdot}019$
$P\ =$	$+\ {\cdot}109$	$\pm\ {\cdot}010$
$I\ =$	$-\ {\cdot}109$	$\pm\ {\cdot}010$
$(F' - P') =$	$+\ {\cdot}021$	$\pm\ {\cdot}031$
Correction to F' in N. Hem. $\Delta F_n'$	$+\ {\cdot}070$	$\pm\ {\cdot}008$

In sending and receiving signals.

	s	Mean error.
$F_s\ =$	$+\ 0{\cdot}005$	The *mean errors* of these quantities are practically insensible.
$M_s =$	$-\ {\cdot}002$	
$P_s\ =$	$-\ {\cdot}001$	
$F_r\ =$	$-\ {\cdot}007$	
$M_r =$	$+\ {\cdot}002$	
$P_r\ =$	$+\ {\cdot}004$	
$F_m =$	${\cdot}000$	
$M_m =$	$-\ {\cdot}257$	$\pm\ {\cdot}016.$

CHAPTER VIII.

FINAL RESULTS OF THE LONGITUDE OPERATIONS.

Cape—Durban.

The definitive result for the difference between the longitudes of the Cape and Durban, from the preceding observations, depends upon three independent operations, viz.:—

1. Finlay at Durban.
2. Maclear at Durban.
3. Pett at Durban.

A discussion of the results in this form furnishes a very severe test of the accuracy of the determination of the Personal Equation of the observers and of the reliability of the final result.

So arranged, these results are the following, obtained by substituting the numerical values of the symbolical representations of the various Personal Equations in the results for the difference of longitude Cape—Durban given in Table K., p. [42].

1. Finlay at Durban.

Date.	Observers at the Cape.		Mean.	Weight.
	M'.	$\frac{P}{2} + \frac{I}{2}$.		
	m s	s	h m s	
1881, Jan. 17	− 50 12·169	12·227	− 0 50 12·198	1·5
„ 21	·209	·177	·193	1·5
„ 22	·099	·087	·093	1·5
„ 27	·129	·167	·148	1·5

2. Maclear at Durban.

Date.	Observers at the Cape.			Mean.	Weight.
	F'.	$\frac{P}{2} + \frac{I}{2}$.	P.		
	m	s		m s	
1881, Aug. 18	− 50	12·246		− 50 12·246	1·0
„ 19		·166		·166	1·0
Sept. 19		·216		·216	1·0
Dec. 23	12·061	·004		·033	1·5
1882, Jan. 8			12·300	·300	1·0
„ 14			·010	·010	1·0
„ 20	·131		·140	·136	1·5
„ 21		·119		·119	1·0
„ 27	·161		·280	·221	1·5

3. PETT at DURBAN.

	Finlay (F′) at the Cape.		
	1882, July 10	h m s − 0 50 12·122	
	13	·132	

The accidental mean errors of the means of these results, may be computed from the agreement of the separate determinations in operations 1 and 2, and are respectively $\pm$ 0s·024 and $\pm$ 0s·035, having regard to the weights. For Operation 3 I have assumed the accidental mean error to be $\pm$ 0s·056 (1), as it cannot be satisfactorily derived from only two determinations.

The results are also affected by the errors in determining the Personal Equations, and these enter, as follows, into the mean results :—

$$1. \text{ - - - } \sqrt{(F'_\epsilon)^2 + (0{\cdot}5\ M'_\epsilon)^2 + (0{\cdot}25\ P_\epsilon)^2 + (0{\cdot}25\ I_\epsilon)^2} = \pm\ 0^s{\cdot}022.$$

$$2. \text{ - - - } \sqrt{(0{\cdot}17\ F'_\epsilon)^2 + (M'_\epsilon)^2 + (0{\cdot}58\ P_\epsilon)^2 + (0{\cdot}25\ I_\epsilon)^2} = \pm\ {\cdot}021.$$

$$3. \text{ - - - } (F' - P')_\epsilon = \pm\ {\cdot}031.$$

Where F'_ϵ, M'_ϵ, &c. denote the *mean errors* of the determinations of F′, M′, &c.

Collecting these results, we have—

DURBAN, EAST OF THE CAPE.

	Observer at Durban.	Resulting Longitude.	Mean Errors. Accidental.	Mean Errors. Per Eqn.	Resulting Mean Error.	Relative Weight.
		h m s	s	s	s	
1	Finlay -	0 50 12·158	±0·024	±0·22	±0·033	2·30
2	Maclear -	·156	± ·035	·021	·041	1·49
3	Pett ..	·126	± ·056	·031	·064	0·61

Where the relative weights have been computed according to the *mean errors*, weight 1 corresponding with a mean error = $\pm$ 0s·050.

These independent results thus accord much within the limits of their *mean errors*, and afford good ground for accepting the mean result, having regard to weight, viz. :—

Durban, East of the Cape. 0h 50m 12s·153
With a *mean error* = $\pm$·024(2)

as entirely satisfactory, and as affording strong proof of the general constancy of the Personal Equation of the observers, and of the accuracy of its determination in each case.

(1) In Chapter VII., the value of the personal equation F′ − P′ is determined with a *mean error* of $\pm$ 0s·038 from observations on four nights; the corresponding mean error for two nights is $\pm$ 0s·056.

(2) This *mean error* slightly in excess of the true *mean* error of the result, as the symbolical expressions F′ and M′ have opposite signs in operations 1 and 2, and thus the errors of their determination are partially eliminated from the mean result. It seems better, however, to regard the operations as strictly independent.

LONGITUDE DURBAN—ADEN.

The arithmetical mean of the 10 results of Table L., p. 43, gives for the difference of Longitude Durban—Aden, apart from personal equation—

$$- 55^{m}\ 48^{s}{\cdot}497 \ \textit{mean error} \pm 0^{s}{\cdot}029.$$

The determinations on the different dates, however, rest on observations of unequal weight.

On Aug. 29 and Sept. 23 there are complete time determinations both before and after the exchange of signals. To these nights I have given Weight 2.

On Aug. 23, Sept. 18, 19, 22, 28, complete time determinations were obtained before and after signals at only one of the stations, with one complete time determination before or after signals at the other. To these nights I have given Weight 1·5.

On the remaining nights there is one complete time determination, either before or after signals, at each station. To these nights I have given Weight 1.

Having regard to these weights, the resulting mean is—

$$- 0^{h}\ 55^{m}\ 48^{s}{\cdot}505 \ \textit{mean error} \pm 0^{s}{\cdot}029.$$

This result is affected by personal error corresponding to the expression—

$$-(F' + \Delta F'_n) + M' - \frac{F_m + F_s}{2} + \frac{M_m + M_s}{2}.$$

If we assume the personal equation of the observers to have remained constant throughout, we have only to substitute the values of these symbolical expressions, as determined in last chapter, when the correction to be applied to the Longitude becomes—

$$- 0^{s}{\cdot}332 \pm 0^{s}{\cdot}030.$$

And the value of the Longitude Durban—Aden is

$$- 0^{h}\ 55^{m}\ 48^{s}{\cdot}837 \ \textit{mean error} \pm 0^{s}{\cdot}042.$$

Besides this result we have exchanges of signals, Aden—Durban and Durban—Cape, on three nights, upon all of which complete time determinations, both before and after the signals, were obtained at both the extreme stations, although the sky was clouded at Durban.

The results are—

LONGITUDE CAPE—ADEN.

1881.	h m s	
Aug. 26	− 1 46 0·68	$-(F' + \Delta F_n') + \frac{P}{2} + \frac{I}{2} - \frac{F_m + F_s}{2} + \frac{M_m - M_r}{2} + \frac{P_r + P_s}{2}.$
27	0·52	$-(F' + \Delta F_n') + \frac{P}{2} + \frac{I}{2}$,, ,, ,,
Sept. 3	0·85	$-(F' + \Delta F_n') + P$,, ,, ,,

Substituting the values of the symbolical expressions, we have—

1881.	h m s
Aug. 26	− 1 46 1·098
27	0·938
Sept. 3	1·160
Mean	− 1 46 1·065 with an accidental *mean error* = ± 0ˢ·067.

The *mean error* of the determination of the Personal Equations is $\pm\, 0^{s}\!\cdot\!024$, so that the real *mean error* of this result is—

$$\pm\, 0^{s}\!\cdot\!070.$$

The difference of Longitude Cape—Aden is thus determined by two independent operations, viz.:—

		h	m	s	Mean Error. s	
	Cape—Durban	– 0	50	12·153	± 0·024	p. [56].
	Durban—Aden	– 0	55	48·837	± ·042	p. [57].
Hence -	Cape—Aden	– 1	46	0·990	± ·048	
	and, directly	– 1	46	1·065	± ·070	p. [57].

Whence we have definitively—

Aden, East of Cape Transit Circle, $1^{h}\ 46^{m}\ 1^{s}\!\cdot\!015$
With a *probable error* = ± ·027

Greenwich—Aden.

The longitude of Aden, as already explained in the Introduction, has been determined by two independent series of operations.

Series A.

Greenwich—Mokattam (near Cairo).

	h	m	s	Mean Error. s	
Apparent difference of longitude	– 2	5	6·58	± 0·028	(1)
Personal Equation in giving and receiving signals			+ ·09	± ·050	(2)
Personal Equation in observing transits			+ ·25	± ·079	(3)
	– 2	5	6·24	± ·098	

Notes.

(1.) Transit of Venus, 1874. British Observations, p. 283; *mean error* is deduced from agreement of results on the four different nights.

(2.) No satisfactory particulars are published about the determination of the various Personal Equations in giving and receiving signals; it is evident from the remarks (*loc. cit.*, p. 287) that the *mean error* of the combined equations is certainly not over estimated at ± 0·35.

(3.) Loc. cit., p. 288; *mean error* deduced from agreement of results on seven nights.

Mokattam—Suez.

	h	m	s		
Apparent difference of longitude	– 0	5	6·881	± 0·066	(4)
Correction for aberration and Personal Equation			– ·050	± ·080	(5)
	– 0	5	6·931	± 0·132	

Notes.

(4.) Transit of Venus, 1874. British observations, p. 345; mean error determined from agreement of the four results.

(5.) The determination of the equation, B − H (loc. cit., p. 329) is affected with a mean error = ± 0s·063 in star observing, exclusive of the error in the determination of their personal error in giving and receiving signals.

Suez—Aden.

	h m s	s	
Definitive difference of longitude	− 0 49 42·662		(6)
Mean error (accidental)		± 0·033	(6)
Mean error in determination of Personal Equation		± ·050	(7)
	− 0 49 42·662 ± 0·060		

Notes.

(6.) Determined by Captains Campbell and Heaviside, R.E., on May, 25, 26, 27, 28, 29, 30, 1877. (G.T. Survey of India, Vol. IX., p. (105)) The accidental mean error of the result is deduced from the agreement of the results on the six nights of observation.

(7.) The Personal Equation employed depends on the following determination of the equation H − C, made at Bombay, *loc. cit.*, Table X., p. 56.

	No. of Stars.	Stars North of Zenith.	Apparent Mean Error.	Stars South of Zenith.	Apparent Mean Error.
		s	s	s	s
1877, April 4	4	+ ·085	± ·023	− ·028	± ·014
5	3	+ ·023	± ·007	− ·004	± ·005
7	7	+ ·052	± ·008	− ·025	± ·011
5	5	− ·027	± ·014	− ·042	± ·004
		+ ·033		− ·025	
Mean Error	-	- ± ·024		± ·008	

Unfortunately these observations were all taken previous to the expedition, and collateral evidence appears to show that about the time in question the relative Personal Equation of the observers was not quite constant.

	H − C N.	S.
At Bolarum, 4 nights in December 1875	+ ·111	+ ·045*
At Madras, Bombay, and Bangalore } February—April 1876, 5 nights }	+ ·123	+ ·038
At Bangalore, 3 nights in December 1876	+ ·133	+ ·066

All these results are in very satisfactory accord, with a very slight tendency to increase with the time; but between 1876 December, and April 1877 we find, as above, a sudden change of nearly 0s·1 diminishing, and it is thus difficult to suppose that with the additional disturbance of a sea voyage the Personal Equation of the observers remained constant from the beginning of April till the end of May. I think, therefore, that the mean error of the Personal Equation cannot be over estimated at ± 0s·050.

* In these means the results of each night have equal weight, instead of a weight deduced from the so called *mean error* of each night; such as is done in the G.T. Survey of India. This latter plan ignores the well known fact that the personal error of every observer varies from night to night by a quantity which is large compared with the accidental error of observation. For example, the accidental mean error of a night's work in the above quoted determinations, computed from the observations of the same night, as compared with the actual errors deduced from the agreement of the results on different nights is—

	N. Stars.	S. Stars.
Computed	± ·014	± ·010
Actual	± ·048	± ·016

Series B.

This series depends on observations made by Dr. Löw, chief of the German expedition for observation of the Transit of Venus at Mauritius in 1874, and by myself in connexion with the expedition of Lord Lindsay (now Earl of Crawford and Balcarres) to the same island for the same object.

The observations have been independently reduced on part of both expeditions. One of these discussions is published by Lord Crawford in full detail (Dunecht Publications, Vol. III.) under the final supervision of Dr. Copeland. The results of an independent discussion by Dr. Auwers have been kindly communicated to me by the author in a letter dated 1884, June 20.

Dr. Copeland's results are as follows:—

	h m s	Dunecht Pubs., Vol. III.
Greenwich—Berlin (Transit Circle) -	− 0 53 34·865	p. 490
Berlin—Alexandria - - -	− 1 5 58·942	491
Alexandria—Suez (Gill's Station) -	− 0 10 38·923	492
Suez—Aden (Gill's Station) -	− 0 49 43·750	493
Greenwich—Aden (Gill's Station) -	− 2 59 56·480	

Dr. Auwers' results are as follows:—

Berlin—Alexandria.

	h m s	Mean Error. s
Observed difference of local times -	− 1 5 58·988	± 0·042
Per. eq in obs. transits (Löw—Gill) -	+ ·051	± ·03
„ „ (Löw—Knorre) -	− ·005	± ·05
„ in obs. mirror signals (L—G) -	− ·021	± ·025
½ correctn to sigs. given by Löw - -	− ·006	± ·01
„ „ Auwers -	− ·033	± ·01
½ retardation of sigs. on Morse recorder at Berlin - - - - -	− ·018	± ·005
Berlin—Alexandria - - - - -	− 1 5 59·020	± 0·078

Alexandria—Suez (Gill's Station).

	h m s	s
Observed difference of local times - -	− 0 10 39·027	± 0·076
Per. eqn in obsns transits - - -	− ·051	± ·03
„ mirror sigs - - -	+ ·021	± ·025
Alexandria—Suez (Gill's Station) - -	− 0 10 39·057	± 0·085
Correction on account of per eqn. introduced for mirror sigs., as relays were employed in this operation.—(D.G.) - - - - - - -	− ·021	
Corrected result - -	− 0 10 39·078	± 0·082

Suez—Aden (Gill's Station).

	h m s	s
Observed difference of local times - -	− 0 49 43·763	± 0·113
Per. eq (L—G) in obs. transits - -	+ ·051	± ·03
„ in obs. mirror sig - - -	− 021	± ·025
	− 0 49 43·733	± 0·120

The result Alexandria—Aden, is free from Personal Equation in observing transits, whence, allowing for the correction introduced by me into Dr. Auwers' result for Alexandra—Suez, we have—

Alexandria—Aden - - - −1 0 22·811 ± 0·139

And applying the longitude of Berlin, already quoted, to Dr. Auwers' results, we have, as the result of Lord Lindsay's Expedition—

GREENWICH—ADEN (GILL'S STATION).

		s
Auwers' reduction - - -	− 2 59 56·696	± 0·160
Copeland's, already quoted - - -	− 2 59 56·480	

Under the superintendence of Captain Heaviside, R.E., the two Longitude Stations (G. T. Survey, Heaviside's Station) and (Gill's Station) at Aden were connected by careful triangulation (G. T. Survey of India, Vol. IX., Appendix, Part II.), from which source the following results are extracted:—

	Latitude. ° ′ ″	Longitude. ° ′ ″
Longitude Station (G. T. Survey) -	N. 12 46 27·00	E. 44 58 57·45
Latitude Station „ -	12 46 27·00	44 58 57·65
Lord Lindsay's (Gill's) Station -	12 47 14·70	44 59 10·61

Hence, to reduce the above results of Series B. to the origin of the Aden—Cape Series (which was that of the G. T. Survey), we have to apply the correction + 0·877 to the results of Auwers and Copeland. Thus we obtain—

Longitude of G. T. Survey Station, Aden.

	h m s	Mean Error s
From sum of Series A. - -	− 2 59 55·833	± 0·154
From Series B., Auwers - - -	55·819	± 0·160
Copeland - -	55·603	

It is well remarked by Lord Crawford, in his preface to Vol. III. of the Dunecht Publications, " Given a large mass of observations . . . . it becomes possible so to " discuss them as to slightly modify the final deductions." It was this consideration which prompted him to publish the work in complete detail. It would be impossible to find two more capable or careful astronomers than Drs. Auwers and Copeland to discuss such a mass of observations, and no better course can be adopted than to take the mean of their results; and (as Dr. Copeland has not computed the *mean error*) to adopt the value of it found by Dr. Auwers, as the definitive result of Lord Lindsay's expedition, viz.:—

$$-\overset{\text{h}}{2}\ \overset{\text{m}}{59}\ \overset{\text{s}}{55{\cdot}711} \pm \overset{\text{s}}{0{\cdot}160}$$

As the *mean errors* of Series A. and Series B. are practically identical, we take their mean as the definitive result for the longitude of Aden, of which the *probable error* is—

$$\pm\, 0{\cdot}6745 \times \frac{\overset{\text{s}}{0{\cdot}16}}{\sqrt{2}}$$

Whence we have the final definitive result—

	h	m	s	Prob. Error.
Aden, East of Greenwich - -	2	59	55·772	± 0·079
Cape, West of Aden (p. [58.]) -	1	46	1·015	± 0·027
Cape, Transit Circle, East of Greenwich	1	13	54·757	± 0·084

The weak point of this result is unquestionably the determination of the longitude Greenwich—Aden. Neither of the two series of operations on which it depends was executed with such refinements or precautions as are necessary for the determination of fundamental longitudes; nor indeed, so far as I know, were these operations planned with a view to the securing of more accuracy than would amply suffice for Transit of Venus purposes.

For refined purposes, the results of the British Transit of Venus party are vitiated by the extraordinary variations of the Personal Equation of the observers engaged in the determination of the Greenwich—Mokattam longitude, the results varying over a range of six-tenths of a second of time on the seven nights upon which Personal Equation was determined. For the longitude Mokattam—Suez there is no comparison of the Personal Equation of the observers before the expedition, and only a somewhat unsatisfactory one after it. In the determination of the longitude Suez—Aden a great part of the advantages, given by the refined instruments and methods and the excellent observations of Captains Campbell and Heaviside, R.E., are lost from the absence of a determination of Personal Equation after as well as before the Aden—Bombay operations; the necessity for such a check is illustrated by the actual change in the personal equation of the observers which I have already quoted. In the case of Lord Lindsay's expedition, the observations lay no claim to high refinement. They were made throughout in the open air, with small portable instruments, which, in the case of Alexandria, were placed on the roof of a hotel, where the observer had to abstain from movement during each complete observation, otherwise the level was disturbed by the change of his position. At Aden and Alexandria the chronometers had to be carried a long distance between the observing station and the telegraph office; the observers were without personal assistance, and the crucial observations for time had often to be made under conditions of extreme fatigue, amounting on one or two occasions nearly to exhaustion, on part of the observers engaged. In fact, the character of the work was only such as it was possible to organise and execute *en route*, and the results fully realised the accuracy expected from them. But it is greatly to be desired that a refined determination of the longitude of Aden should be undertaken. That station is now the origin not only of the Cape of Good Hope and all East and South African longitudes, but also of the longitudes of India, Australia, and New Zealand. The problem is a much easier one than that of the connexion of Aden and the Cape, because the facility of transport would permit easy exchange of observers, and their meeting at an intermediate point for further check on Personal Equation; and besides there would be much less risk of loss of health to those engaged on the work.

Current Time of Transmission of Signals.

The reader is referred to the accompanying sketch map of the South African Telegraphic System in connexion with the following remarks. The exchange of signals for longitude through land lines about 1,100 miles* in length (which pass through a sparsely populated country, through many different kinds of climate, and districts liable to frequent thunderstorms, and occasionally to sudden floods), demands the most hearty co-operation of the telegraph officials as well as much patience on part of the Astronomers. It not unfrequently happened that when the weather was fine at both ends, and all promised well, telegraphic communication was entirely interrupted, and no longitude work could be done, or another route had to be rapidly arranged, or additional relays had to be introduced. For these reasons it was found impossible to equalise resistances and exchange relays in the systematic manner which is usual in the most refined longitude operations. Any attempt of this kind would have involved almost interminable delays, and have added so much to the cost of the operations as entirely to preclude its adoption. Indeed, apart from cost, the additional interval thus created between the determinations of Personal Equation would probably have introduced an additional element of uncertainty, exceeding the advantages which might be hoped for from the perfect equalisation on every occasion of the current time of the going and returning signals. The proof of freedom from systematic error on this account, must be looked for in the agreement of the longitude results notwithstanding the very various conditions of the various portions of the different lines, and in the fact that different lines with various numbers of relays introduced in them were employed.

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* The coast line to Durban measures 1,146 miles.
The midland line to Durban measures 1,088 miles.

The following table gives the current time resulting from the exchange of signals (corrected for Personal Equation of the observers in sending and receiving signals) together with the names of the stations at which relays were introduced.

GW	denotes	George.
PE	„	Port Elizabeth.
FB	„	Fort Beaufort.
KW	„	King William's Town.
UA	„	Umtata.
PMB	„	Pietermaritzburg.
BW	„	Beaufort—West.
GR	„	Graff Rienet.
SE	„	Somerset—East.

Date.	Current Time Cape Durban.	Stations at which relays were introduced.
1881.	s	
June 17	+0·144	GW, PE, UA.
21	·229	BW, GR, SE, FB, UA.
22	·140	GW, PE, KWT, UA.
27	·100	GW, PE, UA.
Aug. 18	·155	GW, PE, UA.
19	·180	Coast line; relay stations not recorded.
26	·193	BW, GR, KWT, UA.
27	·198	Coast line; relay stations not recorded.
Sept. 3	·215	Coast line; UA, PMB.
19	·328	Coast line; relay stations not recorded.
Dec. 23	·215	Coast line; UA, PMB.
1882.		
Jan. 8	·218	Coast line; UA, PMB.
14	·198	BW, GW, FB, UA.
20	·199	Coast line; relay stations not recorded.
21	·178	Coast line; relay stations not recorded.
27	·183	Midland line; relay stations are recorded.
July 10	·181	GW, PE, FB, UA, PMB.
13	·206	BW, GR, FB, UA.

The following are the various current times in the exchange of signals between Durban and Aden :—

1881.		Current Time, Durban and Aden.
		s
Aug.	20	+1·467*
	23	1·279
	26	1·258
	27	1·362
	29	1·274
Sept.	2	1·301
	3	1·315
	13	1·281
	18	1·379
	19	1·276
	22	1·274
	23	1·272
	26	1·286
	28	1·232

Mean	+ 1·291	*probable error*		± 0·007
Personal Eq^{n}	− ·125	„	„	± ·011
Current Time	+ 1·166	„	„	± 0·013

The batteries employed were strictly similar at both ends of the Cable.

* Rejected for reasons stated on page [43].

CHAPTER IX.

LATITUDES OF DURBAN AND ADEN.

No attempt has been made to determine the latitude of the observing stations with high accuracy. The only available Altazimuth instrument was into the hands of Mr. Finlay, to enable him to determine the latitude at Aden, and to employ it in connexion with longitude determinations on the E. coast of Africa. To have detained Mr. Finlay at Durban for the purpose of making latitude determinations seemed unnecessary, as the future operations of the Geodetic Survey of South Africa (for the commencement of which I had then concluded arrangements between the Governments of the Cape Colony and Natal) would provide for accurate astronomical latitude determinations throughout Natal; and the establishment of an observatory in Durban (for which I had furnished the plans) provided for rigorous after determination of the latitude of a point not far from the site of the longitude operations at Durban.

Latitude of Durban.

The results of Mr. Finlay's observations of circum-meridian altitudes at Durban, are the following:—

1881.	Star	Circle.	Latitude.
June 24	η Scorpii - -	L, R	−29° 51′ 33″·2
29	ν² Scorpii - -	R	29·3
,,	20 Ophiuc. - -	L	
Nov. 27	φ Eridani - -	L, R	25·9
,,	β Orionis - -	L, R	25·5
,,	ζ Orionis - -	L, R	33·7
,,	α Pictoris - -	L, R	32·7
,,	α Argûs - -	L, R	30·0

Mean of N. stars - -	−29 51 29·83
S. ,, - -	30·45
Latitude of Durban (Longitude Pillar)	−29 51 30·14

From a preliminary computation by Captain Morris, R.E., of a chain of triangles measured by Lieut. Laffan, R.E., connecting Zwartkop (the initial point and origin of the Geodetic Latitudes and Azimuths of the Survey) with stations near Durban, we have the following results :—

	Longitude East of Zwartkop.	Latitude South of Zwartkop.
	m s	′ ″
Transit Pier of longitude operations	3 5·76	15 58·16
Government Observatory, Durban	3 0·03	15 13·21
Durban Lighthouse	3 13·61	16 51·00

The latitude of Zwartkop, as determined by the Geodetic Survey Astronomical Observations (Talcott's method, Observer, Captain Morris, R.E.) is—

$$-29^\circ\ 35'\ 33''\cdot32,$$

and this reduced to the longitude pier becomes—

$$-29^\circ\ 51'\ 31''\cdot48$$

a result which is, of course, liable to be affected by abnormal local attraction.

Mr. Neison has kindly communicated to me the results of his observations for latitude of the Government Observatory, Durban, viz. :—

	° ′ ″
	− 29 50 47·40
Corrn. to Long. Pillar	−44·95
	− 29 51 32·35

And this must be accepted, for the present, as the most reliable determination of the three.

Latitude of Aden.

Mr. Finlay's Latitude determinations at Aden are the following, taken at the site of the longitude operations :—

Latitude of Aden (G. T. Survey Station).

1881.	By Stars South of the Zenith.	° ′ ″	Mean. ° ′ ″
Aug. 30	α Gruis	+ 12 46 29·3	+ 12 46 28·9
Sept. 15	β Ceti	27·0	
„ 24	θ Ceti	30·8	
„ 25	θ Ceti	28·7	
	By Stars North of the Zenith.		
Sept. 15	β Cassiopeiæ	+ 12 46 23·0	+ 12 46 23·0
„ 24	γ Andromedæ	21·7	
„ 25	γ Andromedæ	24·4	
	Mean		+ 12 46 26·0

The latitude of the same station was also determined by Captain Heaviside, R.E., with a 10-inch theodolite. His results (G.T. Survey of India, Appendix to Part II., p. (111)) give for the mean resulting latitude—

$$+ 12^\circ\ 46'\ 27''$$

I should prefer to reject his observations of Polaris, made at ZD 76°, and without observations of a corresponding star S. of the Zenith, his result then becomes—

$$+ 12^\circ\ 46'\ 26''\cdot 5$$

which agrees with Mr. Finlay's result far within limits of the probable error of either.

I cannot conclude this account without recording an expression of my grateful thanks:—

(1.) To Sir James Anderson, who most generously placed the submarine cables between Aden and Durban entirely at my disposal for this work.

(2.) To James Siveright, Esq., C.M.G., General Manager of Telegraphs at the Cape, for not only placing the whole South African system of land lines at my disposal, but also for making all the necessary arrangements, and supplying all necessary aid. Also for the exact execution of this work to Mr. J. P. Edwards, his able and active assistant, and to the officers in charge of the stations where relays had to be introduced.

(3.) To H. Carlisle, Esq., and C. Stacey, Esq., the Superintendents at Durban and Aden, not only for the efficient aid they rendered, but for their kindly hospitality to all engaged in the work.

(4.) To H. McEwen, Esq., and A. W. Prosser, Esq., members of the telegraph staff at Durban and Aden respectively, for the active share which they took in the work, for the intelligent interest which they displayed, and for the great enhancement of its value which resulted from their labours of love.

DAVID GILL.

An account, by Mr. Finlay, of the longitude operations connecting the secondary stations between Durban and Aden, carried out by him at my suggestion, forms Part III. of the present volume.

D. G.

SECTION I.

MEAN RIGHT ASCENSION

OF

389 TIME STARS

EMPLOYED IN THE LONGITUDE OPERATIONS,

DERIVED FROM OBSERVATIONS WITH THE TRANSIT CIRCLE.

12306. 400.—8/84. Wt.. 1124. E. & S.

SECTION I.

MEAN RIGHT ASCENSION OF 389 TIME STARS EMPLOYED IN THE LONGITUDE OPERATIONS.

No.	Name.	Mean R.A. 1881·0. h m s	Prec. s	Approx. N.P.D. 1881·0. ° ′	Mag.
1	4 Ceti	0 1 38·35	+3·073	93 15	6
2	B.A.C. 23	0 5 31·75	+3·056	118 28	5
3	7 Ceti	0 8 35·66	+3·056	109 38	5·4
4	Lalande 257	0 11 30·32	+3·049	109 43	6·7
5	*d* Piscium	0 14 28·61	+3·084	82 29	6·5
6	9 Ceti	0 16 45·85	+3·051	102 54	6
7	44 Piscium	0 19 18·11	+3·076	88 43	6
8	12 Ceti	0 23 57·93	+3·061	94 37	6
9	13 Ceti	0 29 7·35	+3·060	94 15	6
10	15 Ceti	0 31 59·48	+3·069	91 12	6·7
11	B.A.C. 174	0 34 38·80	+3·055	95 5	6
12	17 Ceti	0 38 11·15	+3·029	101 20	5
13	19 Ceti	0 44 9·90	+3·022	101 19	5·6
14	20 Ceti	0 46 55·59	+3·068	91 48	5
15	22 Ceti	0 50 3·39	+3·012	101 57	6·5
16	23 Ceti	0 52 46·32	+3·008	102 1	6
17	26 Ceti	0 57 41·62	+3·077	89 18	6·7
18	Lalande 1994	1 1 47·13	+3·008	100 25	5·8
19	34 Ceti	1 5 40·37	+3·054	92 53	6·5
20	39 Ceti	1 10 33·83	+3·051	93 10	6
21	42 Ceti	1 13 43·28	+3·065	91 8	6
22	B.A.C. 408	1 16 33·82	+3·105	85 53	6·5
23	47 Ceti	1 20 59·22	+2·960	103 41	6
24	48 Ceti	1 23 53·60	+2·877	112 17	5·6
25	*	1 26 51·84	+2·897	109 35	6
26	50 Ceti	1 30 10·66	+2·926	106 2	6·5
27	ν Piscium	1 35 14·33	+3·115	85 9	5·4
28	o Piscium	1 39 6·62	+3·156	81 27	4
29	54 Ceti	1 44 33·18	+3·181	79 33	6
30	ξ Piscium	1 47 23·72	+3·099	87 25	4
31	56 Ceti	1 51 5·85	+2·807	113 7	5
32	112 Piscium	1 53 57·82	+3·101	87 29	6
33	61 Ceti	1 57 42·71	+3·062	90 56	6·7
34	Lalande 3979	2 3 7·07	+3·054	108 22	6·7
35	ξ Ceti	2 6 41·58	+3·081	81 43	5
36	67 Ceti	2 11 2·84	+2·984	97 0	6
37	B.A.C. 737	2 17 5·81	+2·732	114 23	5
38	ρ Ceti	2 20 12·04	+2·898	102 51	5
39	σ Ceti	2 26 26·82	+2·848	105 48	5
40	ν Ceti	2 29 37·86	+3·145	84 55	4·5
41	δ Ceti	2 33 23·02	+3·070	90 11	4
42	μ Ceti	2 38 30·62	+3·217	80 24	4·5
43	Lalande 5211	2 42 13·87	+2·873	102 59	6·7
44	τ^2 Eridani	2 45 38·41	+2·725	111 31	5·4
45	Lalande 5424	2 49 51·95	+3·198	82 6	6
46	λ Ceti	2 53 20·25	+3·209	81 34	5·6
47	ρ^3 Eridani	2 58 25·84	+2·940	98 4	5
48	Lalande 5759	3 0 40·40	+3·182	96 33	6·5
49	94 Ceti	3 6 42·07	+3·045	91 40	5·6
50	ζ Eridani	3 10 3·22	+2·912	99 47	4·5
51	Lacaille 1051	3 13 6·59	+2·650	112 58	5·6
52	Lalande 6248	3 16 12·13	+2·622	114 4	6·5
53	o Tauri	3 18 24·60	+3·226	81 24	4·3
54	Lalande 6476	3 23 58·83	+2·831	103 7	6
55	τ^5 Eridani	3 28 31·86	+2·646	112 2	4·5

No.	Name.	Mean R.A. 1881·0.			Prec.	Approx. N.P.D. 1881·0.		Mag.
		h	m	s	s	°	′	
56	20 Eridani	3	30	52·10	+2·730	107	53	5
57	22 Eridani	3	34	44·90	+2·967	95	36	5·6
58	24 Eridani	3	38	27·91	+3·043	91	34	6·5
59	τ^6 Eridani	3	41	43·66	+2·592	113	37	4
60	30 Eridani	3	46	48·98	+2·961	95	44	6·5
61	Lalande 7273	3	49	40·42	+2·824	102	27	6
62	Lalande 7384	3	53	0·53	+2·958	95	48	6
63	γ Tauri	3	56	49·61	+3·186	84	21	4
64	Lalande 7685	4	1	16·93	+2·687	108	23	6·7
65	o Eridani	4	6	3·48	+2·923	97	10	4·5
66	μ Tauri	4	9	4·38	+3·253	81	25	5
67	ξ Eridani	4	17	45·38	+2·988	94	2	5·6
68	44 Eridani	4	22	23·03	+3·097	88	53	5·6
69	45 Eridani	4	25	47·46	+3·066	90	19	5·6
70	W. B. IV–585	4	28	29·90	+2·873	99	13	5·6
71	Lalande 8736	4	31	36·82	+3·014	92	43	6·5
72	54 Eridani	4	35	14·19	+2·622	109	55	5
73	Lalande 8935	4	38	22·32	+2·881	98	44	6·5
74	Lalande 9045	4	42	15·63	+2·684	107	10	6·5
75	π^4 Orionis	4	44	52·03	+3·191	84	36	4·5
76	π^5 Orionis	4	48	3·20	+3·122	87	46	4
77	Lalande 9293	4	50	32·58	+2·953	95	22	6
78	64 Eridani	4	54	24·00	+2·784	102	43	6
79	B.A.C. 1559	4	57	19·45	+2·430	116	27	5
80	ι Orionis	5	1	24·21	+3·262	81	40	6
81	λ Eridani	5	3	27·02	+2·870	98	55	4
82	ι Leporis	5	6	44·78	+2·796	102	1	4·5
83	τ Orionis	5	11	49·71	+2·913	96	59	4
84	o Orionis	5	15	41·20	+3·062	90	30	5·6
85	Lalande 10145	5	18	34·25	+3·113	88	16	5·6
86	Lalande 10325	5	23	27·85	+2·991	93	33	6·5
87	v Orionis	5	26	10·49	+2·902	97	23	5
88	c Orionis	5	29	30·96	+2·959	94	55	5
89	ι Orionis	5	29	36·70	+2·933	96	0	3·5
90	σ Orionis	5	32	46·33	+3·011	92	40	4
91	b Orionis	5	36	19·34	+3·106	88	35	6
92	γ Leporis	5	39	30·09	+2·522	112	29	4
93	Lalande 11047	5	43	29·29	+3·304	80	10	6
94	δ Leporis	5	46	12·20	+2·564	110	53	4
95	η Leporis	5	50	59·07	+2·735	104	12	4·3
96	Lalande 11382	5	54	6·15	+3·001	93	5	6·5
97	66 Orionis	5	58	41·14	+3·170	85	50	6
98	B.A.C. 1965	6	1	34·37	+2·503	113	6	6
99	B.A.C. 1994	6	6	4·34	+2·920	96	31	5
100	5 Monocerotis	6	9	3·11	+2·927	96	14	5·4
101	7 Monocerotis	6	13	58·85	+2·891	97	46	6
102	8 Monocerotis	6	17	27·72	+3·181	85	21	5·4
103	10 Monocerotis	6	22	4·99	+2·964	94	41	5
104	13 Monocerotis	6	26	28·08	+3·246	82	34	5
105	ξ^2 Can. Maj.	6	30	4·08	+2·514	112	52	5
106	15 Monocerotis	6	34	25·45	+3·306	80	0	4
107	ξ Geminorum	6	38	36·63	+3·378	76	59	4
108	18 Monocerotis	6	41	39·32	+3·131	87	27	5
109	θ Can. Maj.	6	48	39·69	+2·798	101	53	4·5
110	B.A.C. 2291	6	53	43·34	+2·459	115	15	6·5
111	19 Monocerotis	6	57	0·25	+2·981	94	4	6·5
112	Lalande 13811	7	1	5·43	+2·820	101	6	6
113	20 Monocerotis	7	4	19·05	+2·982	94	3	6·5
114	26 Can. Maj.	7	7	20·07	+2·454	115	44	6
115	B.A.C. 2405	7	11	48·71	+2·406	117	40	6

No.	Name.	Mean R.A. 1881·0.	Prec.	Approx. N.P.D. 1881·0.	Mag.
		h m s	s	° ′	
116	B.A.C. 2433	7 15 57·05	+3·161	89 36	6
117	ε Can. Min.	7 19 8·59	+3·284	80 29	6
118	B.A.C. 2470	7 22 15·96	+2·823	101 18	6·7
119	26 Monocerotis	7 35 33·69	+2·871	99 16	4·5
120	τ Navis	7 39 1·81	+2·409	118 40	4
121	o Puppis	7 43 8·37	+2·495	115 38	5
122	9 Argûs	7 46 15·62	+2·784	103 34	6
123	B.A.C. 2636	7 49 3·57	+3·265	80 49	6
124	27 Monocerotis	7 53 47·43	+3·005	93 20	5·6
125	B.A.C. 2679	7 56 44·36	+3·282	79 43	6·5
126	ζ Monocerotis	8 2 36·76	+3·020	92 38	5·4
127	β Cancri	8 10 3·66	+3·258	80 27	4·3
128	W.B. VIII—486	8 19 51·86	+2·908	98 34	7·6
129	B.A.C. 2846	8 22 50·60	+2·550	115 44	6
130	B.A.C. 2868	8 26 10·05	+2·699	109 9	6
131	δ Hydræ	8 31 21·31	+3·186	83 53	4
132	6 Hydræ	8 34 23·15	+2·850	102 2	6
133	B.A.C. 2954	8 37 49·72	+2·950	96 48	6
134	15 Hydræ	8 45 43·49	+2·955	96 43	6
135	B.A.C. 3082	8 56 1·72	+2·600	116 11	6
136	κ Cancri	9 1 18·02	+3·258	78 51	5
137	θ Hydræ	9 8 10·37	+3·117	87 11	4
138	Lalande 19241	9 42 17·99	+2·985	96 41	7·6
139	13 Sextantis	9 57 58·53	+3·118	86 13	6
140	A Leonis	10 1 35·35	+3·196	79 25	5
141	λ Hydræ	10 4 47·22	+2·939	101 44	4
142	21 Sextantis	10 8 12·60	+2·992	97 24	6
143	22 Sextantis	10 11 43·07	+2·993	97 27	6·5
144	25 Sextantis	10 17 25·64	+3·038	93 27	6
145	μ Hydræ	10 20 20·14	+2·909	106 12	4
146	ρ Leonis	10 26 32·68	+3·165	80 4	4
147	36 Sextantis	10 39 1·50	+3·098	86 53	6
148	l Leonis	10 43 0·14	+3·160	78 49	6
149	p^1 Leonis	10 55 45·44	+3·061	91 49	5
150	χ Leonis	10 58 52·67	−3·122	82 1	5
151	β Crateris	11 5 48·35	+2·945	112 9	4
152	φ Leonis	11 10 36·73	+3·058	92 58	5·4
153	79 Leonis	11 17 59·01	+3·083	87 56	5·6
154	k Crateris	11 21 9·88	+3·026	101 40	6
155	e Leonis	11 24 14·12	+3·065	92 19	5
156	θ Crateris	11 30 38·74	+3·045	99 7	4·5
157	Lalande 22102	11 33 49·72	+3·035	103 49	6
158	A^1 Virginis	11 41 48·05	+3·090	81 5	5·6
159	η Crateris	11 49 57·09	+3·055	106 27	6
160	Lalande 22585	11 54 38·03	+3·067	99 44	6·7
161	B.A.C. 4077	11 59 54·22	+3·073	92 26	6·7
162	Lalande 22818	12 3 59·52	+3·070	83 32	6
163	12 Virginis	12 7 22·36	+3·065	79 4	6
164	Lalande 23006	12 10 55·15	+3·091	106 2	6
165	η Virginis	12 13 49·06	+3·067	90 0	4
166	6 Corvi	12 17 9·59	+3·118	114 10	6·5
167	B.A.C. 4200	12 21 45·23	+3·082	93 55	6·7
168	Piazzi XII—111	12 25 31·60	+3·085	94 23	6·7
169	B.A.C. 4238	12 28 27·66	+3·049	81 36	7
170	χ Virginis	12 33 6·30	+3·097	97 18	5
171	ψ Virginis	12 48 9·95	+3·116	98 52	5
172	44 Virginis	12 53 31·74	+3·090	93 10	6
173	Lalande 24277	12 57 23·78	+3·193	109 57	6
174	B.A.C. 4382	13 0 10·29	+3·161	104 16	6·5
175	θ Virginis	13 3 47·34	+3·103	94 52	4·5

No.	Name.	Mean R.A. 1881·0. h	m	s	Prec. s	Approx. N.P.D. 1881·0. °	′	Mag.
176	54 Virginis	13	7	5·23	+3·200	108	12	6·5
177	58 Virginis	13	11	13·15	+3·144	99	55	6
178	B.A.C. 4462	13	14	33·19	+3·032	84	33	7
179	66 Virginis	13	18	21·55	+3·109	94	32	6
180	72 Virginis	13	24	13·26	+3·122	95	50	6·7
181	*h* Virginis	13	26	42·04	+3·156	99	33	6·5
182	81 Virginis	13	31	21·18	+3·139	97	16	7
183	*m* Virginis	13	35	22·04	+3·149	98	4	6
184	86 Virginis	13	39	35·89	+3·191	101	49	6
185	89 Virginis	13	43	24·40	+3·257	107	31	5
186	*p* Virginis	13	48	35·51	+3·082	90	53	6·5
187	47 Hydræ	13	51	50·61	+3·356	114	22	6
188	τ Virginis	13	55	35·44	+3·048	87	52	4·5
189	95 Virginis	14	0	25·22	+3·176	98	46	6
190	96 Virginis	14	2	40·21	+3·190	99	45	6·5
191	κ Virginis	14	6	32·92	+3·192	99	43	4·5
192	ι Virginis	14	9	46·50	+3·137	95	25	4
193	λ Virginis	14	12	40·25	+3·239	102	49	4
194	υ^2 Virginis	14	15	50·62	+3·092	91	26	6
195	B.A.C. 4773	14	18	16·03	+2·988	83	38	5·5
196	φ Virginis	14	22	4·29	+3·085	91	41	5
197	Lalande 26492	14	24	48·07	+3·000	84	42	6·7
198	109 Virginis	14	40	14·00	+3·033	87	35	4
199	58 Hydræ	14	43	18·16	+3·526	117	27	5
200	12 Libræ	14	47	25·54	+3·472	114	9	6
201	ξ^2 Libræ	14	50	18·69	+3·247	100	54	6
202	δ Libræ	14	54	36·89	+3·203	98	1	5
203	110 Virginis	14	56	53·30	+3·031	87	26	5
204	ν Libræ	14	59	59·39	+3·340	105	47	5
205	ι Libræ	15	5	26·37	+3·412	109	19	5·4
206	3 Serpentis	15	9	16·41	+2·980	84	36	6
207	32 Libræ	15	21	32·76	+3·373	106	17	4
208	ζ^3 Libræ	15	23	57·63	+3·375	106	12	6
209	37 Libræ	15	27	40·48	+3·251	99	38	5
210	41 Libræ	15	32	3·61	+3·438	108	53	5·6
211	κ Libræ	15	35	5·46	+3·451	109	17	5
212	ψ Serpentis	15	38	2·72	+3·018	87	6	6
213	ω Serpentis	15	44	17·06	+3·023	87	26	5·6
214	λ Libræ	15	46	25·61	+3·475	109	48	4
215	48 Libræ	15	51	31·53	+3·353	103	55	5
216	50 Libræ	15	54	22·21	+3·235	98	4	6
217	51 Libræ	15	57	49·49	+3·297	101	2	4·5
218	11 Scorpii	16	0	59·93	+3·328	102	24	6
219	c^2 Scorpii	16	4	58·49	+3·685	117	36	5
220	18 Scorpii	16	9	9·21	+3·240	98	3	6·5
221	Lalande 29689	16	12	17·32	+3·383	104	35	6·7
222	ψ Ophiuchi	16	17	8·44	+3·505	109	45	5
223	χ Ophiuchi	16	20	7·68	+3·471	108	11	5
224	φ Ophiuchi	16	24	19·67	+3·431	106	20	5
225	28 Herculis	16	26	44·34	+2·949	84	13	5·5
226	12 Ophiuchi	16	30	6·43	+3·117	92	3	6·5
227	14 Ophiuchi	16	35	40·93	+3·042	88	35	6
228	25 Scorpii	16	39	34·24	+3·666	115	18	6
229	20 Ophiuchi	16	43	15·06	+3·308	100	34	5
230	23 Ophiuchi	16	48	14·09	+3·206	95	57	5
231	Lalande 30831	16	51	55·51	+3·408	104	40	6·7
232	30 Ophiuchi	16	54	47·10	+3·163	94	2	5
233	Lalande 31109	17	0	42·37	+3·336	101	29	7·6
234	Lalande 31210	17	4	3·24	+3·361	102	32	6·7
235	37 Ophiuchi	17	6	51·24	+2·826	79	16	5

No.	Name.	Mean R.A. 1881·0			Prec.	Approx. N.P.D. 1881·0		Mag.
		h	m	s	s	°	′	
236	41 Ophiuchi - - -	17	10	30·15	+3·080	90	18	5
237	40 Ophiuchi - - -	17	13	52·36	+3·575	110	59	5
238	Lalande 31606 - -	17	17	35·11	+3·586	111	19	6·7
239	B.A.C. 5890 - -	17	20	19·06	+3·188	94	59	5·4
240	51 Ophiuchi - - -	17	24	9·30	+3·657	113	52	5
241	57 Ophiuchi - - -	17	31	22·62	+3·261	98	3	5
242	*o* Serpentis - - -	17	34	43·57	+3·375	102	48	5·4
243	Lalande 32325 - -	17	37	21·68	+3·237	97	1	7·6
244	γ Ophiuchi - - -	17	41	55·54	+3·009	87	15	4
245	Lalande 32633 - -	17	45	50·37	+3·101	91	12	7·6
246	B.A.C. 6060 - -	17	48	55·00	+3·527	108	47	6
247	Lalande 32923 - -	17	53	17·69	+3·185	94	48	6·1
248	7 Sagittarii - - -	17	55	33·54	+3·676	114	17	6
249	B.A.C. 6111 - -	17	57	52·59	+3·679	114	24	7
250	Lalande 33262 - -	18	1	36·93	+2·868	81	17	5
251	μ¹ Sagittarii - - -	18	6	38·78	+3·588	111	5	4
252	Lalande 33596 - -	18	10	6·40	+3·019	87	40	7·6
253	Rumker 6386 - -	18	13	24·30	+2·904	82	47	6·5
254	21 Sagittarii - - -	18	18	15·75	+3·574	110	36	5
255	B.A.C. 6279 - -	18	22	24·88	+3·421	104	39	5·4
256	61 Serpentis - - -	18	25	48·31	+3·098	91	5	6·7
257	B.A.C. 6324 - -	18	28	25·53	+3·333	101	4	6·5
258	B.A.C. 6347 - -	18	31	47·62	+3·585	111	9	6·7
259	B.A.C. 6367 - -	18	37	2·43	+3·268	98	24	5
260	B.A.C. 6388 - -	18	40	51·65	+3·185	94	53	5·4
261	30 Sagittarii - - -	18	43	41·28	+3·612	112	18	6
262	ν¹ Sagittarii - - -	18	46	59·05	+3·626	112	53	4·5
263	θ Serpentis - - -	18	50	18·19	+2·981	85	57	4·5
264	B.A.C. 6488 - -	18	54	45·45	+3·433	105	28	6·7
265	15 Aquilæ - - -	18	58	40·67	+3·168	94	13	6·5
266	19 Aquilæ - - -	19	3	10·20	+2·940	84	7	6·5
267	20 Aquilæ - - -	19	6	13·36	+3·257	98	8	6·5
268	*d* Sagittarii - - -	19	10	40·26	+3·516	109	10	5
269	υ Sagittarii - - -	19	14	54·67	+3·441	106	11	5·4
270	ν Aquilæ - - -	19	20	25·87	+3·071	89	55	5·6
271	*e* Aquilæ - - -	19	24	26·42	+3·139	93	3	5·6
272	B.A.C. 6694 - -	19	27	22·85	+3·629	114	7	7
273	κ Aquilæ - - -	19	30	29·32	+3·231	97	18	5
274	47 Aquilæ - - -	19	36	58·07	+2·824	78	27	6
275	υ Aquilæ - - -	19	39	52·61	+2·907	82	11	6
276	51 Aquilæ - - -	19	44	13·90	+3·308	101	4	6
277	η Aquilæ - - -	19	46	24·64	+3·056	89	18	4
278	β Aquilæ - - -	19	49	28·06	+2·946	83	54	4
279	63 Sagittarii - - -	19	55	18·56	+3·365	103	59	6
280	τ Aquilæ - - -	19	58	19·52	+2·932	83	4	5·5
281	Lalande 38458 - -	20	1	45·26	+3·217	97	7	6·7
282	ξ Capricorni - - -	20	5	48·03	+3·336	102	58	6·7
283	α¹ Capricorni - - -	20	11	3·03	+3·330	102	53	4·5
284	B.A.C. 7014 - -	20	17	16·91	+2·977	85	2	6
285	ρ Capricorni - - -	20	22	4·27	+3·432	108	14	5
286	Wash. 8892 - -	20	24	24·18	+3·372	105	36	6·7
287	ε Delphini - - -	20	27	31·64	+2·866	79	6	4
288	Lalande 40029 - -	20	37	45·16	+2·993	85	2	7·6
289	ε Aquarii - - -	20	41	13·98	+3·251	99	57	4·5
290	ω Capricorni - - -	20	44	43·02	+3·594	117	22	4·5
291	19 Capricorni - - -	20	48	4·30	+3·404	108	24	6
292	11 Aquarii - - -	20	54	17·81	+3·162	95	13	6
293	η Capricorni - - -	20	57	37·85	+3·427	110	20	5
294	ν Aquarii - - -	21	3	6·60	+3·269	101	53	4·5
295	α Equulei - - -	21	9	52·50	+2·997	85	15	4

No.	Name.	Mean R.A. 1881·0.	Prec.	Approx. N.P.D. 1881·0.	Mag.
		h m s	s	° ′	
296	16 Aquarii	21 14 49·94	+3·152	95 6	6
297	ζ Capricorni	21 19 52·31	+3·438	112 57	4
298	Lalande 41765	21 23 18·77	+3·375	109 41	6·7
299	8 Pisc. Aust.	21 29 16·82	+3·484	116 43	5·5
300	ξ Aquarii	21 31 24·98	+3·194	98 23	5
301	41 Capricorni	21 35 14·04	+3·421	113 48	5
302	46 Capricorni	21 38 39·48	+3·218	99 38	5·5
303	27 Aquarii	21 41 11·93	+3·045	87 52	5·5
304	Lalande 42574	21 45 5·22	+3·380	109 11	6·7
305	B.A.C. 7628	21 47 57·39	+3·135	94 52	6
306	B.A.C. 7649	21 52 5·46	+3·357	111 47	6·7
307	B.A.C. 7665	21 55 38·74	+3·305	108 30	6·7
308	ι Aquarii	22 0 0·51	+3·246	104 28	4·5
309	e Aquarii	22 4 15·65	+3·213	102 10	5·6
310	41 Aquarii	22 7 43·53	+3·323	111 41	6
311	θ Aquarii	22 10 33·20	+3·169	98 24	4·5
312	γ Aquarii	22 15 30·57	+3·093	92 0	4
313	π Aquarii	22 19 12·01	+3·065	89 14	5
314	σ Aquarii	22 24 20·86	+3·182	101 19	5
315	υ Aquarii	22 28 10·93	+3·278	111 21	5·6
316	κ Aquarii	22 31 35·57	+3·116	94 51	6
317	20 Pisc. Aust.	22 39 0·59	+3·297	115 52	6
318	τ^2 Aquarii	22 43 17·38	+3·185	104 13	4
319	λ Aquarii	22 46 24·33	+3·133	98 13	4
320	ρ Pegasi	22 49 14·25	+3·015	81 50	5·5
321	2 Piscium	22 53 21·51	+3·071	89 41	6·5
322	h^1 Aquarii	22 58 57·39	+3·125	98 22	6·5
323	c^2 Aquarii	23 3 5·97	+3·205	111 49	4
324	59 Pegasi	23 5 43·73	+3·028	81 56	5·5
325	φ Aquarii	23 8 9·49	+3·128	96 42	5
326	γ Piscium	23 10 59·76	+3·059	87 23	4
327	B.A.C. 8119	23 13 13·74	+3·100	95 47	6
328	b^1 Aquarii	23 16 43·12	+3·169	110 47	4·5
329	κ Piscium	23 20 49·93	+3·070	89 26	5·4
330	Lalande 45980	23 23 22·90	+3·092	95 11	6·7
331	16 Piscium	23 30 18·88	+3·069	88 34	6
332	ι Piscium	23 33 49·77	+3·059	85 2	4·5
333	i^1 Aquarii	23 38 1·67	+3·117	108 56	5
334	δ Sculptoris	23 42 43·48	+3·128	118 48	5
335	22 Piscium	23 45 52·27	+3·070	87 44	6
336	B.A.C. 8311	23 48 41·19	+3·074	90 34	6·5
337	ω Piscium	23 53 12·04	+3·068	83 48	4
338	2 Ceti	23 57 38·54	+3·078	108 2	4·5

SECTION II.

MEAN RIGHT ASCENSION

OF

87 SOUTHERN CIRCUMPOLAR STARS

EMPLOYED IN THE LONGITUDE OPERATIONS,

DERIVED FROM OBSERVATIONS WITH THE TRANSIT CIRCLE.

ORIGINALLY CIRCULATED FOR USE OF THE OBSERVERS OF THE TRANSIT OF VENUS IN 1882.

CATALOGUE of 87 SOUTHERN CIRCUMPOLAR STARS for 1882·0, from OBSERVATIONS made at the ROYAL OBSERVATORY, CAPE OF GOOD HOPE, in the year 1881.

THE following Southern Circumpolar Stars were selected for determining Azimuth in the recent operations which connect the longitudes of Aden and the Cape of Good Hope.

These stars have been regularly observed with the Transit-circle of the Observatory during the year 1881, and I have thought it desirable to publish the resulting Right Ascensions without delay for the use of Expeditions to the Southern Hemisphere in connection with the Transit of Venus of the present year.

The North-polar Distances are taken from Mr. Stone's Catalogue of 12,441 stars for 1880.

The Proper Motions have also generally been taken from the same work; when not given by Mr. Stone they have been independently investigated. When printed within brackets, the Proper Motions either depend on an interval not exceeding ten years, or the earlier observations are not sufficiently numerous or accordant to give a very precise value; but when any value is given it is to be understood that there is no doubt of the existence of a Proper Motion approximately of the amount stated.

The magnitudes are taken from the *Uranometria Argentina,* excepting those printed within brackets, which are taken from Mr. Stone's Cape Catalogue.

To reduce the Right Ascensions to a homogeneous system it was necessary, in the first place, to compare the personal errors of the four observers.

All the observations were made with a reversing prism conveniently mounted on the eye-piece between it and the observer's eye. By rotation of the prism the observer could make the star appear to move through the field from right to left, or from left to right at pleasure, and all the transits were observed over half the wires with the apparent motion from right to left, and over the other half from left to right; or if the wires were unsymmetrically observed, both sets were reduced to the middle wire, and the mean of the two sets was taken. A rigorous discussion showed that, by this arrangement, the difference of personal equation for transits above and transits below the pole was completely eliminated.

But one of the observers, Mr. Freeman, proved to have a very considerable personal equation, which had already been remarked by Mr. Stone (Cape Observations 1871–3, Introduction p. ix., and Cape Observations 1874, pp. viii. and ix.). Mr. Freeman is an experienced observer, but he systematically observes slow-moving stars too late, and appears to allow them to pass the centre of the wire about one second of arc before noting the time of transit, at least I find, by an elaborate comparison of his habit of observing, that his observations of circumpolar stars require the correction

$$+ 0^s{\cdot}09 - 0^s{\cdot}0697 \text{ sec. } \delta$$

and that this reduces his observations to very precise agreement with the mean of the other observers. The relative personal equations of the other observers for circumpolar stars are very trifling.

In the absence of bright stars near the South Pole, the Right Ascensions of Circumpolar Stars determined at this Observatory must depend fundamentally on the Right Ascensions of such circumpolars as can be observed at both culminations in the winter months.

If, therefore, the Transit-circle has a systematic tendency, in these months, to change its azimuth in one direction between the evening and morning observations, the whole system of fundamental azimuth stars will be affected by a systematic error, and this error will correspond with an error in the computed azimuth of the Transit-circle which will be a function of the Right Ascension, and may be expressed by

$$a + b \sin \alpha + c \cos \alpha + \&c.$$

To examine this point I have discussed the difference of Right Ascensions deduced from observations above and below pole, where the observations occur between sunset and midnight, and where therefore the upper and lower culminations occur at different seasons of the year.

Equations were formed of the type

$$a + b \sin \alpha + c \cos \alpha = \frac{\alpha' - \alpha_{,}}{f' - f_{,}}$$

where

α = The Star's approximate Right Ascension.

α' & $\alpha_{,}$ = The Star's R.A. deduced respectively from upper and lower transits.

f' & $f_{,}$ = The Star's Azimuth factor at upper and lower transit respectively.

The weights of these equations were computed by the formula

$$p = \frac{n'n_{,}}{n' + n_{,}}$$

where n' and $n_{,}$ are the number of observations above and below pole.

The solution of these equations by the method of least squares, having regard to the weight of each, gave the values of a, b, and c with their *mean errors* as follows:—

$$a = -\ 0^{s}{\cdot}0027 \pm 0^{s}{\cdot}0033$$
$$b = -\ 0{\cdot}0035 \pm 0{\cdot}0047$$
$$c = -\ 0{\cdot}0042 \pm 0{\cdot}0047$$

and the *mean error* of an equation of weight unity $\pm\ 0^{s}{\cdot}0414$.

It is obvious therefore that the observations are sufficiently accurate, and that there is no evidence of systematic diurnal change in the Azimuth of the instrument.

A more complete and definitive Catalogue of Circumpolar Stars will afterwards be published, but it is hoped that the present Catalogue will be found amply sufficient for the purposes for which it is intended.

DAVID GILL.

Royal Observatory, Cape of Good Hope,
1882, April 16.

B 2

No. in Stone.	Star's Name.	Magnitude.	Mean R.A. 1882·0.	No. of Obs.	Precess.	Proper Motion.	Mean N.P.D. 1882·0 (from Stone).	Precess.	Proper Motion.
			h m s		s	s	° ′ ″	″	″
20	Lacaille 9745 -	(7·0)	0 2 25·70	5	+ 2·827		176 41 46·36	−20·05	
37	γ^3 Octantis - -	5·6	0 4 39·52	6	+ 2·855	− 0·014	172 52 49·75	−20·05	+ 0·05
100	o Octantis - -	(6·3)	0 12 47·83	7	− 1·286	+ 0·012	179 1 8·49	−20·02	0·00
146	β Hydri - - -	2·7	0 19 31·71	9	+ 2·541	+ 0·720	167 55 8·08	−19·98	− 0·32
300	Lacaille 248 -	(6·3)	0 39 48·25	11	− 0·546		176 20 52·38	−19·75	
330	λ Hydri - - -	5·6	0 44 29·65	8	+ 2·070	+ 0·048	165 33 58·68	−19·68	+ 0·01
645	Lacaille 505 -	6·3	1 32 53·25	10	+ 0·334	+ 0·007	169 6 14·31	−18·43	+ 0·13
725	Lacaille 634 -	6·1	1 44 20·91	12	− 4·179	+ 0·010	175 21 54·55	−18·01	
755	Lacaille 606 -	6·1	1 48 54·78	5	− 0·687	− 0·026	170 45 34·60	−17·83	
804	Lacaille 637 -	6·3	1 56 4·51	5	− 0·241	(+0·050)	168 55 32·15	−17·54	
899	Lacaille 709 -	6·7	2 10 22·64	10	− 0·092		167 10 40·62	−16·90	
1117	Lacaille 1029 -	(7·0)	2 38 23·71	16	− 9·893		176 14 21·34	−15·45	
1211	ν Hydri - - -	5·1	2 51 14·90	8	− 0·453	− 0·014	165 32 57·59	−14·71	
1359	Lacaille 1105 -	6·3	3 11 35·31	4	− 2·247		169 26 13·00	−13·44	
1396	Lacaille 1848 -	(7·0)	3 15 7·28	6	−39·286		178 38 24·46	−13·22	
1496	Lacaille 1222 -	(6·3)	3 31 33·76	10	− 1·950		168 0 53·65	−12·10	
1630	Lacaille 1414 -	(7·0)	3 45 30·41	7	− 9·922		175 6 12·23	−11·11	
1768	Lacaille 1592 -	6·5	4 4 30·70	9	−12·171		175 36 28·53	− 9·68	
1785	Lacaille 1444 -	6·8	4 8 2·90	9	− 2·972	+ 0·006	168 56 54·69	− 9·41	
2006	Lacaille 1839 -	(7·0)	4 34 17·36	14	−17·443		176 31 42·75	− 7·33	
2210	Lacaille 1752 -	6·0	4 58 35·34	6	− 1·779	(+0·006)	165 7 5·24	− 5·31	
2330	Lacaille 1921 -	5·8	5 12 20·83	4	− 7·034		172 37 31·38	− 4·14	
2452	Lacaille 2066 -	6·8	5 25 28·41	7	− 9·483		173 59 23·64	− 3·01	
2653	Lacaille 2138 -	5·8	5 46 35·18	7	− 4·954	+ 0·034	170 33 23·68	− 1·17	− 0·93
2724	Lacaille 2296 -	6·1	5 53 4·73	21	−11·725		174 50 22·57	− 0·61	
2758	Lacaille 2210 -	5·5	5 58 14·93	5	− 4·057	− 0·006	169 22 49·28	− 0·15	
2901	* - - - -	(7·3)	6 12 6·64	11	−43·481		178 21 26·31	+ 1·06	
2985	Lacaille 2426 -	7·1	6 20 42·73	5	− 6·406		172 0 13·01	+ 1·81	
3290	ζ Mensæ - -	5·8	6 49 50·66	9	− 4·889	− 0·005	170 41 15·85	+ 4·33	
3713	Lacaille 3274 -	6·7	7 27 53·80	20	−19·339		176 50 1·17	+ 7·50	
4068	Lacaille 3238 -	6·8	7 56 54·81	7	− 4·543		171 17 20·93	+ 9·79	
4191	A Octantis - -	(7·0)	8 5 50·53	16	−41·176	− 0·014	178 31 25·43	+10·47	− 0·02
4389	θ Chamæleontis -	4·7	8 24 9·46	5	− 1·649	− 0·050	167 6 12·45	+11·80	− 0·01
4486	Lacaille 3537 -	6·2	8 31 16·20	6	− 3·257		170 31 36·79	+12·30	
4967	ζ Octantis - -	5·7	9 13 33·54	19	− 7·474	− 0·080	175 11 19·44	+15·00	− 0·02
5146	ι Chamæleontis -	5·8	9 28 2·06	7	− 1·730	− 0·060	170 16 37·35	+15·81	− 0·08
5252	ζ Chamæleontis -	5·5	9 37 18·44	7	− 1·542	+ 0·001	170 24 38·99	+16·29	+ 0·03
5351	Lacaille 4169 -	7·1	9 47 32·55	14	− 6·147		175 28 11·67	+16·79	
5501	Lacmæleontis -	6·0	10 3 49·30	5	− 1·346		171 38 37·32	+17·53	
5911	aille 4510 -	6·9	10 37 48·39	11	− 2·862	(−0·002)	175 28 43·56	+18·78	
5994	δ^2 Chamæleontis -	4·9	10 44 39·74	4	+ 0·645	− 0·030	169 55 5·26	+18·98	+ 0·01
6011	Lacaille 4578 -	(7·0)	10 46 58·43	9	− 3·365		176 16 40·81	+19·04	
6146	η Octantis - -	6·3	11 0 6·00	5	− 0·192	− 0·055	173 57 33·53	+19·37	+ 0·08
6387	Lacaille 4784 -	(7·0)	11 23 38·07	5	+ 0·955		174 18 20·70	+19·80	
6481	π^1 Chamæleontis -	6·2	11 32 24·42	5	+ 2·463	− 0·032	165 14 38·12	+19·91	+ 0·09
6513	Lacaille 4865 -	(7·0)	11 34 43·67	13	+ 1·446		174 50 0·58	+19·93	
6684	ε Chamæleontis -	5·0	11 53 47·13	6	+ 2·908	− 0·021	167 33 54·59	+20·05	+ 0·07
6703	Lacaille 4991 -	6·6	11 56 28·34	10	+ 2·839	− 0·043	174 58 29·10	+20·05	
6836	β Chamæleontis -	4·6	12 11 27·32	4	+ 3·405	− 0·017	168 39 25·21	+20·03	− 0·02
7017	Brisbane 4091 -	(7·0)	12 35 20·73	9	+16·926	− 0·088	179 9 4·96	+19·82	0·00
7073	ι Octantis - -	6·0	12 42 43·49	9	+ 5·636	+ 0·037	174 28 54·76	+19·71	0·00
7167	Lacaille 5325 -	(7·0)	12 54 43·57	11	+ 8·963	(−0·306)	176 55 29·81	+19·48	(+0·22)
7233	Lacaille 5406 -	6·3	13 4 31·12	5	+ 4·793	− 0·004	167 49 14·15	+19·26	+ 0·08
7387	κ Octantis - -	5·7	13 22 5·70	13	+ 8·631	− 0·052	175 10 47·61	+18·78	+ 0·05
7546	Lacaille 5633 -	6·6	13 40 42·41	12	+ 7·160		172 4 48·62	+18·15	

Stone 5351—Lac. 4169. A star, 7·5 magnitude, precedes 13ˢ·76 and is 0″·35 North.

No. in Stone.	Star's Name.	Magnitude.	Mean R.A. 1882·0.	No. of Obs.	Precess.	Proper Motion.	Mean N.P.D. 1882·0 (from Stone).	Precess.	Proper Motion.
			h m s		s	s	° ′ ″	″	″
7731	Brisbane 4614 -	(7·0)	14 2 7·90	14	+ 36·481		178 50 7·47	+17·27	
7780	δ Octantis - -	4·7	14 8 9·89	10	+ 8·955	− 0·053	173 7 31·00	+17·00	+ 0·02
7960	z Octantis - -	6·8	14 31 51·59	19	+ 23·230	− 0·160	177 39 48·40	+15·81	+ 0·05
8083	Brisbane 5046 -	5·9	14 44 23·10	5	+ 9·804	− 0·011	172 33 43·69	+15·11	
8363	ρ Octantis - -	5·9	15 16 17·60	10	+ 12·793	+ 0·091	174 4 3·13	+13·14	− 0·03
8601	Lacaille 6484 -	6·7	15 43 31·91	9	+ 8·139		167 40 33·33	+11·25	
8896	γ Apodis - -	3·9	16 15 23·79	5	+ 9·040	− 0·045	168 37 45·16	+ 8·84	+ 0·16
8914	Brisbane 5607 -	6·3	16 17 14·24	22	+ 20·914	0·000	176 8 11·60	+ 8·69	+ 0·04
8984	β Apodis - -	4·5	16 26 15·57	10	+ 8·501	− 0·105	167 16 1·52	+ 7·98	+ 0·34
9145	Lacaille 6948 -	6·8	16 44 42·27	6	+ 8·157		166 1 25·04	+ 6·47	
9273	* - - -	(7·0)	16 56 57·75	8	+ 30·065		177 16 15·28	+ 5·45	
9393	Lacaille 7088 -	6·4	17 9 25·47	6	+ 11·078	− 0·008	170 44 41·90	+ 4·39	+ 0·06
9538	Lacaille 7078 -	6·4	17 24 23·10	9	+ 18·673		175 9 39·14	+ 3·10	
9588	Lacaille 7184 -	(6·3)	17 29 41·04	5	+ 14·163		173 11 9·15	+ 2·65	
9725	Brisbane 6058 -	5·8	17 45 22·48	16	+ 35·715	− 0·112	177 39 33·69	+ 1·28	
9817	Lacaille 7348 -	6·5	17 55 14·17	9	+ 16·756		174 25 14·61	+ 0·42	
10085	σ Octantis - -	5·8	18 28 6·12	20	+107·729	+0·075	179 16 25·37	− 2·45	+ 0·02
10343	Lacaille 7751 -	(7·0)	18 55 10·39	15	+ 17·680		174 55 14·99	− 4·78	
10611	Lacaille 8094 -	6·9	19 34 12·16	7	+ 11·414	0·000	171 38 27·16	− 8·01	− 0·04
10885	Lacaille 8257 -	7·0	20 14 13·90	16	+ 15·322		174 48 11·84	−11·09	
10907	Lacaille 8360 -	6·5	20 18 15·05	5	+ 10·605		171 41 3·42	−11·38	
11135	α Octantis - -	5·6	20 50 22·18	9	+ 7·501	−0·001	167 28 18·50	−13·57	+ 0·40
11435	λ Octantis - -	5·7	21 32 39·94	13	+ 9·852	0·000	173 15 33·08	−16·05	0·00
11542	Lacaille 8927 -	6·6	21 49 29·15	5	+ 6·531		168 13 32·00	−16·89	
11665	C Octantis - -	6·4	22 8 38·44	19	+ 13·474	−0·035	176 33 55·73	−17·73	− 0·08
11807	Lacaille 9123 -	(7·0)	22 30 44·87	8	+ 8·211		174 21 27·02	−18·55	
12005	Lacaille 9332 -	6·3	22 58 43·20	5	+ 5·100	+0·034	170 7 1·04	−19·34	
12069	τ Octantis - -	6·0	23 9 42·68	15	+ 11·980	+0·036	178 7 45·81	−19·57	− 0·02
12124	Lacaille 9401 -	(7·0)	23 17 9·26	5	+ 6·975		176 21 28·32	−19·70	
12199	Lacaille 9464 -	(7·0)	23 27 47·51	13	+ 6·707		177 3 2·49	−19·86	
12260	Lacaille 9560 -	6·1	23 37 28·51	6	+ 3·776		169 26 47·42	−19·96	
12272	Lacaille 9563 -	(7·0)	23 39 42·85	5	+ 4·304		174 31 5·67	−19·97	

SECTION III.

PLACES

OF

28 NORTHERN CIRCUMPOLAR STARS

OBSERVED AT

ADEN,

WITH THE AUTHORITIES ON WHICH THE ADOPTED PLACES DEPEND.

SECTION III.

LIST OF STARS USED FOR DETERMINING AZIMUTHAL ERRORS AT ADEN.

No.	Star's Name.	Mag.	Mean R.A. 1881·0.			Approx. N.P.D. 1881·0.		Authority for Star's Place.
			h	m	s	°	′	
1	Bradley 6 - -	6·7	0	9	29·87	13	43	
2	Bradley 24 -	6	0	19	31·73	10	36	Greenwich Catalogues, 1864 and 1872.
3	Cephei - -	6·5	1	2	2·59	10	58	
4	α Ursæ Minoris -	2	1	15	7·97	1	20	
5	40 Cassiopeiæ -	6	1	29	1·89	17	34	
6	50 Cassiopeiæ -	4	1	53	17·93	18	9	
7	36 Hev. Casiopeiæ -	6·5	2	26	44·92	17	42	
8	Piazzi III–160 -	5·3	3	50	11·80	9	38	Greenwich Catalogues, 1864 and 1872.
9	51 Hev. Cephei -	5	6	44	16·56	2	46	
10	35 Draconis - -	5	17	54	46·67	13	1	
11	χ Draconis - -	4·3	18	23	12·06	17	19	
12	Groombr. 2784 -	6·7	19	2	55·87	13	9	Radcliffe Catalogue, 1845.
13	τ Draconis - -	5	19	17	50·04	16	52	
14	σ Draconis - -	5·3	19	32	35·19	20	32	Greenwich Catalogues, 1860, 1864, and 1872.
15	λ Ursæ Minoris -	6·3	19	43	7·69	1	3	
16	64 Draconis - -	5·7	20	0	1·74	25	31	Greenwich Catalogues, 1864 and 1872.
17	κ Cephei - -	4·5	20	12	52·22	12	39	
18	73 Draconis - -	5·6	20	33	3·75	15	27	
19	76 Draconis - -	6	20	51	6·75	7	55	
20	77 Draconis - -	6	21	7	51·18	12	21	
21	β Cephei - -	3	21	27	7·24	19	58	
22	11 Cephei - -	5	21	40	10·43	19	14	
23	24 Cephei - -	5·4	22	7	31·01	18	14	
24	Bradley 2993 -	5·3	22	22	35·81	4	30	Greenwich Catalogues, 1860, 1864, and 1872.
25	31 Cephei - -	5	22	32	49·79	16	58	
26	Bradley 3038 -	5	22	47	54·52	7	29	Greenwich Catalogue, 1872.
27	Bradley 3147 -	6	23	27	50·03	3	21	Greenwich Catalogues, 1864 and 1872.
28	γ Cephei - -	3·4	23	34	28·45	13	2	

In all cases where no authority is mentioned in the last column, the star's place has been taken from "*Mittlere und Scheinbare Oerter*, &c."

SECTION IV.

OBSERVATIONS WITH THE CAPE TRANSIT CIRCLE.

SECTION IV.—TABLE 1.

DETERMINATION OF COLLIMATION ERROR OF CAPE TRANSIT CIRCLE.

Date.	Hour.	Reading for line of Collimation.	Collimation Error.	Observer.
1881.		rev.	s	
April 9	6½	30·168	+0·013	P.
	6½	30·190	−0·008	I.
April 14	6¾	30·162	+0·019	P.
	6½	30·177	+0·005	I.
May 12	6¾	30·162	+0·019	P.
	7	30·175	+0·007	I.
May 20	6¼	30·151	+0·030	P.
May 23	6½	30·137	+0·043	P.
	6½	30·138	+0·042	I.
June 16	6¾	30·170	+0·011	P.
	6½	30·167	+0·014	I.
June 17	6½	30·164	+0·017	P.
	6½	30·172	+0·010	I.
June 20	7	30·134	+0·046	P.
	6½	30·138	+0·042	I.
June 21	6¾	30·153	+0·028	P.
	6¾	30·158	+0·023	I.
June 22	6½	30·145	+0·035	P.
	6½	30·145	+0·035	I.
June 27	6¾	30·148	+0·032	P.
	6¾	30·139	+0·041	I.
Aug. 18	5¼	30·151	+0·030	P.
	8½	30·165	+0·016	I.
Aug. 19	5¼	30·162	+0·019	P.
	8¾	30·144	+0·036	I.
Aug. 25	5½	30·145	+0·035	P.
	8¾	30·147	+0·033	I.
Aug. 26	5¾	30·155	+0·026	P.
	8½	30·147	+0·033	I.
Aug. 27	5½	30·153	+0·028	P.
	8½	30·149	+0·031	I.

Date.	Hour.	Reading for line of Collimation.	Collimation Error.	Observer.
1881.		rev.	s	
Aug. 28	5¼	30·162	+0·019	P.
	6½	30·156	+0·025	I.
Sept. 3	8¼	30·156	+0·025	P.
Sept. 19	5½	30·149	+0·031	P.
	5½	30·168	+0·013	I.
Dec. 23	7	30·173	+0·009	P.
	7	30·193	−0·011	I.
Dec. 29	6¾	30·182	·000	P.
Dec. 30	6¾	30·185	−0·003	P.
1882.			s	
Jan. 8	22	30·151	+0·030	P.
Jan. 9	6½	30·161	+0·020	I.
Jan. 14	6¼	30·165	+0·016	P.
Jan. 17	6¼	30·176	+0·006	P.
Jan. 20	6	30·193	−0·010	P.
Jan. 21	6¾	30·186	−0·004	I.
Jan. 26	6½	30·196	−0·013	P.
Jan. 27	9	30·180	+0·002	P.
Jan. 28	6¾	30·184	−0·002	P.
Feb. 13	6¾	30·187	−0·005	P.
Feb. 14	6¼	30·194	−0·011	P.
	6½	30·192	−0·010	I.
Feb. 15	6¾	30·181	+0·001	P.
	6¾	30·179	+0·003	I.
Feb. 17	6¾	30·171	+0·010	P.
	7	30·193	−0·010	I.

SECTION IV.—TABLE 2.

DETERMINATIONS OF LEVEL ERROR OF THE TRANSIT CIRCLE.

Date.	Hour.	Level Error. Observed.	Level Error. Adopted.	Observer.
1881.		s	s	
April 9	7¼	−1·023	−1·028	P.
	11¾	−1·033		
	7¼	−1·050	−1·050	I.
April 13	7¼	−1·049	−1·049	P.
	7	−1·061	−1·061	I.
April 14	7	−1·058	−1·060	P.
	11½	−1·063		
	7	−1·089	−1·089	I.
May 12	7	−1·081	−1·069	P.
	11½	−1·057		
	7	−1·081	−1·081	I.
May 20	6½	−1·036	−1·036	P.
May 23	7	−1·047	−1·050	P.
	11¾	−1·052		
	7	−1·055	−1·055	I.
June 16	6½	−1·183		
	8¾	−1·187	−1·181	P.
	13½	−1·174		
	6½	−1·188		
	13½	−1·167	−1·178	I.
June 17	6½	−1·162		
	8¾	−1·153	−1·153	P.
	13¼	−1·145		
	6½	−1·171		
	13¼	−1·156	−1·164	I.
June 20	6½	−1·057		
	9	−1·052	−1·052	P.
	12½	−1·048		
	6½	−1·068		
	9	−1·058	−1·057	I.
	12½	−1·046		
June 21	6½	−1·063		
	8¾	−1·066	−1·062	P.
	14¾	−1·057		
	6½	−1·065		
	8¾	−1·080	−1·068	I.
	14¾	−1·059		
June 22	6	−1·052		
	8¾	−1·040	−1·044	P.
	12¼	−1·041		
	6½	−1·046		
	8¾	−1·054	−1·050	I.
	12½	−1·049		
June 27	6¼	−1·135	−1·109	
	9	−1·083	−1·083	P.
	12¾	−1·082		
	6½	−1·125	−1·110	
	9	−1·095	−1·086	I.
	12¾	−1·077		
1881.		s	s	
Aug. 18	5½	+0·206		
	8¼	+0·211	+0·214	P.
	12	+0·225		
	8¼	+0·192	+0·191	I.
	10¼	+0·189		
Aug. 19	5½	+0·225		
	8½	+0·237	+0·234	P.
	11	+0·240		
	8½	+0·258	+0·250	I.
	11	+0·242		
Aug. 25	8½	+0·397	+0·400	P.
	10	+0·402		
	8½	+0·386	+0·388	I.
	9¾	+0·389		
Aug. 26	8½	+0·380	+0·372	P.
	12	+0·364		
	8¾	+0·367	+0·367	I.
	9½	+0·367		
Aug. 27	8¼	+0·344	+0·343	P.
	11¼	+0·341		
	8½	+0·348	+0·340	I.
	9½	+0·333		
Aug. 28	6½	+0·309	+0·318	P.
	11¼	+0·326		
	6½	+0·305	+0·317	I.
	11¼	+0·328		
Sept. 3	7¼	+0·419	+0·421	P.
	10¾	+0·422		
Sept. 19	6¼	+0·530		
	8½	+0·528	+0·533	P.
	10¾	+0·541		
	6¼	+0·506		
	8½	+0·504	+0·504	I.
	10¼	+0·502		
Dec. 23	7¼	+0·286		
	10¼	+0·290	+0·289	P.
	13¾	+0·292		
	7¼	+0·257		
	9¾	+0·262	+0·261	I.
	13¾	+0·264		
Dec. 29	7½	+0·236	+0·236	P.
	7½	+0·224	+0·224	I.
Dec. 30	7½	+0·245	+0·242	P.
	12¼	+0·238		

Date.	Hour.	Level Error. Observed.	Level Error. Adopted.	Observer.
		s	s	
1882. Jan. 8	9	+0·162	+0·162	P.
Jan. 9	7 7	+0·127 +0·108	+0·127 +0·108	P. I.
Jan. 14	6	+0·026	+0·026	P.
Jan. 17	6½ 11¾	−0·016 −0·013	−0·015	P.
Jan. 20	6½ 12	−0·028 −0·033	−0·031	P.
Jan. 21	9¼ 7 9½	−0·030 −0·059 −0·043	−0·030 −0·051	P. I.
Jan. 26	7 10¾	−0·072 −0·060	−0·066	P.
Jan. 27	6½ 11	−0·052 −0·036	−0·044	P.
1882. Jan. 28	7	−0·054	−0·054	P.
Feb. 13	6¾ 11¾ 7 11¼	−0·246 −0·239 −0·249 −0·244	−0·242 −0·247	P. I.
Feb. 14	6 11¼ 7 11	−0·249 −0·259 −0·244 −0·269	−0·254 −0·257	P. I.
Feb. 15	6½ 11¼ 6½ 11	−0·240 −0·250 −0·252 −0·256	−0·245 −0·254	P. I.
Feb. 17	7 11 7 11	−0·255 −0·262 −0·297 −0·288	−0·258 −0·293	P. I.

SECTION IV.—TABLE 3.

DETERMINATION OF AZIMUTH ERROR OF CAPE TRANSIT CIRCLE.

Date.	Observer.	Name of Star.	Time of Transit corrected for Collimation and Level.	Star's Apparent R.A.	Deduced Azimuth Error.	Adopted Azimuth Error.
			h m s	h m s	s	s
1881. Apr. 9	P.	Lacaille 8798 S.P.	9 33 56·31	9 32 29·95	+0·374	+0·400
		Lacaille 4169	9 49 18·42	9 47 45·22	+0·401	
		Lacaille 248 S.P.	12 40 51·74	12 39 27·22	+0·354	
		ι Octantis	12 44 27·35	12 42 54·16	+0·473	
	I.	Lacaille 9123 S.P.	10 31 58·18	10 30 31·75	+0·269	+0·328
		Lacaille 4578	10 48 49·33	10 47 16·30	+0·334	
		Lacaille 9464 S.P.	11 28 45·83	11 27 22·44	+0·321	
		Lacaille 4865	11 36 28·39	11 34 56·03	+0·339	
Apr. 13	I.	- - - - - - - -				+0·406
Apr. 14	P.	Lacaille 8798 S.P.	9 34 0·88	9 32 30·84	+0·437	+0·415
		Lacaille 4169	9 49 22·76	9 47 44·06	+0·528	
		Lacaille 248 S.P.	12 40 56·80	12 39 27·45	+0·303	
		ι Octantis	12 44 30·87	12 42 54·08	+0·391	
	I.	Lacaille 9123 S.P.	10 32 2·44	10 30 32·57	+0·378	+0·446
		Lacaille 4578	10 48 53·52	10 47 15·26	+0·418	
		Lacaille 9464 S.P.	11 28 49·95	11 27 23·46	+0·397	
		Lacaille 4865	11 36 34·01	11 34 55·54	+0·589	
May 12	P.	Lacaille 9464 S.P.	11 28 20·48	11 27 31·41	+0·514	+0·477
		Lacaille 4865	11 35 53·41	11 34 51·53	+0·490	
		ι Octantis	14 33 23·57	14 32 17·45	+0·428	
	I.	Lacaille 248 S.P.	12 40 24·66	12 39 30·97	+0·260	+0·405
		ι Octantis	12 43 54·37	12 42 52·20	+0·591	
		Lacaille 5452	13 18 24·02	13 17 22·35	+0·454	
		Lacaille 634 S.P.	13 45 0·66	13 44 6·71	+0·317	

Date.	Observer.	Name of Star.	Time of Transit corrected for Collimation and Level.	Star's Apparent R.A.	Deduced Azimuth Error.	Adopted Azimuth Error.
1881.			h m s	h m s	s	s
May 20	P.	Lacaille 9464 S.P.	11 28 31·87	11 27 34·26	+0·472	
		Lacaille 4865	11 36 0·18	11 34 50·06	+0·540	+0·490
		Lacaille 248 S.P.	12 40 32·70	12 39 32·62	+0·403	
		ι Octantis	12 44 1·25	12 42 51·24	+0·546	
May 23	P.	Lacaille 248 S.P.	12 40 36·96	12 39 33·30	+0·373	
		Lacaille 5325	12 56 14·49	12 54 58·95	+0·454	+0·392
		Lacaille 634 S.P.	13 45 13·61	13 44 8·85	+0·287	
		Brisbane 4614	14 4 24·74	14 2 57·80	+0·452	
	I.	Lacaille 4991	11 57 48·05	11 56 35·77	+0·439	
		Lacaille 9745 S.P.	12 3 15·10	12 2 12·33	+0·376	+0·466
		z Octantis	14 33 36·04	14 32 16·85	+0·535	
		Lacaille 1029 S.P.	14 39 8·68	14 38 6·95	+0·515	
June 16	P.	Lacaille 248 S.P.	12 40 7·33	12 39 39·82	+0·336	
		κ Octantis	13 22 47·89	13 22 13·24	+0·280	+0·327
		Brisbane 6058	17 46 28·21	17 45 49·57	+0·322	
		Lacaille 8094	19 34 51·79	19 34 17·62	+0·368	
	I.	Lacaille 634 S.P.	13 44 40·49	13 44 11·63	+0·274	
		Brisbane 6058	17 46 28·32	17 45 49·57	+0·338	+0·282
		Lacaille 3274 S.P.	19 28 5·04	19 27 36·69	+0·235	
June 17	P.	ι Octantis	12 43 23·05	12 42 46·82	+0·405	+0·397
		σ Octantis	18 30 27·55	18 29 29·13	+0·389	
	I.	κ Octantis	13 22 48·37	13 22 13·05	+0·283	
		Lacaille 634 S.P.	13 44 41·59	13 44 11·83	+0·271	+0·309
		Brisbane 6058	17 46 29·96	17 45 49·70	+0·372	
June 20	P.	κ Octantis	13 22 50·76	13 22 12·48	+0·294	
		Lacaille 634 S.P.	13 44 43·79	13 44 12·45	+0·400	+0·365
		Brisbane 6058	17 46 32·85	17 45 50·03	+0·361	
		Lacaille 2296 S.P.	17 53 23·40	17 52 51·61	+0·406	
	I.	z Octantis	14 32 56·36	14 32 11·09	+0·490	
		Lacaille 1921 S.P.	17 12 44·65	17 12 11·98	+0·416	+0·448
		Lacaille 7078	17 25 15·71	17 24 36·05	+0·437	
June 21	P.	κ Octantis	13 22 51·28	13 22 12·29	+0·280	
		Lacaille 634 S.P.	13 44 45·23	13 44 12·66	+0·356	+0·340
		A Octantis S.P.	20 5 41·14	20 5 17·20	+0·384	
		Lacaille 8257	20 15 1·83	20 14 22·41	+0·341	
	I.	z Octantis	14 32 55·06	14 32 10·78	+0·403	
		Lacaille 1029 S.P.	14 38 43·10	14 38 10·98	+0·313	+0·390
		Lacaille 3274 S.P.	19 28 5·96	19 27 35·61	+0·379	
		Lacaille 8360	20 18 58·86	20 18 20·09	+0·465	
June 22	P.	κ Octantis	13 22 52·25	13 22 12·09	+0·317	
		Lacaille 634 S.P.	13 44 46·08	13 44 12·87	+0·374	+0·355
		Brisbane 6058	17 46 33·15	17 45 50·20	+0·287	
		Lacaille 2296 S.P.	17 53 24·65	17 52 51·55	+0·440	
	I.	z Octantis	14 32 57·87	14 32 10·46	+0·524	
		Lacaille 1029 S.P.	14 38 44·20	14 38 11·19	+0·297	+0·429
		Lacaille 1921 S.P.	17 12 46·31	17 12 12·00	+0·404	
		Lacaille 7078	17 25 17·80	17 24 36·10	+0·491	
June 27	P.	Lacaille 634 S.P.	13 44 53·00	13 44 13·97	+0·309	+0·294
		Lacaille 5802	14 8 58·78	14 8 14·71	+0·278	
	I.	z Octantis	14 32 57·83	14 32 8·80	+0·346	+0·346

Date.	Observer.	Name of Star.	Time of Transit corrected for Collimation and Level.	Star's Apparent R.A.	Deduced Azimuth Error.	Adopted Azimuth Error.
1881.			h m s	h m s	s	s
Aug. 18	P.	Brisbane 5607	16 18 1·00	16 17 18·51	+0·859	
		Lacaille 1839 S.P.	16 34 31·69	16 34 11·39	+0·853	+0·874
		Lacaille 4169 S.P.	21 47 40·37	21 47 18·26	+0·955	
		C Octantis	22 9 41·32	22 8 57·80	+0·827	
	I.	Brisbane 6058	17 46 28·76	17 45 40·17	+0·828	
		Lacaille 2296 S.P.	17 53 21·59	17 52 56·50	+0·731	+0·825
		Lacaille 8257	20 15 6·26	20 14 25·92	+0·915	
Aug. 19	P.	Brisbane 5607	16 18 1·86	16 17 18·22	+0·876	
		Lacaille 1839 S.P.	16 34 32·02	16 34 11·71	+0·917	+0·912
		Lacaille 4169 S.P.	21 47 40·89	21 47 18·25	+0·987	
		C Octantis	22 9 42·84	22 8 57·85	+0·867	
	I.	Brisbane 6058	17 46 30·78	17 45 39·76	+0·902	
		Lacaille 2296 S.P.	17 53 22·13	17 52 56·69	+0·803	+0·903
		ζ Octantis S.P.	21 13 43·60	21 13 20·00	+0·957	
		C Octantis	22 9 43·70	22 8 57·85	+0·949	
Aug. 25	P.	Brisbane 5607	16 18 6·32	16 17 16·49	+0·932	
		Lacaille 1839 S.P.	16 34 39·87	16 34 13·70	+0·900	+0·909
		ζ Octantis S.P.	21 13 49·41	21 13 20·25	+0·959	
		C Octantis	22 9 48·45	22 8 58·09	+0·843	
	I.	Lacaille 2296 S.P.	17 53 29·49	17 52 57·87	+0·721	
		σ Octantis	18 30 43·03	18 29 5·14	+0·905	+0·768
		ζ Octantis S.P.	21 13 51·15	21 13 20·25	+0·764	
		B Octantis	21 18 8·61	21 16 36·67	+0·680	
Aug. 26	P.	Brisbane 5607	16 18 6·22	16 17 16·19	+0·871	
		Lacaille 1839 S.P.	16 34 41·35	16 34 14·04	+0·880	+0·870
		Lacaille 4169 S.P.	21 47 48·10	21 47 18·31	+0·933	
		C Octantis	22 9 48·76	22 8 58·10	+0·796	
	I.	Lacaille 2296 S.P.	17 53 30·13	17 52 58·08	+0·781	
		σ Octantis	18 30 42·91	18 29 3·71	+0·913	+0·883
		Lacaille 8257	20 15 14·05	20 14 25·29	+1·043	
		ζ Octantis S.P.	21 13 51·65	21 13 20·31	+0·796	
Aug. 27	P.	Brisbane 5607	16 18 6·83	16 17 15·90	+0·856	
		Lacaille 1839 S.P.	16 34 42·29	16 34 14·38	+0·916	+0·879
		ζ Octantis S.P.	21 13 52·04	21 13 20·37	+0·912	
		C Octantis	22 9 50·14	22 8 58·11	+0·832	
	I.	Lacaille 2296 S.P.	17 53 31·45	17 52 58·29	+0·778	
		σ Octantis	18 30 46·28	18 29 2·23	+0·970	+0·886
		Lacaille 8257	20 15 14·42	20 14 25·18	+0·970	
		ζ Octantis S.P.	21 13 52·66	21 13 20·37	+0·827	
Aug. 28	P.	Brisbane 5607	16 18 7·36	16 17 15·60	+0·831	
		Lacaille 1839 S.P.	16 34 43·82	16 34 14·38	+0·886	+0·824
		ζ Octantis S.P.	21 13 54·43	21 13 20·44	+0·798	
		C Octantis	22 9 50·79	22 8 58·11	+0·782	
	I.	Brisbane 6058	17 46 36·75	17 45 35·91	+0·956	
		Lacaille 2296 S.P.	17 53 33·40	17 52 58·50	+0·721	+0·869
		σ Octantis	18 30 46·28	18 29 0·73	+0·973	
		ζ Octantis S.P.	21 13 53·88	21 13 20·44	+0·825	
Sept. 3	P.	Brisbane 6058	17 46 37·04	17 45 33·13	+0·820	
		Lacaille 2296 S.P.	17 53 39·40	17 52 59·79	+0·847	+0·935
		C Octantis	22 9 59·92	22 8 57·98	+1·045	
		Lacaille 4510 S.P.	22 38 10·89	22 37 34·15	+1·027	
Sept. 19	P.	Lacaille 7751	18 56 26·82	18 55 15·05	+0·916	
		A Octantis S.P.	20 5 56·07	20 5 24·05	+0·973	+0·912
		τ Octantis	23 11 42·59	23 10 17·44	+0·859	
		Lacaille 4991 S.P.	23 57 11·08	23 56 16·24	+0·900	

Date.	Observer.	Name of Star.	Time of Transit corrected for Collimation and Level.	Star's Apparent R.A.	Deduced Azimuth Error.	Adopted Azimuth Error.
			h m s	h m s	s	s
1881. Sept. 19	I.	Lacaille 3274 S.P.	19 28 35·33	19 27 44·04	+0·777	+0·866
		Lacaille 8257	20 15 34·30	20 14 21·88	+1·042	
		Lacaille 4169 S.P.	21 48 15·00	21 47 20·34	+0·794	
		C Octantis	22 10 11·15	22 8 56·46	+0·850	
Dec. 23	P.	Lacaille 634	1 45 15·86	1 44 23·61	+1·172	+1·161
		z Octantis S.P.	2 31 59·44	2 31 44·24	+1·230	
		Lacaille 3274	7 29 12·00	7 28 12·95	+1·275	
		Lacaille 8257 S.P.	8 14 34·53	8 14 3·44	+0·968	
	I.	z Octantis S.P.	2 32 6·35	2 31 44·24	+0·873	+1·036
		Lacaille 1029	2 39 25·32	2 38 30·76	+1·162	
		Lacaille 7751 S.P.	6 55 30·52	6 54 59·90	+0·964	
		Lacaille 3274	7 29 9·79	7 28 12·95	+1·143	
Dec. 29	P.	z Octantis S.P.	2 32 2·02	2 31 47·52	+1·130	+1·098
		Lacaille 1029	2 39 19·77	2 38 28·84	+1·066	
	I.	Lacaille 1848	3 16 41·40	3 15 23·50	+1·164	+1·115
		Brisbane 5607 S.P.	4 17 29·97	4 17 5·87	+1·065	
1882. Jan. 8	P.	Brisbane 6058 S.P.	5 45 15·45	5 45 5·56	+1·155	+1·103
		Lacaille 2296	5 53 57·46	5 53 14·49	+1·051	
Jan. 9	P.	Lacaille 1592	4 5 21·27	4 4 37·18	+1·034	+1·064
		Brisbane 5607 S.P.	4 17 28·45	4 17 9·01	+1·093	
Jan. 14	P.	Lacaille 1414	3 46 15·55	3 45 33·48	+1·127	+1·127
Jan. 17	P.	Lacaille 1592	4 5 15·71	4 4 34·98	+0·982	+0·964
		Brisbane 5607	4 17 30·03	4 17 11·61	+0·946	
Jan. 20	P.	Brisbane 6058 S.P.	5 45 19·94	5 45 10·24	+0·967	+0·925
		Lacaille 2296	5 53 49·92	5 53 12·62	+0·882	
Jan. 21	P.	Lacaille 1592	4 5 12·23	4 4 33·81	+0·888	+0·913
		Brisbane 5607 S.P.	4 17 31·30	4 17 15·58	+1·069	
		Lacaille 7751 S.P.	6 55 22·97	6 55 2·12	+0·855	
		Lacaille 3274	7 28 53·26	7 28 11·77	+0·840	
Jan. 26	P.	Brisbane 5607 S.P.	4 17 32·10	4 17 14·76	+0·801	+0·797
		Lacaille 2296	5 53 45·93	5 53 11·48	+0·792	
Jan. 27	P.	Brisbane 5607 S.P.	4 17 31·20	4 17 15·13	+0·885	+0·866
		Lacaille 2296	5 53 46·07	5 53 11·28	+0·846	
Jan. 28	P.	Lacaille 1592	4 5 7·02	4 4 31·69	+0·792	+0·836
		Brisbane 5607 S.P.	4 17 31·78	4 17 15·49	+0·845	
		Brisbane 6058 S.P.	5 45 23·04	5 45 13·99	+0·870	
		Lacaille 2296	5 53 45·45	5 53 11·07	+0·837	
Feb. 13	P.	Brisbane 6058 S.P.	5 45 28·12	5 45 22·64	+0·792	+0·713
		Lacaille 2296	5 53 35·83	5 53 7·41	+0·750	
		A Octantis	8 7 6·26	8 6 23·38	+0·663	
		Lacaille 8257 S.P.	8 14 20·98	8 14 5·41	+0·647	
	I.	σ Octantis S.P.	6 27 19·17	6 27 42·22	+0·684	+0·710
		ζ Mensæ	6 50 19·89	6 49 54·90	+0·731	
		Lacaille 3274	7 28 39·44	7 28 6·61	+0·772	
		Lacaille 8094 S.P.	7 34 26·45	7 34 8·93	+0·653	
Feb. 14	P.	Brisbane 6058 S.P.	5 45 28·04	5 45 23·22	+0·807	+0·709
		Lacaille 2296	5 53 34·78	5 53 7·16	+0·703	
		A Octantis	8 7 5·87	8 6 22·77	+0·683	
		Lacaille 8257 S.P.	8 14 20·72	8 14 5·55	+0·643	

Date.	Observer.	Name of Star.	Time of Transit corrected for Collimation and Level.	Star's Apparent R.A.	Deduced Azimuth Error.	Adopted Azimuth Error.
1882.			h m s	h m s	s	s
Feb. 14	I.	σ Octantis S.P. - - -	6 27 19·82	6 27 44·10	+0·694	
		ζ Mensæ - - - -	6 50 19·44	6 49 54·78	+0·733	+0·743
		Lacaille 3274 - - -	7 28 39·09	7 28 6·31	+0·787	
		Lacaille 8094 S.P. - - -	7 34 26·22	7 34 9·05	+0·756	
Feb. 15	P.	σ Octantis S.P. - - -	6 27 24·87	6 27 45·99	+0·643	
		ζ Mensæ - - - -	6 50 18·91	6 49 54·66	+0·696	+0·680
		Lacaille 3274 - - -	7 28 36·84	7 28 6·01	+0·671	
		Lacaille 8094 S.P. - - -	7 34 25·95	7 34 9·18	+0·709	
	I.	Brisbane 6058 S.P. - - -	5 45 30·08	5 45 23·81	+0·708	
		Lacaille 2296 - - -	5 53 35·19	5 53 6·90	+0·832	
		A Octantis - - - -	8 7 10·41	8 6 22·13	+0·859	+0·777
		Lacaille 8257 S.P. - - -	8 14 19·76	8 14 5·70	+0·708	
Feb. 17	P.	σ Octantis S.P. - - -	6 27 21·38	6 27 49·61	+0·742	
		ζ Mensæ - - - -	6 50 17·79	6 49 54·43	+0·671	+0·727
		Lacaille 3274 - - -	7 28 36·28	7 28 5·39	+0·728	
		Lacaille 8094 S.P. - - -	7 34 25·06	7 34 9·42	+0·768	

The above Azimuthal Errors have been deduced from each Polar Star in combination with the Clock Star; the observations of the Clock Star are not given in this table.

SECTION IV.—TABLE 4.

OBSERVATIONS WITH THE CAPE TRANSIT CIRCLE BY MR. PETT.

Date.	Name of Star.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.		h m s		s	s	m s
April 9	Lalande 19241 - - -	9 43 50·42	6	49·69	20·48	−1 29·21
	13 Sextantis - - - -	9 59 30·95	6	30·38	1·16	−1 29·22
	λ Hydræ - - - -	10 6 19·77	6	18·96	49·80	−1 29·16
	21 Sextantis - - - -	10 9 45·24	6	44·50	15·21	−1 29·29
	22 Sextantis - - - -	10 13 15·64	6	14·90	45·70	−1 29·20
	η Virginis - - - -	12 15 22·00	6	21·38	52·09	−1 29·29
	6 Corvi - - - -	12 18 43·16	6	42·13	12·80	−1 29·33
	B.A.C. 4200 - - -	12 23 18·32	6	17·64	48·29	−1 29·35
	Piazzi XII–111 - - -	12 27 4·72	6	4·03	34·67	−1 29·36
April 14	Lalande 19241 - - - -	9 43 54·57	6	53·83	20·42	−1 33·41
	13 Sextantis - - - -	9 59 35·07	6	34·50	1·10	−1 33·40
	λ Hydræ - - - -	10 6 23·94	6	33·12	49·74	−1 33·38
	21 Sextantis - - - -	10 9 49·49	6	48·74	15·16	−1 33·58
	22 Sextantis - - - -	10 13 19·94	6	19·19	45·65	−1 33·54
	6 Corvi - - - -	12 18 47·39	6	46·36	12·80	−1 33·56
	B.A.C. 4200 - - -	12 23 22·64	6	21·95	48·29	−1 33·66
	Piazzi XII–111 - - -	12 27 8·97	6	8·28	34·67	−1 33·61
May 12	A¹ Virginis - - - -	11 42 48·86	6	48·42	50·81	−0 57·61
	η Crateris - - - -	11 50 58·38	6	57·49	59·94	−0 57·55
	Lalande 22585 - - -	11 55 39·13	6	38·36	40·88	−0 57·48
	B.A.C. 4077 - - -	12 0 55·32	6	54·63	57·07	−0 57·56
	λ Virginis - - - -	14 13 42·24	6	41·42	43·73	−0 57·69
	B.A.C. 4773 - - -	14 19 17·45	6	16·96	19·29	−0 57·67
	φ Virginis - - - -	14 23 5·95	6	5·32	7·65	−0 57·67

Date.	Name of Star.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.		h m s		s	s	m s
May 20	A¹ Virginis	11 42 56·66	6	56·26	50·73	−1 5·53
	η Crateris	11 51 6·14	6	5·29	59·87	−1 5·42
	Lalande 22585	11 55 47·01	6	46·28	40·81	−1 5·47
	B.A.C. 4077	12 1 3·02	6	2·43	57·00	−1 5·43
	44 Virginis	12 54 40·90	6	40·29	34·80	−1 5·49
	Lalande 24277	12 58 33·51	6	32·60	27·02	−1 5·58
	θ Virginis	13 4 56·62	6	55·98	50·45	−1 5·53
May 23	B.A.C. 4382	13 1 23·01	6	22·17	13·46	−1 8·71
	θ Virginis	13 4 59·87	6	59·18	50·44	−1 8·74
	54 Virginis	13 8 18·11	6	17·22	8·49	−1 8·73
	86 Virginis	13 40 48·84	4	48·04	39·23	−1 8·81
	τ Virginis	13 56 47·97	6	47·39	38·69	−1 8·70
	ι Virginis	14 10 59·30	6	58·60	49·88	−1 8·72
June 16	44 Virginis	12 54 7·54	6	6·70	34·60	−0 32·10
	Lalande 24277	12 58 0·06	6	58·93	26·81	−0 32·12
	B.A.C. 4382	13 0 46·38	6	45·35	13·29	−0 32·06
	θ Virginis	13 4 23·04	6	22·17	50·27	−0 31·90
	7 Sagittarii	17 56 11·46	6	10·26	37·95	−0 32·31
	μ¹ Sagittarii	18 7 16·51	6	15·36	43·06	−0 32·30
	21 Sagittarii	18 18 53·59	6	52·45	20·02	−0 32·43
	B.A.C. 6279	18 23 2·33	6	1·30	28·98	−0 32·32
June 17	44 Virginis	12 54 8·37	6	7·60	34·59	−0 33·01
	Lalande 24277	12 58 0·83	6	59·76	26·80	−0 32·96
	B.A.C. 4382	13 0 47·21	6	46·25	13·28	−0 32·97
	θ Virginis	13 4 23·94	4	23·14	50·26	−0 32·88
	μ¹ Sagittarii	18 7 17·36	6	16·28	43·08	−0 33·20
	Rumker 6386	18 14 1·84	6	1·25	27·98	−0 33·27
	21 Sagittarii	18 18 54·29	6	53·21	20·03	−0 33·18
	B.A.C. 6279	18 23 3·09	6	2·13	28·99	−0 33·14
June 20	66 Virginis	13 19 0·92	6	0·23	24·53	−0 35·70
	m Virginis	13 36 1·64	6	0·89	25·16	−0 35·73
	86 Virginis	13 40 15·53	6	14·72	39·09	−0 35·63
	47 Hydræ	13 52 30·74	6	29·72	54·09	−0 35·63
	μ¹ Sagittarii	18 7 19·78	6	18·82	43·12	−0 35·70
	Lalande 33596	18 10 46·60	6	46·02	10·20	−0 35·82
	Rumker 6386	18 14 4·19	6	3·68	28·01	−0 35·67
	21 Sagittarii	18 18 56·81	6	55·85	20·08	−0 35·77
June 21	66 Virginis	13 19 1·70	6	0·97	24·52	−0 36·45
	86 Virginis	13 39 16·28	6	15·43	39·08	−0 36·35
	p Virginis	13 49 15·70	6	15·03	38·62	−0 36·41
	47 Hydræ	13 52 31·53	6	30·47	54·08	−0 36·39
	63 Sagittarii	19 55 59·90	6	59·02	22·50	−0 36·52
	ρ Capricorni	20 22 45·74	6	44·80	8·19	−0 36·61
	Washington 8892	20 25 5·52	6	4·62	28·04	−0 36·58
	ε Delphini	20 28 12·14	6	11·64	35·10	−0 36·54
June 22	66 Virginis	13 19 2·32	6	1·62	24·52	−0 37·10
	m Virginis	13 36 2·94	6	2·19	25·14	−0 37·05
	86 Virginis	13 40 17·01	6	16·20	39·07	−0 37·13
	47 Hydræ	13 52 32·29	6	31·27	54·07	−0 37·20
	μ¹ Sagittarii	18 7 21·51	6	20·55	43·14	−0 37·41
	Lalande 33596	18 10 48·24	6	47·65	10·22	−0 37·43
	Rumker 6386	18 14 5·89	6	5·38	28·04	−0 37·34
	21 Sagittarii	18 18 58·46	6	57·50	20·11	−0 37·39

Date.	Name of Star.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.		h m s		s	s	s
June 27	86 Virginis	13 40 22·28	6	21·37	39·03	− 42·34
	47 Hydræ	13 52 37·48	6	36·37	54·03	− 42·34
	96 Virginis	14 3 26·61	6	25·74	43·47	− 42·27
	B.A.C. 4773	14 19 2·05	6	1·42	19·16	− 42·26
	B.A.C. 6324	18 29 13·13	6	12·26	29·68	− 42·58
	B.A.C. 6347	18 32 35·66	6	34·62	52·05	− 42·57
	B.A.C. 6367	18 37 49·84	6	49·01	6·52	− 42·49
	B.A.C. 6388	18 41 38·95	6	38·17	55·66	− 42·51
Aug. 18	c^2 Scorpii	16 5 34·41	6	34·79	2·35	− 32·44
	χ Ophiuchi	16 20 43·28	6	43·78	11·39	− 32·39
	12 Ophiuchi	16 30 41·65	6	42·32	9·81	− 32·51
	23 Ophiuchi	16 48 49·49	6	50·13	17·66	− 32·47
	ζ Capricorni	21 20 29·19	6	29·63	57·05	− 32·58
	Lalande 41765	21 23 55·54	6	56·01	23·43	− 32·58
	8 Piscis Australis	21 29 53·79	6	54·18	21·64	− 32·54
	ζ Aquarii	21 32 1·42	6	2·02	29·41	− 32·61
Aug. 19	28 Herculis	16 27 20·09	6	20·88	47·52	− 33·36
	12 Ophiuchi	16 30 42·49	6	43·19	9·80	− 33·39
	23 Ophiuchi	16 48 50·40	6	51·06	17·65	− 33·41
	Lalande 30831	16 52 32·14	6	32·70	59·31	− 33·39
	B.A.C. 7649	21 52 43·16	6	43·64	10·11	− 33·53
	B.A.C. 7665	21 56 16·29	6	16·81	43·32	− 33·49
	υ Aquarii	22 28 48·56	6	49·03	15·47	− 33·56
Aug. 25	12 Ophiuchi	16 30 47·84	6	48·72	9·71	− 39·01
	23 Ophiuchi	16 48 55·65	6	56·48	17·56	− 38·92
	Lalande 31109	17 1 24·24	6	25·02	46·04	− 38·98
	Lalande 31210	17 4 45·13	6	45·90	6·96	− 38·94
	11 Aquarii	20 55 0·44	6	1·28	22·19	− 39·09
	η Capricorni	20 58 20·91	6	21·59	42·55	− 39·04
	ν Aquarii	21 3 49·43	6	50·21	11·12	− 39·09
Aug. 26	14 Ophiuchi	16 36 23·00	4	23·84	44·14	− 39·70
	20 Ophiuchi	16 43 57·68	6	58·42	18·60	− 39·82
	23 Ophiuchi	16 48 56·52	6	57·29	17·54	− 39·75
	30 Ophiuchi	16 55 29·57	6	30·36	50·54	− 39·82
	Lalande 31210	17 4 46·04	6	46·75	6·95	− 39·80
	ξ Aquarii	21 32 8·76	6	9·51	29·44	− 40·07
	41 Capricorni	21 35 58·13	6	58·73	18·81	− 39·92
	27 Aquarii	21 41 55·35	6	56·20	16·26	− 39·94
	B.A.C. 7649	21 52 49·49	6	50·11	10·15	− 39·96
Aug. 27	Lalande 30831	16 52 39·46	6	40·12	59·18	− 40·94
	30 Ophiuchi	16 55 30·65	6	31·42	50·53	− 40·89
	37 Ophiuchi	17 7 34·43	6	35·34	54·39	− 40·95
	41 Ophiuchi	17 11 13·67	6	14·48	33·58	− 40·90
	Lalande 41765	21 24 3·91	6	4·52	23·45	− 41·07
	8 Piscis Australis	21 30 2·24	6	2·78	21·67	− 41·11
	ξ Aquarii	21 32 9·89	6	10·62	29·44	− 41·18
	41 Capricorni	21 35 59·34	6	59·91	18·81	− 41·10
Aug. 28	c^2 Scorpii	16 5 43·78	6	44·26	2·18	− 42·08
	25 Scorpii	16 40 19·74	6	20·25	38·11	− 42·14
	20 Ophiuchi	16 44 0·06	6	0·72	18·56	− 42·16
	Lalande 30831	16 52 40·66	6	41·27	59·17	− 42·10
	ζ Capricorni	21 20 38·86	6	39·38	57·07	− 42·31
	8 Piscis Australis	21 30 3·51	6	4·00	21·67	− 42·33
	ξ Aquarii	21 32 11·08	6	11·71	29·44	− 42·27
	41 Capricorni	21 36 0·63	6	1·15	18·81	− 42·34

Date.	Name of Star.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.		h m s		s	s	s
Sept. 3	μ Ophiuchi	17 32 13·26	6	14·08	26·23	− 47·85
	ο Serpentis	17 35 34·38	6	35·15	47·32	− 47·83
	Lalande 32325	17 38 12·35	6	13·19	25·30	− 47·89
	γ Ophiuchi	17 42 45·84	6	46·77	58·95	− 47·82
	ξ Aquarii	21 32 16·58	6	17·40	29·44	− 47·96
	41 Capricorni	21 36 6·21	6	6·87	18·81	− 48·06
	π Aquarii	22 20 3·54	6	4·45	16·40	− 48·05
	σ Aquarii	22 25 12·69	6	13·48	25·37	− 48·11
Sept. 19	7 Sagittarii	17 56 40·28	6	41·06	37·45	− 63·61
	Lalande 33262	18 2 42·71	6	43·76	40·02	− 63·74
	B.A.C. 6347	18 32 54·54	6	55·34	51·64	− 63·70
	B.A.C. 6367	18 38 8·84	6	9·76	6·13	− 63·63
	B.A.C. 6388	18 41 58·04	6	58·98	55·28	− 63·70
	30 Sagittarii	18 44 48·31	6	49·11	45·39	− 63·72
	h^1 Aquarii	23 0 4·79	6	5·71	1·89	− 63·82
	c^2 Aquarii	23 4 13·68	6	14·47	10·61	− 63·86
	Lalande 45980	23 24 30·37	6	31·31	27·39	− 63·92
	16 Piscium	23 31 26·24	6	27·23	23·36	− 63·87
Dec. 23	ο Piscium	1 39 51·18	6	52·20	11·30	− 40·90
	ξ Piscium	1 48 8·19	6	9·16	28·34	− 40·82
	ξ^1 Ceti	2 7 26·24	6	27·26	46·42	− 40·84
	67 Ceti	2 11 47·42	6	48·22	7·40	− 40·82
	B.A.C. 737	2 17 50·33	6	50·86	10·06	− 40·80
	ρ Ceti	2 20 56·61	6	57·33	16·52	− 40·81
	26 Monocerotis	7 36 18·71	6	19·48	38·73	− 40·75
	τ Navis	7 39 46·68	6	47·14	6·44	− 40·70
	ο Puppis	7 43 53·19	6	53·71	13·06	− 40·65
	9 Argûs	7 47 0·48	6	1·19	20·55	− 40·64
	β Cancri	8 10 48·69	6	49·72	9·07	− 40·65
Dec. 29	Lalande 5211	2 42 55·88	6	56·51	18·38	− 38·13
	τ^2 Eridani	2 46 20·26	6	20·76	42·74	− 38·02
	Lalande 5424	2 50 34·14	6	35·06	56·99	− 38·07
	λ Ceti	2 54 2·51	6	3·44	25·32	− 38·12
Dec. 30	20 Eridani	3 31 33·63	6	34·20	56·66	− 37·54
	22 Eridani	3 35 26·62	6	27·38	49·78	− 37·60
	24 Eridani	3 39 9·77	6	10·58	32·92	− 37·66
	30 Eridani	3 47 30·80	6	31·55	53·90	− 37·65
	Lalande 7273	3 50 22·16	6	22·82	45·18	− 37·64
	Lalande 7384	3 53 42·34	6	43·09	5·48	− 37·61
	ν Tauri	3 58 1·64	6	32·56	54·90	− 37·66
	10 Monocerotis	6 22 47·05	6	47·82	10·28	− 37·54
	ξ^2 Canis Majoris	6 30 45·94	6	46·44	8·90	− 37·54
	15 Monocerotis	6 35 7·74	6	8·73	31·21	− 37·52
	18 Monocerotis	6 42 21·44	6	22·32	44·83	− 37·49
1882.						
Jan. 8	Lalande 9293	4 51 10·95	6	11·64	37·69	− 33·95
	64 Eridani	4 55 2·23	6	2·82	28·91	− 33·91
	B.A.C. 1559	4 57 57·49	6	57·86	23·98	− 33·88
	ι Leporis	5 7 23·09	6	23·69	49·76	− 33·93
Jan. 9	22 Eridani	3 35 22·50	6	23·14	49·71	− 33·43
	τ^6 Eridani	3 42 21·13	6	21·49	48·01	− 33·48
	Lalande 7273	3 50 18·16	6	18·70	45·10	− 33·60
	Lalande 7384	3 53 38·30	6	38·93	5·41	− 33·52
	μ Tauri	4 9 42·39	6	43·22	9·77	− 33·45

Date.	Name of Star.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1882.		h m s		s	s	s
Jan. 14	Lalande 5759 - - -	3 1 16·14	6	16·70	45·19	− 31·51
	τ^5 Eridani - - - -	3 29 7·63	6	7·93	36·15	− 31·78
	22 Eridani - - - -	3 35 20·82	6	21·40	49·66	− 31·74
	24 Eridani - - - -	3 39 3·94	6	4·58	32·80	− 31·78
	Lalande 7384 - - -	3 53 36·47	6	37·05	5·37	− 31·68
Jan. 17	Lalande 6248 - - -	3 16 46·78	6	46·95	16·26	− 30·69
	τ^5 Eridani - - - -	3 29 6·64	6	6·84	36·10	− 30·74
	W.B. IV-585 - - -	4 29 5·03	6	5·44	34·76	− 30·68
	10 Monocerotis - - -	6 22 40·57	6	41·04	10·35	− 30·69
	15 Monocerotis - - -	6 35 1·29	6	1·97	31·33	− 30·64
	18 Monocerotis - - -	6 42 15·02	6	15·59	44·95	− 30·64
	19 Monocerotis - - -	6 57 34·92	6	36·40	5·70	− 30·70
Jan. 20	30 Eridani - - - -	3 47 22·97	6	23·37	53·72	− 29·65
	ν Tauri - - - -	3 57 23·89	6	24·45	54·76	− 29·69
	W.B. IV-585 - - -	4 29 4·13	6	4·48	34·73	− 29·75
	54 Eridani - - - -	4 35 48·14	6	48·33	18·72	− 29·61
	ξ^2 Canis Majoris - - -	6 30 38·49	6	38·64	8·95	− 29·69
	15 Monocerotis - - -	6 35 0·43	6	1·05	31·33	− 29·72
	19 Monocerotis - - -	6 57 34·97	6	35·39	5·71	− 29·68
	Lalande 13811 - - -	7 1 40·02	6	40·35	10·70	− 29·65
	20 Monocerotis - - -	7 4 53·79	6	54·22	24·52	− 29·70
Jan. 21	44 Eridani - - - -	4 22 57·00	6	57·50	28·14	− 29·36
	45 Eridani - - - -	4 26 21·37	6	21·85	52·54	− 29·31
	W.B. IV-585 - - -	4 29 3·73	6	4·09	34·72	− 29·37
	Lalande 8736 - - -	4 32 10·72	6	11·16	41·85	− 29·31
	π^4 Orionis - - - -	4 45 26·19	6	26·75	57·40	− 29·35
	π^5 Orionis - - - -	4 48 37·29	6	37·81	8·47	− 29·34
	Lalande 13811 - - -	7 1 39·69	6	40·02	10·70	− 29·32
	20 Monocerotis - - -	7 4 53·45	6	53·88	24·52	− 29·36
	26 Canis Majoris - - -	7 7 54·18	6	54·30	24·98	− 29·32
	B.A.C. 2433 - - -	7 16 31·47	6	31·96	2·75	− 29·21
	ϵ Canis Minoris - - -	7 19 43·23	6	43·85	14·49	− 29·36
Jan. 26	ν Tauri - - - -	3 57 21·96	6	22·41	54·70	− 27·71
	μ Tauri - - - -	4 9 36·78	6	37·26	9·61	− 27·65
	Lalande 9045 - - -	4 42 47·81	5	47·97	20·20	− 27·77
	π^4 Orionis - - - -	4 45 24·67	6	25·12	57·36	− 27·76
	π^5 Orionis - - - -	4 48 35·74	6	36·15	8·43	− 27·72
	Lalande 9293 - - -	4 51 4·95	6	5·26	37·56	− 27·70
	64 Eridani - - - -	4 54 56·18	6	56·41	28·76	− 27·65
	B.A.C. 1559 - - -	4 57 51·44	6	51·48	23·79	− 27·69
	1 Orionis - - - -	5 1 56·92	4	57·40	29·66	− 27·74
	τ Orionis - - - -	5 12 22·01	6	22·30	54·73	− 27·57
Jan. 27	44 Eridani - - - -	4 22 55·32	6	55·78	28·08	− 27·70
	45 Eridani - - - -	4 26 19·55	6	19·99	52·48	− 27·51
	W.B. IV-585 - - -	4 29 1·83	6	2·16	34·65	− 27·51
	54 Eridani - - - -	4 35 45·86	6	46·03	18·63	− 27·40
	Lalande 9045 - - -	4 42 47·45	4	47·67	20·19	− 27·48
	π^4 Orionis - - - -	4 45 24·44	6	24·95	57·35	− 27·60
	π^5 Orionis - - - -	4 48 35·35	6	35·82	8·42	− 27·40
	τ Orionis - - - -	5 12 21·84	6	22·20	54·72	− 27·48
Jan. 28	ν Tauri - - - -	3 57 21·40	6	21·90	54·67	− 27·23
	μ Tauri - - - -	4 9 36·21	6	36·74	9·58	− 27·16
	54 Eridani - - - -	4 35 45·58	6	45·74	18·62	− 27·12
	Lalande 9045 - - -	4 42 47·13	6	47·33	20·18	− 27·15
	π^4 Orionis - - - -	4 45 24·02	6	24·51	57·34	− 27·17
	π^5 Orionis - - - -	4 48 35·00	6	35·45	8·41	− 27·04
	Lalande 9293 - - -	4 51 4·24	6	4·59	37·54	− 27·05
	64 Eridani - - - -	4 54 55·56	6	55·82	28·74	− 27·08

Date.	Name of Star.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1882.		h m s		s	s	s
Jan. 28	B.A.C. 1559	4 57 50·79	6	50·85	23·76	− 27·09
	ι Leporis	5 7 16·44	6	16·71	49·60	− 27·11
	τ Orionis	5 12 21·42	6	21·75	54·71	− 27·04
	Lalande 10145	5 19 6·20	6	6·65	39·56	− 27·09
	σ Orionis	5 53 18·27	6	18·65	51·57	− 27·08
Feb. 13	υ Orionis	5 26 37·15	6	37·25	15·34	− 21·91
	c Orionis	5 29 57·74	6	57·87	35·91	− 21·96
	σ Orionis	5 33 13·15	6	13·30	51·38	− 21·92
	b Orionis	5 36 46·34	6	46·54	24·54	− 22·00
	γ Leporis	5 39 56·56	6	56·45	34·50	− 21·95
	W.B. VIII–986	8 20 19·08	6	19·16	57·36	− 21·80
	B.A.C. 2868	8 26 37·24	6	37·17	15·35	− 21·82
	δ Hydræ	8 31 48·85	6	49·11	27·20	− 21·91
	6 Hydræ	8 34 50·48	6	50·51	28·62	− 21·89
	B.A.C. 2954	8 38 17·02	6	17·12	55·30	− 21·82
Feb. 14	υ Orionis	5 26 36·84	6	36·92	15·33	− 21·59
	c Orionis	5 29 57·39	6	57·41	35·90	− 21·51
	σ Orionis	5 33 12·87	6	13·01	51·37	− 21·64
	b Orionis	5 36 45·99	6	46·18	24·53	− 21·65
	W.B. VIII–486	8 20 18·81	6	18·88	57·36	− 21·52
	B.A.C. 2868	8 26 36·91	6	36·83	15·34	− 21·49
	δ Hydræ	8 31 48·49	6	48·74	27·20	− 21·54
	6 Hydræ	8 34 50·08	6	50·10	28·62	− 21·48
	B.A.C. 2954	8 38 16·69	6	16·78	55·30	− 21·48
Feb. 15	7 Monocerotis	6 14 25·09	6	25·17	3·89	− 21·28
	8 Monocerotis	6 17 54·05	6	54·29	33·21	− 21·08
	15 Monocerotis	6 34 52·01	6	52·31	31·20	− 21·11
	18 Monocerotis	6 42 5·77	6	5·98	44·83	− 21·15
	B.A.C. 2433	7 16 23·57	6	23·75	2·68	− 21·07
	ε Canis Minoris	7 19 35·31	6	35·60	14·44	− 21·16
	B.A.C. 2470	7 22 42·34	6	42·39	21·18	− 21·21
	o Puppis	7 43 34·59	6	34·43	13·32	− 21·11
	9 Argûs	7 46 42·09	6	42·09	20·88	− 21·21
Feb. 17	7 Monocerotis	6 14 24·19	6	24·29	3·86	− 20·43
	8 Monocerotis	6 17 53·34	6	53·60	33·19	− 20·41
	15 Monocerotis	6 34 51·26	6	51·59	31·18	− 20·41
	18 Monocerotis	6 42 4·99	6	5·22	44·81	− 20·41
	B.A.C. 2433	7 16 22·80	6	23·01	2·66	− 20·35
	ε Canis Minoris	7 19 34·48	6	34·81	14·43	− 20·38
	B.A.C. 2470	7 22 41·45	6	41·53	21·17	− 20·36
	o Puppis	7 43 33·76	6	33·61	13·30	− 20·31
	9 Argûs	7 46 41·26	6	41·28	20·86	− 20·42

SECTION IV.—TABLE 5.

OBSERVATIONS WITH THE CAPE TRANSIT CIRCLE BY MR. FREEMAN.

Date.	Name of Star.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
		h m s		s	s	m s
1881. April 9	36 Sextantis	10 40 34·00	6	33·35	4·28	−1 29·07
	l Leonis	10 44 32·44	6	31·91	2·98	−1 28·93
	p^1 Leonis	10 57 18·06	6	17·33	48·26	−1 29·07
	χ Leonis	11 0 35·07	6	34·49	55·54	−1 28·95
	A^1 Virginis	11 43 20·62	6	20·06	51·03	−1 29·03
	η Crateris	11 51 30·13	6	29·18	0·13	−1 29·05
	Lalande 22585	11 56 10·87	6	10·03	41·05	−1 28·98
	B.A.C. 4077	12 1 26·99	6	26·26	57·23	−1 29·03
April 13	13 Sextantis	9 59 34·05	6	33·49	1·11	−1 32·38
	λ Hydræ	10 6 22·96	6	22·15	49·76	−1 32·39
	21 Sextantis]	10 9 48·17	6	47·42	15·17	−1 32·25
	22 Sextantis	10 13 18·84	6	18·09	45·66	−1 32·43
	l Leonis	10 44 35·91	6	35·46	2·94	−1 32·52
	p^1 Leonis	10 57 21·27	6	20·62	48·24	−1 32·38
	χ Leonis	11 0 28·43	6	27·93	55·51	−1 32·42
April 14	ρ Leonis	10 28 9·19	6	8·72	35·41	−1 33·31
	36 Sextantis	10 40 37·94	6	37·35	4·24	−1 33·11
	7 Leonis	10 44 36·54	6	36·09	2·93	−1 33·16
	p^1 Leonis	10 57 22·11	6	21·44	48·23	−1 33·21
	χ Leonis	11 0 29·14	6	28·63	55·50	−1 33·13
	A^1 Virginis	11 43 24·76	6	24·27	51·01	−1 33·26
	η Crateris	11 51 34·37	6	33·44	0·12	−1 33·32
	B.A.C. 4077	12 1 31·09	6	30·40	57·22	−1 33·18
May 12	6 Corvi	12 18 11·06	6	9·97	12·68	−0 57·29
	B.A.C. 4200	12 22 46·14	6	45·41	48·19	−0 57·22
	Piazzi XII–111	12 26 32·64	6	31·90	34·58	−0 57·32
	B.A.C. 4238	12 29 28·36	6	27·84	30·61	−0 57·23
	m Virginis	13 36 23·46	6	22·67	25·33	−0 57·34
	86 Virginis	13 40 37·44	6	36·59	39·25	−0 57·34
	47 Hydræ	13 52 52·68	6	51·59	54·23	−0 57·36
	τ Virginis	13 56 36·72	6	36·10	38·69	−0 57·41
May 23	Lalande 23006	12 12 7·31	6	6·47	58·04	−1 8·43
	η Virginis	12 15 0·90	6	0·32	51·89	−1 8·43
	B.A.C. 4200	12 22 57·12	6	56·48	48·11	−1 8·37
	12 Libræ	14 48 38·98	6	37·97	29·40	−1 8·57
	δ Libræ	14 55 49·76	6	49·05	40·44	−1 8·61
	110 Virginis	14 58 5·87	6	5·34	56·71	−1 8·63
	ν Libræ	15 1 12·46	6	11·61	3·10	−1 8·51
June 16	m Virginis	13 35 58·04	6	57·10	25·19	−0 31·91
	86 Virginis	13 40 11·93	6	10·94	39·12	−0 31·82
	47 Hydræ	13 52 27·13	6	25·92	54·12	−0 31·80
	τ Virginis	13 56 11·17	6	10·40	38·59	−0 31·81
	30 Ophiuchi	16 55 23·97	6	23·10	50·94	−0 32·16
	Lalande 31606	17 18 12·81	6	11·67	39·42	−0 32·25
	B.A.C. 6367	18 37 39·49	6	38·55	6·36	−0 32·19
	B.A.C. 6388	18 41 28·52	6	27·64	55·50	−0 32·14
	30 Sagittarii	18 44 18·91	6	17·75	45·55	−0 32·20
	19 Aquilæ	19 3 46·47	6	45·75	13·82	−0 31·93
June 17	m Virginis	13 35 59·11	6	58·21	25·19	−0 33·02
	86 Virginis	13 40 12·84	6	11·87	39·11	−0 32·76
	47 Hydræ	13 52 28·21	6	27·01	54·11	−0 32·90
	τ Virginis	13 56 12·02	6	11·27	38·58	−0 32·69

Date.	Name of Star.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.		h m s		s	s	s
June 17	41 Ophiuchi	17 11 7·62	6	6·83	33·94	− 32·89
	40 Ophiuchi	17 14 30·76	6	29·63	56·66	− 32·97
	Lalande 31606	17 18 13·31	6	12·19	39·43	− 32·76
	51 Ophiuchi	17 24 47·86	6	46·68	13·70	− 32·98
June 20	96 Virginis	14 3 19·88	6	19·13	43·52	− 35·61
	ι Virginis	14 10 26·00	6	25·31	49·78	− 35·53
	λ Virginis	14 13 19·94	6	19·14	43·66	− 35·48
	υ^2 Virginis	14 16 30·02	6	29·40	53·88	− 35·52
	Lalande 31210	17 4 43·64	6	42·84	7·32	− 35·52
	Lalande 31606	17 18 15·99	6	15·05	39·45	− 35·60
	57 Ophiuchi	17 32 2·86	6	2·14	26·62	− 35·52
June 21	96 Virginis	14 3 20·51	6	19·70	43·51	− 36·19
	ι Virginis	14 10 26·85	6	26·11	49·78	− 36·33
	λ Virginis	14 13 20·74	6	19·88	43·66	− 36·22
	υ^2 Virginis	14 16 30·82	6	30·15	53·88	− 36·27
	20 Aquilæ	19 6 54·43	6	53·65	17·32	− 36·33
	υ Sagittarii	19 15 36·11	6	35·19	58·79	− 36·40
	e Aquilæ	19 25 7·27	6	6·57	30·24	− 36·33
June 22	96 Virginis	14 3 21·28	6	20·53	43·50	− 37·03
	ι Virginis	14 10 27·49	6	26·81	49·77	− 37·04
	λ Virginis	14 13 21·54	6	20·74	43·65	− 37·09
	υ^2 Virginis	14 16 31·35	6	30·73	53·87	− 36·86
	Lalande 31210	17 4 45·36	6	44·56	7·33	− 37·23
	Lalande 31606	17 18 17·58	6	16·65	39·47	− 37·18
	μ Ophiuchi	17 32 4·53	6	3·80	26·63	− 37·17
June 27	109 Virginis	14 41 0·04	6	59·39	17·28	− 42·11
	12 Libræ	14 48 12·68	6	11·58	29·36	− 42·22
	δ Libræ	14 55 23·28	6	22·47	40·41	− 42·06
	ν Libræ	15 0 46·11	6	45·17	3·09	− 42·08
	μ^1 Sagittarii	18 7 26·58	6	25·57	43·20	− 42·37
	Lalande 33596	18 10 53·08	5	52·46	10·27	− 42·19
	Rumker 6386	18 14 10·94	6	10·39	28·09	− 42·30
	21 Sagittarii	18 19 3·54	6	2·53	20·17	− 42·36
Aug. 18	40 Ophiuchi	17 14 28·38	6	28·80	56·47	− 32·33
	B.A.C. 5890	17 20 54·35	6	54·94	22·78	− 32·16
	51 Ophiuchi	17 24 45·33	6	45·72	13·56	− 32·16
	o Serpentis	17 35 19·36	6	19·87	47·56	− 32·31
	α^1 Capricorni	20 11 39·41	6	39·91	7·53	− 32·38
	B.A.C. 7014	20 17 52·86	6	53·55	21·07	− 32·48
	ρ Capricorni	20 22 40·84	6	41·29	8·91	− 32·38
	Washington 8892	20 25 0·66	6	1·14	28·76	− 32·38
Aug. 19	37 Ophiuchi	17 7 26·88	6	27·76	54·52	− 33·24
	41 Ophiuchi	17 11 6·09	6	6·85	33·69	− 33·16
	40 Ophiuchi	17 14 29·13	6	29·65	56·46	− 33·19
	51 Ophiuchi	17 24 46·29	6	46·78	13·55	− 33·23
	ζ Capricorni	21 20 29·91	6	30·41	57·05	− 33·36
	8 Piscis Australis	21 29 54·48	6	54·93	21·65	− 33·28
	ξ Aquarii	21 32 2·03	6	2·70	29·42	− 33·28
	41 Capricorni	21 35 51·74	6	52·23	18·78	− 33·45
Aug. 25	51 Ophiuchi	17 24 51·69	6	52·30	13·46	− 38·84
	o Serpentis	17 35 25·48	6	26·17	47·47	− 38·70
	Lalande 32633	17 46 32·04	6	32·82	54·03	− 38·79
	B.A.C. 6060	17 49 37·16	6	37·81	59·14	− 38·67
	B.A.C. 6111	17 58 35·03	6	35·63	56·95	− 38·68

Date.	Name of Star.	Transit reduced to Centre Wire. * h	m	s	No. of Wires.	Seconds of Clock Time of True Transit. s	Seconds of Tabular Apparent R.A. s	Clock Slow. s
1881. Aug. 25	Lalande 40029	20	38	27·27	6	28·10	49·35	−38·75
	ε Aquarii	20	41	56·61	6	57·32	18·44	−38·88
	ω Capricorni	20	45	26·24	6	26·80	47·93	−38·87
	19 Capricorni	20	48	47·14	6	47·78	8·95	−38·83
Aug. 26	51 Ophiuchi	17	24	52·51	6	53·11	13·44	−39·67
	o Serpentis	17	35	26·39	6	27·10	47·45	−39·65
	Lalande 32633	17	46	32·77	6	33·59	54·02	−39·57
	B.A.C. 6060	17	49	38·13	6	38·77	59·12	−39·65
	B.A.C. 6111	17	58	35·99	6	36·59	56·94	−39·65
	ρ Capricorni	20	22	47·88	6	48·53	8·89	−39·64
	Lalande 40029	20	38	28·34	6	29·22	49·35	−39·87
	ω Capricorni	20	45	27·23	6	27·80	47·93	−39·87
	19 Capricorni	20	48	48·13	6	48·78	8·95	−39·83
	η Capricorni	20	58	21·66	6	22·30	42·55	−39·75
	ν Aquarii	21	3	50·19	6	50·91	11·11	−39·80
Aug. 27	B.A.C. 5890	17	21	2·62	6	3·39	22·65	−40·74
	o Serpentis	17	35	27·49	6	28·17	47·44	−40·73
	Lalande 32633	17	46	33·97	6	34·77	54·00	−40·77
	B.A.C. 6060	17	49	39·26	6	39·89	59·11	−40·78
	B.A.C. 6111	17	58	37·06	6	37·62	56·92	−40·70
	ρ Capricorni	20	22	49·24	6	49·86	8·89	−40·97
	Lalande 40029	20	38	29·35	6	30·21	49·34	−40·87
	ω Capricorni	20	45	28·24	6	28·77	47·92	−40·85
	19 Capricorni	20	48	49·24	6	49·86	8·95	−40·91
Aug. 28	o Serpentis	17	35	28·69	6	29·34	47·42	−41·92
	B.A.C. 6060	17	49	40·41	6	41·00	59·09	−41·91
	B.A.C. 6347	18	32	33·39	6	33·95	51·99	−41·96
	30 Sagittarii	18	44	27·13	6	27·69	45·73	−41·96
	Lalande 40029	20	38	30·65	6	31·48	49·34	−42·14
	ε Aquarii	20	41	59·81	6	0·50	18·42	−42·08
	ω Capricorni	20	45	29·58	6	30·07	47·92	−42·15
	19 Capricorni	20	48	50·43	6	51·02	8·95	−42·07
Sept. 19	d Sagittarii	19	11	47·16	6	47·92	44·41	−63·51
	υ Sagittarii	19	16	1·44	6	2·22	58·76	−63·46
	e Aquilæ	19	25	32·90	6	33·78	30·23	−63·55
	47 Aquilæ	19	38	3·99	6	4·99	1·64	−63·35
	υ Aquilæ	19	40	58·77	6	59·74	56·27	−63·47
	63 Sagittarii	19	56	25·46	6	26·26	22·76	−63·50
	8 Piscis Australis	21	30	24·49	6	25·18	21·55	−63·63
	ξ Aquarii	21	32	31·98	6	32·83	29·37	−63·46
	41 Capricorni	21	36	21·44	6	22·16	18·73	−63·43
	27 Aquarii	21	42	18·87	6	19·80	16·20	−63·60
	B.A.C. 7649	21	53	12·83	6	13·56	10·12	−63·44
	B.A.C. 7665	21	56	46·13	6	46·89	43·34	−63·55
Dec. 23	ζ Eridani	3	10	47·76	6	48·43	7·96	−40·47
	Lacaille 1051	3	13	50·98	6	51·47	11·03	−40·44
	Lalande 6248	3	16	56·54	6	57·00	16·55	−40·45
	Lalande 6476	3	24	43·41	6	44·03	3·53	−40·50
	19 Monocerotis	6	58	15·10	6	15·84	5·47	−40·37
	Lalande 13811	7	1	50·08	4	50·72	10·47	−40·25
	20 Monocerotis	7	5	3·92	6	4·66	24·26	−40·40
	B.A.C. 2433	7	16	41·90	6	42·69	2·37	−40·32
	B.A.C. 2470	7	23	0·68	6	1·33	21·27	−40·06

Date.	Name of Star.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.		h m s		s	s	s
Dec. 29	ζ Eridani	3 10 44·98	6	45·66	7·92	−37·74
	Lacaille 1051	3 13 48·24	6	48·71	10·98	−37·73
	20 Eridani	3 31 33·78	6	34·33	56·67	−37·66
	24 Eridani	3 39 9·97	6	10·76	32·92	−37·84
1882.						
Jan. 9	Lalande 5424	2 50 29·42	6	30·23	56·89	−33·34
	Lacaille 1051	3 13 43·88	6	44·24	10·85	−33·39
	44 Eridani	4 23 0·89	6	1·61	28·24	−33·37
	Lalande 8736	4 32 14·44	6	15·10	41·94	−33·16
Jan. 21	64 Eridani	4 54 57·64	6	57·94	28·82	−29·12
	B.A.C. 1559	4 57 52·89	6	52·97	23·86	−29·11
	ι Leporis	5 7 18·48	6	18·79	49·68	−29·11
	τ Orionis	5 12 23·62	6	24·00	54·77	−29·23
	66 Orionis	5 59 15·22	6	15·77	46·73	−29·04
	B.A.C. 1994	6 6 38·40	6	38·79	9·60	−29·19
	7 Monocerotis	6 14 32·94	6	33·31	4·10	−29·21
	8 Monocerotis	6 18 1·97	6	2·52	33·38	−29·14
	15 Monocerotis	6 34 59·81	6	0·44	31·33	−29·11
Feb. 13	7 Monocerotis	6 14 25·57	6	25·66	3·91	−21·75
	8 Monocerotis	6 17 54·82	6	55·06	33·23	−21·83
	15 Monocerotis	6 34 52·61	6	52·92	31·22	−21·70
	18 Monocerotis	6 42 6·24	6	6·45	44·85	−21·60
	B.A.C. 2433	7 16 24·15	6	24·34	2·69	−21·65
	ε Canis Minoris	7 19 35·93	6	36·24	14·46	−21·78
	B.A.C. 2470	7 22 42·93	6	42·97	21·20	−21·77
	ο Puppis	7 43 35·23	6	35·07	13·34	−21·73
	9 Argûs	7 46 42·59	6	42·59	20·89	−21·70
Feb. 14	7 Monocerotis	6 14 25·15	6	25·24	3·90	−21·34
	8 Monocerotis	6 17 54·25	6	54·50	33·22	−21·28
	15 Monocerotis	6 34 52·13	6	52·45	31·21	−21·24
	18 Monocerotis	6 42 6·02	6	6·24	44·84	−21·40
	ε Canis Minoris	7 19 35·61	6	35·93	14·45	−21·48
	B.A.C. 2470	7 22 42·51	6	42·55	21·19	−21·36
	ο Puppis	7 43 34·73	6	34·56	13·33	−21·23
	9 Argûs	7 46 42·21	6	42·22	20·88	−21·34
Feb. 15	υ Orionis	5 26 36·24	6	36·36	15·31	−21·05
	c Orionis	5 29 56·67	6	56·83	35·88	−20·95
	σ Orionis	5 33 12·14	6	12·32	51·35	−20·97
	b Orionis	5 36 45·29	6	45·53	24·51	−21·02
	γ Leporis	5 39 55·63	6	55·53	34·46	−21·07
	W.B. VIII–486	8 20 18·29	6	18·40	57·36	−21·04
	B.A.C. 2868	8 26 36·48	6	36·43	15·34	−21·09
	δ Hydræ	8 31 47·97	6	48·27	27·19	−21·08
	6 Hydræ	8 34 49·59	6	49·65	28·61	−21·04
	B.A.C. 2954	8 38 16·09	6	16·22	55·30	−20·92
Feb. 17	υ Orionis	5 26 35·44	6	35·49	15·28	−20·21
	c Orionis	5 29 55·99	6	56·07	35·85	−20·22
	σ Orionis	5 33 11·29	6	11·40	51·32	−20·08
	b Orionis	5 36 44·60	6	44·77	24·48	−20·29
	γ Leporis	5 39 54·83	6	54·66	34·43	−20·23
	W.B. VIII–486	8 20 17·44	6	17·47	57·35	−20·12
	δ Hydræ	8 31 47·07	6	47·29	27·19	−20·10
	6 Hydræ	8 34 48·68	6	48·66	28·61	−20·05
	B.A.C. 2954	8 38 15·32	6	15·39	55·30	−20·09

SECTION V.

OBSERVATIONS WITH CAPE HUT-TRANSIT.

SECTION V.—TABLE 1.

DETERMINATIONS OF COLLIMATION ERROR OF SMALL TRANSIT AT THE CAPE BY MR. FINLAY.

Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Observation. Lamp W.	Lamp E.	Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Observation. Lamp W.	Lamp E.
1881.	r	r	s	s	1882.	r	r	s	s
Apr. 9	10·511	10·500	−0·058	+0·024	Jan. 26	10·499	10·500	−0·013	−0·021
14	10·519	10·500	−0·073	+0·039	27	10·547	10·500	−0·193	+0·159
					28	10·532	10·500	−0·137	+0·103
Dec. 17	10·532	10·500		+0·101	Feb. 14	10·525	10·500	−0·109	+0·075
23	10·536	10·500	−0·151	+0·117	15	10·533	10·500	−0·141	+0·107
30	10·527	10·500	−0·118	+0·084	May 27	10·550	10·550	−0·017	−0·017
1882.					July 10	10·576	10·550	−0·114	+0·080
Jan. 15	10·552	10·500	−0·212	+0·178	13	10·554	10·545	−0·051	+0·017
16	10·542	10·500	−0·174	+0·140					
17	10·545	10·500	−0·185	+0·151	1883.				
20	10·545	10·500	−0·185	+0·151	Jan. 3	10·664	10·500	−0·631	+0·597

SECTION V.—TABLE 2.

DETERMINATIONS OF LEVEL ERROR OF SMALL TRANSIT AT THE CAPE BY MR. FINLAY.

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1881.		d	s
April 9	W.	+1·39	+0·123
	W.	+1·51	
	E.	+1·13	+0·086
	E.	+0·88	
14	W.	+3·75	+0·319
	E.	+5·10	+0·404
	E.	+4·18	
May 12	E.	−0·25	−0·026
	E.	−0·36	
	W.	−0·83	−0·070
20	E.	+8·84	+0·766
	E.	+8·76	
	Level altered.		
23	E.	−4·55	−0·407
	W.	−7·52	−0·654
	W.	−5·70	−0·496*
December 23	E.	+1·18	+0·106
	E.	+1·10	
	W.	−0·23	−0·021
	W.	+0·03	+0·002*
	E.	+2·10	+0·195
	E.	+1·18	+0·110*
	W.	+0·71	+0·066
	W.	+1·24	+0·115*
30	E.	−0·96	−0·098
	E.	−1·29	
	W.	−0·78	−0·046
	W.	−0·29	

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1882.		d	s
January 14	E.	+1·35	+0·119
	E.	+1·38	
15	W.	+3·33	+0·300
	W.	+3·56	
	E.	+2·81	+0·229
	E.	+2·45	
16	E.	+3·36	+0·285
	E.	+3·20	
	W.	+3·55	+0·335
	W.	+4·15	
17	E.	+5·53	+0·457
	E.	+4·98	
	W.	+4·84	+0·432
	W.	+5·10	
20	E.	−0·75	−0·082
	E.	−1·14	
	W.	−0·74	−0·048
	W.	−0·35	
26	W.	+1·06	+0·102
	W.	+1·40	
	E.	+1·10	+0·066
	E.	+0·40	
27	W.	+1·43	+0·150
	W.	+2·03	
	E.	+1·81	+0·158
	E.	+0·88	+0·076*

Date.		Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1882.			d	s
January	28	W.	+1·58	+0·157
		W.	+2·04	
		E.	+2·94	+0·247
		E.	+2·74	
February	13	W.	+0·55	+0·048
		E.	+1·20	+0·080
		E.	+0·64	
	14	E.	+1·13	+0·091
		E.	+0·98	
		W.	+1·39	+0·121
	15	W.	+2·08	+0·196
		W.	+2·44	
		E.	+1·71	+0·149
	17	W.	+5·70	+0·496
		E.	+5·60	+0·487
		E.	+4·88	+0·424*
May	22	E.	+4·46	+0·389
		W.	+3·96	+0·345
		W.	+5·33	+0·463*
	27	E.	+3·40	+0·296
		E.	+2·76	+0·240*
		W.	+3·06	+0·266

Date.		Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1882.			d	s
July	10	W.	+3·75	+0·320
		W.	+3·61	
		E.	+3·41	+0·280
		E.	+3·04	
		E.	+2·83	+0·246
		E.	+0·43	+0·037*
		W.	+1·55	+0·135
		W.	+3·01	+0·262*
	13	W.	+1·70	+0·160
		W.	+1·96	
		E.	+1·80	+0·157
		E.	+0·75	+0·065*
		E.	+1·80	+0·157
		E.	+0·63	+0·054*
		W.	+0·58	+0·050
		W.	+1·93	+0·167*
1883.				
January	20	E.	+1·90	+0·165
		W.	+2·23	+0·217
		W.	+2·75	
	22	E.	−1·38	−0·131
		E.	−1·63	
		W.	+0·25	+0·021

SECTION V.—TABLE 3.

DETERMINATION OF AZIMUTH ERROR OF SMALL TRANSIT AT THE CAPE BY MR. FINLAY.

Date.		Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Tabular Time of Transit.	Azimuth Error.
1881.				h m s	h m s	s
April	9	W.	Lacaille 8798 S.P.	9 33 7·98	9 32 29·94	−0·829
			Lacaille 4169	9 48 8·41	9 47 44·88	
		E.	Lacaille 248 S.P.	12 40 11·70	12 39 28·12	−0·857
			ι Octantis	12 43 19·74	12 42 54·67	
April	14	W.	Lacaille 9123 S.P.	10 31 12·62	10 30 32·57	−0·290
			Lacaille 4578	10 47 48·43	10 47 14·51	
		E.	Lacaille 9464 S.P.	11 28 4·43	11 27 23·35	−0·201
			Lacaille 4865	11 35 31·62	11 34 55·61	
May	12	E.	Lacaille 9464 S.P.	11 27 51·00	11 27 31·29	+0·923
			Lacaille 4865	11 35 34·63	11 34 51·60	
		W.	z Octantis	14 33 14·38	14 32 17·52	+1·098
May	23	E.	Lacaille 248 S.P.	12 40 12·01	12 39 34·20	−0·355
			Lacaille 5325	12 55 27·09	12 54 59·37	
		W.	Lacaille 634 S.P.	13 44 43·42	13 44 7·67	−0·277

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Tabular Time of Transit.	Azimuthal Error.
1881.			h m s	h m s	s
Dec. 23	E.	z Octantis S.P. - -	2 33 5·42	2 31 44·31	−2·170
		Lacaille 1029 - -	2 38 39·96	2 38 30·32	
	W.	Lacaille 1222 - -	3 32 5·15	3 31 37·51	−2·466
		Lacaille 6484 S.P. -	3 44 16·51	3 43 29·88	
	E.	Lacaille 3274 - -	7 28 14·56	7 28 12·97	−2·411
		Lacaille 8094 S.P. -	7 34 57·53	7 34 6·15	
	W.	A Octantis - - -	8 5 47·12	8 6 29·56	−2·505
		Lacaille 8360 S.P. -	8 19 1·64	8 18 9·25	
Dec. 30	E.	Lacaille 1592 - -	4 5 0·85	4 4 39·17	−2·136
		Lacaille 6727 S.P. -	4 16 15·35	4 15 21·69	
	W.	Lacaille 2426 - -	6 21 20·87	6 20 50·58	−2·416
		σ Octantis S.P. - -	6 30 13·27	6 26 50·95	
1882.					
Jan. 17	E.	Brisbane 5607 S.P. -	4 18 54·16	4 17 11·57	−2·789
		Lacaille 1839 - -	4 34 54·22	4 34 24·05	
	W.	Lacaille 2210 - -	5 59 15·01	5 58 19·87	−3·025
		σ Octantis S.P. - -	6 31 29·55	6 27 3·91	
Jan. 20	E.	Lacaille 1592 - -	4 5 15·88	4 4 33·64	−2·863
		Brisbane 5607 S.P. -	4 19 0·93	4 17 12·59	
	W.	σ Octantis S.P. - -	6 31 51·39	6 27 8·62	−3·207
		ζ Mensæ - - -	6 50 54·65	6 49 56·99	
Jan. 26	W.	Brisbane 5607 S.P. -	4 18 18·13	4 17 14·72	−3·217
		Lacaille 1839 - -	4 34 0·73	4 34 20·89	
	E.	Lacaille 2066 - -	5 25 32·56	5 25 33·37	−3·245
		Lacaille 7184 S.P. -	5 30 26·16	5 29 38·88	
Jan. 27	W.	Lacaille 6817 S.P. -	4 26 55·63	4 26 16·45	−3·316
		Lacaille 1752 - -	4 58 54·23	4 58 37·60	
	E.	Brisbane 6058 S.P. -	5 46 44·10	5 45 12·59	−3·113
		Lacaille 2296 - -	5 53 11·27	5 53 11·48	
Jan. 28	W.	Lacaille 1592 - -	4 4 25·21	4 4 31·22	−3·329
		Brisbane 5607 S.P. -	4 18 26·31	4 17 15·45	
	E.	Lacaille 2066 - -	5 25 37·55	5 25 32·98	−3·170
		Lacaille 7184 S.P. -	5 30 30·79	5 29 39·24	
Feb. 13	W.	σ Octantis S.P. - -	6 32 12·39	6 27 41·90	−3·246
		ζ Mensæ - - -	6 50 37·92	6 49 54·82	
	E.	Lacaille 3274 - -	7 28 19·34	7 28 6·62	−3·164
		Lacaille 8094 S.P. -	7 35 27·07	7 34 8·99	
Feb. 14	E.	Brisbane 6058 S.P. -	5 47 26·00	5 45 22·30	−3·043
		Lacaille 2296 - -	5 53 41·45	5 53 7·36	
	W.	A Octantis - - -	8 5 41·49	8 6 22·59	−3·214
		Lacaille 8257 S.P. -	8 15 38·12	8 14 6·16	
Feb. 15	W.	Brisbane 6058 S.P. -	5 47 33·62	5 45 22·89	−3·290
		Lacaille 2296 - -	5 53 40·93	5 53 7·10	
	E.	A Octantis - - -	8 5 45·52	8 6 21·95	−3·126
		Lacaille 8257 S.P. -	8 15 39·31	8 14 6·31	

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Tabular Time of Transit.	Azimuthal Error.
1882.			h m s	h m s	s
Feb. 17	W.	σ Octantis S.P. - -	6 32 41·42	6 27 49·29	−3·451
		ζ Mensæ - - -	6 50 44·77	6 49 54·35	
	E.	Lacaille 3274 - -	7 28 23·84	7 28 5·40	−3·301
		Lacaille 8094 S.P. -	7 35 36·11	7 34 9·48	
May 22	E.	Lacaille 4991 - -	11 57 39·18	11 56 40·53	−1·065
		Lacaille 9745 S.P. -	12 3 35·35	12 2 11·37	
	W.	Lacaille 235 S.P. -	12 45 38·43	12 44 26·54	−1·450
		Lacaille 5325 - -	12 55 56·23	12 55 11·45	
May 27	E.	Lacaille 4643 - -	11 0 24·33	11 0 10·45	−0·165
		τ Octantis S.P. - -	11 9 53·52	11 9 34·17	
	W.	κ Octantis - - -	13 22 37·03	13 22 26·09	−0·325
		Lacaille 634 S.P. -	13 44 19·46	13 44 2·00	
July 10	W.	Lacaille 1105 S.P. -	15 12 46·16	15 11 28·35	+0·161
		Lacaille 6216 - -	15 17 57·39	15 16 37·58	
	E.	Lacaille 1592 S.P. -	16 5 18·68	16 4 6·03	+0·561
		Brisbane 5607 - -	16 19 14·32	16 17 48·71	
	E.	σ Octantis - - -	18 33 2·54	18 31 16·66	+0·411
		ζ Mensæ S.P. - -	18 50 55·69	18 49 38·74	
	W.	Lacaille 8094 - -	19 35 49·12	19 34 29·90	+0·046
		Lacaille 3238 S.P. -	19 58 2·16	19 56 43·45	
July 13	W.	Lacaille 1105 S.P. -	15 12 50·97	15 11 28·64	+0·031
		Lacaille 6216 - -	15 17 59·87	15 16 37·15	
	E.	Lacaille 1592 S.P. -	16 5 27·33	16 4 6·56	+0·165
		Brisbane 5607 - -	16 19 12·81	16 17 48·22	
	E.	σ Octantis - - -	18 32 42·11	18 31 16·90	+0·049
		ζ Mensæ S.P. - -	18 51 0·50	18 49 38·76	
	W.	Lacaille 3274 S.P. -	19 28 39·88	19 27 15·55	−0·084
		Lacaille 8094 - -	19 35 52·63	19 34 30·03	
1883.					
Jan. 22	E.	Lacaille 6817 S.P. -	4 26 24·03	4 27 27·08	+0·917
	W.	Lacaille 2426 - -	6 20 43·07	6 21 55·10	+0·937

SECTION V.—TABLE 4.

OBSERVATIONS WITH THE SMALL TRANSIT AT THE CAPE BY MR. FINLAY.

Date.	Name of Star.	Position of Lamp.	Time of Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	m s
Apr. 9	Lalande 19241	W.	9 42 52·31	5	51·97	20·48	−0 31·49
	13 Sextantis		9 58 33·07	5	32·61	1·16	−0 31·45
	λ Hydræ		10 5 21·57	5	21·31	49·80	−0 31·51
	21 Sextantis		10 8 47·07	5	46·75	15·21	−0 31·54
	22 Sextantis		10 12 17·53	5	17·21	45·70	−0 31·51
	η Virginis	E.	12 14 24·15	5	23·77	52·09	−0 31·68
	6 Corvi		12 17 44·59	5	44·55	12·80	−0 31·75
	B.A.C. 4200		12 22 20·33	5	20·00	48·29	−0 31·71
	Piazzi XII–111		12 26 6·67	5	6·36	34·67	−0 31·69
Apr. 14	ρ Leonis	W.	10 27 12·75	5	12·70	35·41	−0 37·29
	36 Sextantis		10 39 41·57	5	41·57	4·24	−0 37·33
	l Leonis		10 43 40·27	5	40·21	2·93	−0 37·28
	p^1 Leonis		10 56 25·49	5	25·53	48·23	−0 37·30
	χ Leonis		10 59 32·77	5	32·73	55·50	−0 37·23
	A^1 Virginis	E.	11 42 28·29	5	28·50	51·01	−0 37·49
	η Crateris		11 50 37·29	5	37·68	0·12	−0 37·56
	B.A.C. 4077		12 2 34·55	5	34·83	57·22	−0 37·61
	η Virginis		12 14 29·38	4	29·66	52·09	−0 37·57
May 12	A^1 Virginis	E.	11 42 25·29	5	26·01	50·81	−0 35·20
	η Crateris		11 50 34·81	5	35·18	59·94	−0 35·24
	Lalande 22585		11 55 15·65	5	16·11	40·88	−0 35·23
	B.A.C. 4077		12 0 31·75	5	32·31	57·07	−0 35·24
	λ Virginis	W.	14 13 18·65	5	18·84	43·73	−0 35·11
	B.A.C. 4773		14 18 53·81	4	54·33	19·29	−0 35·04
	φ Virginis		14 22 42·29	5	42·67	7·65	−0 35·02
May 23	B.A.C. 4382	E.	13 0 46·77	5	46·34	13·46	−0 32·88
	θ Virginis		13 4 23·81	5	23·37	50·44	−0 32·93
	54 Virginis		13 7 41·85	5	41·43	8·49	−0 32·94
	86 Virginis	W.	13 40 12·75	5	11·92	39·23	−0 32·69
	τ Virginis		13 56 12·19	5	11·45	38·69	−0 32·76
	ι Virginis		14 10 23·33	5	22·63	49·88	−0 32·75
Dec. 23	σ Ceti	E.	2 27 7·89	5	7·41	31·27	−0 36·14
	τ^2 Eridani		2 46 19·27	5	19·01	42·80	−0 36·21
	Lalande 5424		2 50 34·61	5	33·35	57·03	−0 36·32
	λ Ceti		2 54 2·95	5	1·67	25·36	−0 36·31
	Lalande 6476	W.	3 24 40·59	5	39·51	3·53	−0 35·98
	22 Eridani		3 35 27·07	5	25·73	49·82	−0 35·91
	24 Eridani		3 39 10·41	5	8·93	32·95	−0 35·98
	30 Eridani		3 47 31·25	5	29·93	53·93	−0 36·00
	Lalande 13811	E.	7 1 47·41	5	46·75	10·47	−0 36·28
	20 Monocerotis		7 5 1·49	5	0·56	24·26	−0 36·30
	26 Canis Majoris		7 8 1·08	5	1·02	24·77	−0 36·25
	B.A.C. 2405		7 12 29·88	5	29·89	53·37	−0 36·52
	B.A.C. 2846	W.	8 23 31·92	5	31·45	55·25	−0 36·20
	B.A.C. 2868		8 26 51·91	5	51·18	14·81	−0 36·37
	δ Hydræ		8 32 4·43	5	2·74	26·55	−0 36·19
	6 Hydræ		8 35 5·27	5	4·26	28·02	−0 36·24

Date.	Name of Star.	Position of Lamp.	Time of Transit reduced to Centre Wire.			No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
			h	m	s		s	s	m s
1881. Dec. 30	Lalande 7273	E.	3	50	28·79	5	27·99	45·18	−0 42·81
	Lalande 7384		3	53	49·33	5	48·31	5·48	−0 42·83
	ν Tauri		3	57	39·13	5	37·76	54·90	−0 42·86
	μ Tauri		4	9	54·17	5	52·73	9·82	−0 42·91
	5 Monocerotis	W.	6	9	52·51	5	51·22	8·35	−0 42·87
	7 Monocerotis		6	14	48·23	5	47·00	4·05	−0 42·95
	15 Monocerotis		6	35	15·91	5	14·06	31·21	−0 42·85
	18 Monocerotis		6	42	29·29	5	27·69	44·83	−0 42·86
1882. Jan. 17	44 Eridani	E.	4	23	35·85	5	34·76	28·18	−1 6·58
	45 Eridani		4	26	59·97	5	58·95	52·58	−1 6·37
	W.B. IV.–585		4	29	41·79	5	41·18	34·76	−1 6·42
	Lalande 8935		4	39	34·31	5	33·68	27·23	−1 6·45
	B.A.C. 1965	W.	6	2	45·95	4	45·59	39·15	−1 6·44
	B.A.C. 1994		6	7	17·25	5	16·05	9·61	−1 6·44
	5 Monocerotis		6	10	15·97	5	14·74	8·40	−1 6·34
	7 Monocerotis		6	15	11·64	4	10·49	4·11	−1 6·38
Jan. 20	44 Eridani	E.	4	23	41·09	5	39·52	28·15	−1 11·37
	45 Eridani		4	27	5·31	5	3·80	52·56	−1 11·24
	W.B. IV–585		4	29	47·17	5	46·03	34·73	−1 11·30
	Lalande 8736		4	32	54·53	5	53·12	41·86	−1 11·26
	ξ Geminorum	W.	6	39	56·39	5	53·76	42·63	−1 11·13
	18 Monocerotis		6	42	58·33	5	56·19	44·95	−1 11·24
	B.A.C. 2291		6	55	0·26	5	59·47	48·22	−1 11·25
	19 Monocerotis		6	58	18·79	5	16·96	5·71	−1 11·25
Jan. 26	45 Eridani	W.	4	26	16·78	3	15·07	52·49	−0 22·58
	Lalande 8935		4	38	51·14	2	49·84	27·14	−0 22·70
	Lalande 9045		4	42	43·97	4	43·09	20·20	−0 22·89
	π^4 Orionis		4	45	22·19	5	20·22	57·35	−0 22·87
	π^5 Orionis		4	48	32·99	3	31·16	8·43	−0 22·73
	Lalande 9293		4	51	1·77	5	0·30	37·56	−0 22·74
	64 Eridani		4	54	52·65	5	51·55	28·76	−0 22·79
	o Orionis	E.	5	16	10·82	4	9·07	46·45	−0 22·62
	Lalande 10145		5	19	3·98	3	2·12	39·58	−0 22·54
	b Orionis		5	36	49·25	5	47·40	24·74	−0 22·66
	γ Leporis		5	39	58·02	4	57·37	34·74	−0 22·63
	Lalande 11047		5	43	59·93	5	57·68	35·00	−0 22·68
Jan. 27	Lalande 8935	W.	4	38	53·40	1	51·92	27·13	−0 24·79
	π^4 Orionis		4	45	24·46	3	22·28	57·34	−0 24·94
	π^5 Orionis		4	48	35·10	2	33·08	8·42	−0 24·66
	λ Eridani		5	3	58·29	5	56·82	31·94	−0 24·88
	ι Leporis		5	7	15·77	5	14·44	49·62	−0 24·82
	τ Orionis		5	12	21·13	5	19·56	54·72	−0 24·84
	o Orionis		5	16	13·27	5	11·39	46·44	−0 24·95
	b Orionis	E.	5	36	51·37	5	49·84	24·73	−0 25·11
	γ Leporis		5	40	0·17	4	59·81	34·73	−0 25·08
	B.A.C. 1965		6	2	4·58	4	4·21	39·08	−0 25·13
Jan. 28	44 Eridani	W.	4	22	56·99	5	55·06	28·07	−0 26·99
	45 Eridani		4	26	21·21	5	19·36	52·47	−0 26·89
	W.B. IV–585		4	29	3·15	5	1·74	34·63	−0 27·11
	Lalande 8736		4	32	10·43	5	8·69	41·77	−0 26·92
	o Orionis	E.	5	16	15·19	5	13·75	46·43	−0 27·32
	Lalande 10145		5	19	8·35	5	6·80	39·56	−0 27·24
	b Orionis		5	36	53·61	5	52·07	24·72	−0 27·35
	γ Leporis		5	40	2·27	5	1·96	34·72	−0 27·24

Date.	Name of Star.	Position of Lamp.	Time of Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1882.			h m s		s	s	m s
Feb. 13	7 Monocerotis - - -	W.	6 15 3·29	5	1·81	3·91	−0 57·90
	8 Monocerotis - - -		6 18 33·17	5	31·09	33·23	−0 57·86
	15 Monocerotis - - -		6 35 31·33	5	28·97	31·22	−0 57·75
	18 Monocerotis - - -		6 42 44·73	5	42·73	44·85	−0 57·88
	B.A.C. 2433 - - -	E.	7 17 2·31	5	0·69	2·69	−0 58·00
	ε Canis Minoris - -		7 20 14·45	5	12·41	14·46	−0 57·95
	B.A.C. 2470 - - -		7 23 20·37	5	19·30	21·20	−0 58·10
	o Puppis - - -		7 44 11·70	5	11·36	13·34	−0 58·02
	9 Argûs - - -		7 47 19·97	5	19·00	20·89	−0 58·11
Feb. 14	υ Orionis - - -	E.	5 27 16·67	5	15·46	15·33	−1 0·13
	c Orionis - - -		5 30 37·33	5	36·01	35·90	−1 0·11
	σ Orionis - - -		5 33 52·93	5	51·51	51·37	−1 0·14
	b Orionis - - -		5 37 26·31	5	24·70	24·53	−1 0·17
	γ Leporis - - -		5 40 35·13	5	34·66	34·48	−1 0·18
	W.B. VIII–486 -	W.	8 20 59·03	4	57·64	57·36	−1 0·28
	B.A.C. 2868 - - -		8 27 16·51	5	15·66	15·34	−1 0·32
	δ Hydræ - - -		8 32 29·71	5	27·63	27·20	−1 0·43
	6 Hydræ - - -		8 35 30·29	5	29·08	28·62	−1 0·46
	B.A.C. 2954 - - -		8 38 57·21	5	55·73	55·30	−1 0·43
Feb. 15	υ Orionis - - -	W.	5 27 19·01	5	17·57	15·31	−1 2·26
	c Orionis - - -		5 30 39·69	5	38·12	35·88	−1 2·24
	σ Orionis - - -		5 33 55·27	5	53·59	51·35	−1 2·24
	b Orionis - - -		5 37 28·77	5	26·89	24·51	−1 2·38
	γ Leporis - - -		5 40 37·41	5	36·76	34·46	−1 2·30
	W.B. VIII–486 - -	E.	8 21 0·99	5	59·92	57·36	−1 2·56
	B.A.C. 2868 - - -		8 27 18·55	5	18·00	15·34	−1 2·66
	δ Hydræ - - -		8 32 31·65	5	29·87	27·19	−1 2·68
	6 Hydræ - - -		8 35 32·17	5	31·25	28·61	−1 2·64
	B.A.C. 2954 - - -		8 38 59·17	5	57·99	55·30	−1 2·69
Feb. 17	7 Monocerotis - - -	W.	6 15 11·43	5	10·18	3·86	−1 6·32
	8 Monocerotis - - -		6 18 41·43	5	39·50	33·19	−1 6·31
	15 Monocerotis - - -		6 35 39·77	5	37·55	31·18	−1 6·37
	18 Monocerotis - - -		6 42 53·05	5	51·23	44·81	−1 6·42
	B.A.C. 2433 - - -	E.	7 17 10·39	5	9·03	2·66	−1 6·37
	ε Canis Minoris - -		7 20 22·89	5	21·06	14·43	−1 6·63
	B.A.C. 2470 - - -		7 23 28·53	5	27·79	21·17	−1 6·62
	o Puppis - - -		7 44 19·72	5	19·81	13·30	−1 6·51
	9 Argûs - - -		7 47 28·07	5	27·44	20·86	−1 6·58
May 22	12 Virginis - - -	E.	12 8 35·55	5	35·29	28·06	−1 7·23
	Lalande 23006 - -		12 12 8·17	5	8·44	1·07	−1 7·37
	η Virginis - - -		12 15 2·19	5	2·12	54·84	−1 7·28
	6 Corvi - - - -		12 18 22·65	5	23·10	15·69	−1 7·41
	θ Virginis - - -	W	13 5 0·95	5	0·33	53·44	−1 6·89
	58 Virginis - - -		13 12 26·67	5	26·19	19·39	−1 6·80
	66 Virginis - - -		13 19 35·21	5	34·60	27·73	−1 6·87
	72 Virginis - - -		13 25 27·01	5	26·44	19·49	−1 6·95
May 27	79 Leonis - - -	E.	11 18 15·77	5	15·86	1·37	−0 14·49
	κ Crateris - - -		11 21 29·45	5	29·61	15·33	−0 14·28
	e Leonis - - -		11 24 33·85	5	33·95	19·60	−0 14·35
	B.A.C. 3925 - - -		11 27 4·31	5	4·44	50·14	−0 14·30
	h Virginis - - -	W.	13 27 2·61	5	2·64	48·35	−0 14·29
	95 Virginis - - -		14 0 45·01	5	46·09	31·69	−0 14·40
	96 Virginis - - -		14 3 0·95	5	1·03	46·71	−0 14·32
	κ Virginis - - -		14 6 53·71	5	53·79	39·44	−0 14·35
	ι Virginis - - -		14 10 7·29	5	7·34	52·92	−0 14·42
	λ Virginis - - -		14 13 1·25	5	1·36	46·90	−0 14·46

Date.	Name of Star.	Position of Lamp.	Time of Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1882.			h m s		s	s	m s
July 10	32 Libræ	W.	15 22 58·07	5	58·32	39·77	−1 18·55
	ζ^3 Libræ		15 25 22·81	5	23·06	4·67	−1 18·39
	41 Libræ		15 33 29·03	5	29·28	10·82	−1 18·46
	κ Libræ		15 36 30·91	5	31·16	12·71	−1 18·45
	51 Libræ	E.	15 59 14·75	5	15·32	56·49	−1 18·83
	18 Scorpii		16 10 34·49	5	35·07	16·14	−1 18·93
	Lalande 29689		16 13 42·93	5	43·47	24·56	−1 18·91
	ϕ Ophiuchi		16 25 45·45	5	45·99	27·06	−1 18·93
	B.A.C. 6367	E.	18 38 28·20	4	28·62	9·76	−1 18·86
	B.A.C. 6388		18 42 17·43	5	17·85	58·83	−1 19·02
	30 Sagittarii		18 45 8·09	5	8·43	49·32	−1 19·11
	B.A.C. 6488		18 56 11·57	5	11·88	53·11	−1 18·77
	15 Aquilæ		19 0 6·41	5	6·76	47·82	−1 18·94
	51 Aquilæ	W.	19 45 38·95	5	40·03	21·29	−1 18·74
	β Aquilæ		19 50 53·37	5	53·45	34·82	−1 18·63
	Lalande 38458		20 3 10·87	5	10·98	52·46	−1 18·52
July 13	32 Libræ	W.	15 23 2·13	5	2·25	39·75	−1 22·50
	ζ^3 Libræ		15 25 26·93	5	27·05	4·64	−1 22·41
	37 Libræ		15 29 9·45	5	9·56	47·23	−1 22·33
	41 Libræ		15 33 33·05	5	33·17	10·79	−1 22·38
	48 Libræ	E.	15 53 0·89	5	1·10	38·60	−1 22·50
	50 Libræ		15 55 51·27	5	51·48	29·05	−1 22·43
	51 Libræ		15 59 18·77	5	18·98	56·47	−1 22·51
	18 Scorpii		16 10 38·41	5	38·59	16·12	−1 22·47
	B.A.C. 6279	E.	18 23 54·97	5	55·14	32·52	−1 22·62
	B.A.C. 6367		18 38 32·25	5	32·39	9·78	−1 22·61
	B.A.C. 6388		18 42 21·35	5	21·48	58·85	−1 22·63
	γ^1 Sagittarii		18 48 29·69	5	29·82	7·15	−1 22·67
	B.A.C. 6488		18 56 15·67	5	15·78	53·13	−1 22·65
	ν Aquilæ	W.	19 21 55·47	5	55·43	32·87	−1 22·56
	e Aquilæ		19 25 56·03	5	56·01	33·54	−1 22·47
	51 Aquilæ		19 45 43·91	5	43·96	21·33	−1 22·63
	η Aquilæ		19 47 54·04	4	54·06	31·61	−1 22·45
1883.							
Jan. 20	Stone 2268	E.	5 7 18·09	5	18·11	15·33	−1 2·78
	Stone 2335		5 14 20·23	5	20·39	17·72	−1 2·67
	Stone 2515	W.	5 33 43·58	5	43·85	41·12	−1 2·73
	Stone 2562		5 38 14·40	5	14·59	12·13	−1 2·46
	Stone 2622		5 45 7·82	5	8·01	5·40	−1 2·61
Jan. 22	Stone 2031	E.	4 39 11·21	5	11·00	4·07	−1 6·93
	Stone 2081		4 44 24·42	5	24·37	17·40	−1 6·97
	Stone 2113		4 47 36·55	5	36·32	29·36	−1 6·96
	Stone 2145		4 51 51·64	5	51·67	44·80	−1 6·87
	Stone 2772	W.	6 1 8·40	5	8·35	1·27	−1 7·08
	Stone 2806		6 4 6·12	5	5·87	59·00	−1 6·87
	Stone 2839		6 7 30·27	5	30·17	23·13	−1 7·04
	Stone 2880		6 12 35·92	5	35·92	28·98	−1 6·94

SECTION V.—TABLE 5.

DETERMINATION OF COLLIMATION ERROR OF THE SMALL TRANSIT AT THE CAPE BY MR. MACLEAR.

Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Aberration.		Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Aberration.	
			Lamp W.	Lamp E.				Lamp W.	Lamp E.
1881.	rev.	rev.	s	s	1881.	rev.	rev.	s	s
April 9	10·512	10·500	−0·062	+0·028	June 20	10·535 10·540	10·500	−0·158	+0·123
April 12	10·512	10·500	−0·062	+0·028	June 21	10·538 10·540	10·500	−0·163	+0·129
April 14	10·519	10·500	−0·088	+0·054	June 22	10·548 10·544	10·500	−0·189	+0·155
April 20	10·523	10·500	−0·103	+0·069	June 27	10·543 10·543	10·500	−0·178	+0·144
April 22	10·524	10·500	−0·107	+0·073	July 12	10·560	10·500	−0·242	+0·208
April 28	10·512	10·500	−0·062	+0·028	1882. Feb. 13	10·527 10·526 10·529	10·500	−0·118	+0·084
May 12	10·532	10·500	−0·137	+0·103	Feb. 17	10·539 10·531	10·500	−0·148	+0·114
May 20	10·531	10·500	−0·133	+0·099					
May 23	10·528	10·500	−0·122	+0·088					
June 16	10·529 10·538	10·500	−0·144	+0·110					
June 17	10·537 10·537	10·500	−0·156	+0·122					

SECTION V.—TABLE 6.

DETERMINATION OF LEVEL ERROR OF THE SMALL TRANSIT AT THE CAPE BY MR. MACLEAR.

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.	Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1881.		d	s	1881.		d	s
April 9	W. E. E.	+ 1·03 + 1·65 + 1·13	+0·089 +0·118	May 20	W. W. E. E.	+ 9·07 + 9·94 + 9·44 + 9·24	+0·827 +0·813
April 12	E. E.	+ 1·95 + 2·14	+0·166 +0·182	May 23	E. E. W.	− 5·54 − 4·82 − 5·09	−0·450 −0·443
April 13	E. E. W.	+ 3·48 + 3·18 + 3·20	+0·289 +0·278	June 16	E. E. W. W. W. W. E. E.	− 8·90 − 9·24 −10·22 − 9·94 − 9·19 − 7·99 − 7·62 − 7·75	−0·789 −0·878 −0·747 −0·668
April 14	W. W. E.	+ 2·86 + 3·61 + 4·11	+0·275 +0·357	June 17	E. E. W. W. W. W. E. E.	− 8·38 − 8·71 − 9·50 − 9·44 − 8·53 − 8·39 − 7·29 − 7·80	−0·743 −0·823 −0·736 −0·656
April 20	E. E. W. W.	+ 7·82 + 7·85 + 8·60 + 9·20	+0·682 +0·774				
April 22	W. W. E. E.	− 2·70 − 2·64 − 2·47 − 2·88	−0·232 −0·233				
April 28	E.	+ 0·26	+0·022				
May 12	E. W. W. W.	− 0·68 − 1·16 − 1·08 − 1·08	−0·057 −0·094 −0·091				

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1881.		d	s
June 20	E.	−13·45	−1·146
	E.	−12·90	
	W.	−13·56	−1·180
	W.	−13·31	−1·148
	W.	−13·18	
	E.	−13·39	−1·185
	E.	−13·85	
		Level altered.	
June 21	E.	+ 0·45	+0·038
	E.	− 0·13	−0·011*
	W.	+ 0·63	+0·055
	W.	+ 1·75	+0·152*
	W.	+ 1·51	+0·125
	W.	+ 1·36	
	E.	+ 1·44	+0·128
	E.	+ 1·51	
June 22	E.	− 0·09	−0·012
	E.	− 0·18	
	W.	+ 1·24	+0·108
	W.	+ 2·04	+0·177*
	W.	+ 3·33	+0·290
	W.	+ 3·31	
	E.	+ 2·69	+0·234
	E.	+ 1·55	+0·135*

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1881.		d	s
June 27	W.	− 3·41	−0·298
	W.	− 3·44	
	E.	− 2·45	−0·213
	E.	− 3·04	−0·264*
	E.	− 3·49	−0·303
	E.	− 4·08	−0·354*
	W.	− 4·74	−0·410
July 12	W.	+ 0·04	+0·003
	E.	− 2·01	−0·163
	E.	− 1·73	
July 13	W.	− 2·26	−0·197
	W.	− 1·68	−0·146*
July 28	W.	− 3·86	−0·328
	E.	− 0·73	−0·062
1882.			
February 13	W.	+ 0·39	+0·034
	W.	+ 1·10	+0·096*
	E.	+ 0·66	+0·057
February 14	E.	+ 1·16	+0·101
	W.	+ 0·93	+0·104
	W.	+ 1·44	
February 15	W.	+ 2·98	+0·259
	E.	+ 2·76	+0·228
	E.	+ 2·48	
February 17	W.	+ 5·15	+0·464
	W.	+ 5·51	
	E.	+ 4·91	+0·427

SECTION V.—TABLE 7.

DETERMINATION OF AZIMUTH ERROR OF THE SMALL TRANSIT AT THE CAPE BY MR. MACLEAR.

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Tabular Time of Transit.	Azimuth Error.
1881.			h m s	h m s	s
April 9	W.	Lacaille 9123 S.P. -	10 31 10·35	10 30 31·75	−0·790
April 13	E.	Lacaille 8798 S.P. -	9 33 8·94	9 32 30·65	−0·148
	W.	Lacaille 4578 - -	10 47 47·35	10 47 14·72	−0·361
April 14	W.	Lacaille 8798 S.P. -	9 33 9·24	9 32 30·83	−0·190
		Lacaille 4169 - -	9 48 18·80	9 47 43·72	
	E.	Lacaille 248 S.P. -	12 40 10·65	12 39 28·35	−0·373
		ι Octantis - -	12 43 28·84	12 42 54·59	
May 12	E.	Lacaille 248 S.P. -	12 39 55·25	12 39 31·87	+0·888
		ι Octantis - -	12 43 35·26	12 42 52·71	
	W.	κ Octantis - -	13 23 3·68	13 22 17·26	+1·243
		Lacaille 634 S.P. -	13 44 28·09	13 44 6·61	

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Tabular Time of Transit.	Azimuth Error.
1881.			h m s	h m s	s
May 20	W.	Lacaille 9464 S.P. -	11 27 51·36	11 27 34·15	+0·971
		Lacaille 4865 - -	11 35 31·87	11 34 50·13	
	E.	Lacaille 248 S.P. -	12 39 53·91	12 39 33·52	+0·997
		ι Octantis - - -	12 43 33·67	12 42 51·76	
May 23	E.	Lacaille 4991 - -	11 57 4·34	11 56 35·40	−0·361
		Lacaille 9745 S.P. -	12 2 49·93	12 2 12·40	
	W.	z Octantis - - -	14 32 45·03	14 32 16·92	−0·178
		Lacaille 1029 S.P. -	14 38 40·48	14 38 6·51	
June 16	E.	Lacaille 235 S.P. -	12 44 52·58	12 44 27·13	−0·612
		κ Octantis - - -	13 22 29·91	13 22 12·46	
	W.	Lacaille 634 S.P. -	13 44 42·01	13 44 11·53	−0·686
	W.	σ Octantis - - -	18 29 11·04	18 29 35·21	−0·747
		Lacaille 3274 S.P. -	19 28 12·56	19 27 36·71	
	E.	Lacaille 3238 S.P. -	19 57 14·51	19 56 48·72	−0·638
		Lacaille 8257 - -	20 14 38·23	20 14 21·71	
June 17	E.	κ Octantis - - -	13 22 27·95	13 22 12·19	−0·736
		Lacaille 505 S.P. -	13 33 15·40	13 32 49·22	
	W.	Lacaille 634 S.P. -	13 44 42·93	13 44 11·73	−0·808
		z Octantis - - -	14 32 18·56	14 32 12·06	
	W.	Lacaille 7088 - -	17 9 50·36	17 9 31·78	−0·868
		Lacaille 2138 S.P. -	17 46 55·13	17 46 27·80	
	E.	σ Octantis - - -	18 28 59·28	18 29 28·82	−0·816
June 20	E.	κ Octantis - - -	13 22 18·94	13 22 11·70	−1·652
		Lacaille 634 S.P. -	13 44 52·75	13 44 12·35	
	W.	z Octantis - - -	14 32 2·52	14 32 11·16	−1·585
	W.	Lacaille 1752 S.P. -	16 58 57·50	16 58 30·39	−1·476
		Lacaille 7088 - -	17 9 46·82	17 9 31·83	
	E.	Brisbane 6058 - -	17 45 38·87	17 45 49·24	−1·659
		Lacaille 2296 S.P. -	17 53 29·94	17 52 51·80	
		σ Octantis - - -	18 28 4·51	18 29 30·12	
June 21	E.	κ Octantis - - -	13 22 14·24	13 22 11·51	−2·097
		Lacaille 505 S.P. -	13 33 22·03	13 32 49·61	
	W.	Lacaille 709 S.P. -	14 10 50·54	14 10 18·78	−2·125
		z Octantis - - -	14 31 51·60	14 32 10·85	
	W.	Lacaille 3274 S.P. -	19 28 32·48	19 27 35·63	−2·216
		Lacaille 8094 - -	19 34 29·25	19 34 18·19	
	E.	A Octantis S.P. - -	20 6 50·79	20 5 16·48	−2·187
		Lacaille 8360 - -	20 18 31·55	20 18 20·22	

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Tabular Time of Transit.	Azimuth Error.
			h m s	h m s	s
1881. June 22	E.	κ Octantis - - - Lacaille 505 S.P. -	13 22 12·29 13 33 22·65	13 22 11·31 13 32 49·71	−2·255
	W.	Lacaille 709 S.P. - z Octantis - - -	14 10 51·36 14 31 46·97	14 10 18·85 14 32 10·53	−2·336
	W.	Lacaille 7088 - - Lacaille 2066 S.P. -	17 9 43·43 17 25 58·70	17 9 31·85 17 25 17·12	−2·313
	E.	Lacaille 7348 - - Lacaille 2210 S.P. -	17 55 29·61 17 58 41·68	17 55 25·07 17 58 8·29	- 2·235
June 27	W.	Lacaille 505 S.P. - Lacaille 5633 - -	13 33 34·68 13 40 37·60	13 32 50·23 13 40 45·58	−5·100
	E.	z Octantis - - - Lacaille 1029 S.P. -	14 30 47·39 14 39 39·39	14 32 8·87 14 38 11·84	−5·114
1882. Feb. 13	W.	Brisbane 6058 S.P. - Lacaille 2296 - -	5 47 24·59 5 53 37·88	5 45 21·72 5 53 7·61	−3·144
	E.	A Octantis - - - Lacaille 8257 S.P. -	8 5 40·55 8 15 34·15	8 6 23·20 8 14 6·02	−3·159
Feb. 14	E.	σ Octantis S.P. - - ζ Mensæ - - -	6 32 7·03 6 50 41·68	6 27 43·80 6 49 54·70	−3·087
	W.	Lacaille 3274 - - Lacaille 8094 S.P. -	7 28 23·73 7 35 27·60	7 28 6·32 7 34 9·11	−2·956
Feb. 15	W.	σ Octantis S.P. - - ζ Mensæ - - -	6 32 11·74 6 50 42·72	6 27 45·68 6 49 54·58	−3·111
	E.	Lacaille 3274 - - Lacaille 8094 S.P. -	7 28 22·78 7 35 31·52	7 28 6·02 7 34 9·24	−3·171
Feb. 17	W.	Brisbane 6058 S.P. - Lacaille 2296 - -	5 47 40·86 5 53 42·65	5 45 24·08 5 53 6·59	−3·420
	E.	A Octantis - - - Lacaille 8257 S.P. -	8 5 37·98 8 15 46·03	8 6 20·72 8 14 6·62	−3·433

SECTION V.—TABLE 8.

OBSERVATIONS WITH THE SMALL TRANSIT AT THE CAPE BY MR. MACLEAR.

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
April 9	36 Sextantis	W.	10 39 36·15	5	35·70	4·28	−31·42
	l Leonis		10 43 34·99	5	34·44	2·98	−31·46
	p^1 Leonis		10 56 20·19	5	19·80	48·26	−31·54
	χ Leonis		10 59 27·45	5	26·94	55·54	−31·40
	A^1 Virginis	E.	11 42 23·03	5	22·56	51·03	−31·53
	η Crateris		11 50 31·75	5	31·63	0·13	−31·50
	Lalande 22585		11 55 12·87	5	12·65	41·05	−31·60
	B.A.C. 4077		12 0 28·89	5	28·57	57·23	−31·34
April 13	13 Sextantis	E.	9 58 37·95	5	38·12	1·11	−37·01
	λ Hydræ		10 5 26·69	5	26·93	49·76	−37·17
	21 Sextantis		10 8 52·35	5	52·57	15·17	−37·40
	22 Sextantis		10 12 22·69	5	22·91	45·66	−37·25
	l Leonis	W.	10 43 40·03	5	39·91	2·94	−36·97
	p^1 Leonis		10 56 25·05	4	25·04	48·24	−36·80
	χ Leonis		10 59 32·47	5	32·37	55·51	−36·86
April 14	Lalande 19241	W.	9 42 57·37	5	57·45	20·42	−37·03
	13 Sextantis		9 58 38·25	5	38·27	1·10	−37·17
	λ Hydræ		10 5 26·67	5	26·78	49·74	−37·04
	21 Sextantis		10 8 52·29	5	52·37	15·16	−37·21
	22 Sextantis		10 12 22·65	5	22·73	45·65	−37·08
	6 Corvi	E.	12 17 49·99	5	50·38	12·80	−37·58
	B.A.C. 4200		12 22 25·39	5	25·58	48·29	−37·29
	Piazzi XII–111		12 26 11·81	5	12·01	34·67	−37·34
May 12	6 Corvi	E.	12 17 47·63	5	47·86	12·68	−35·18
	B.A.C. 4200		12 22 22·79	5	23·30	48·19	−35·11
	Piazzi XII–111		12 26 9·21	5	9·71	34·58	−35·13
	B.A.C. 4238		12 29 5·05	5	5·72	30·61	−35·11
	m Virginis	W.	13 35 59·93	5	0·25	25·33	−34·92
	86 Virginis		13 40 13·95	5	14·20	39·25	−34·95
	47 Hydræ		13 52 28·99	5	28·97	54·23	−34·74
	τ Virginis		13 56 13·07	5	13·58	38·69	−34·89
May 20	A^1 Virginis	W.	11 42 23·43	5	24·58	50·73	−33·85
	η Crateris		11 50 32·67	5	33·65	59·87	−33·78
	Lalande 22585		11 55 13·59	5	14·62	40·81	−33·81
	B.A.C. 4077		12 0 29·71	5	30·80	57·00	−33·80
	44 Virginis	E.	12 54 7·27	5	8·58	34·80	−33·78
	Lalande 24277		12 57 59·81	5	1·01	27·02	−33·99
	θ Virginis		13 4 22·87	5	24·17	50·45	−33·72
May 23	Lalande 23006	E.	12 11 31·26	3	30·84	58·04	−32·80
	η Virginis		12 14 25·03	5	24·55	51·89	−32·66
	B.A.C. 4200		12 22 21·35	5	20·87	48·11	−32·76
	12 Libræ	W.	14 48 2·87	3	2·20	29·40	−32·80
	δ Libræ		14 55 13·83	5	13·20	40·44	−32·76
	110 Virginis		14 57 30·05	5	29·44	56·71	−32·73
	ν Libræ		15 0 36·33	5	35·68	3·10	−32·58

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
June 16	ψ Virginis	E.	12 48 36·89	5	36·02	12·82	−23·20
	44 Virginis		12 53 58·69	5	57·81	34·60	−23·21
	B.A.C. 4382		13 0 37·38	4	36·51	13·29	−23·22
	θ Virginis		13 4 14·39	5	13·51	50·27	−23·24
	p Virginis	W.	13 49 3·16	3	1·92	38·65	−23·27
	τ Virginis		13 56 2·93	5	1·68	38·59	−23·09
	λ Virginis		14 13 7·95	5	6·71	43·69	−23·02
	υ² Virginis		14 16 18·07	5	16·82	53·91	−22·91
	B.A.C. 5890	W.	17 20 47·15	5	45·99	22·95	−23·04
	51 Ophiuchi		17 24 37·75	5	36·64	13·69	−22·95
	57 Ophiuchi		17 31 50·81	5	49·65	26·58	−23·07
	o Serpentis		17 35 11·71	5	10·56	47·64	−22·92
	ν Aquilæ		19 20 53·87	5	52·69	29·55	−23·14
	η Aquilæ	E.	19 46 52·29	5	51·49	28·24	−23·25
	β Aquilæ		19 49 55·65	5	54·84	31·58	−23·26
	Lalande 38458		20 2 12·89	5	12·11	48·93	−23·18
	ξ Capricorni		20 6 15·51	5	14·75	51·80	−22·95
June 17	θ Virginis	E.	13 4 14·33	5	13·44	50·26	−23·18
	54 Virginis		13 7 32·53	4	31·70	8·31	−23·39
	58 Virginis		13 11 40·19	5	39·32	16·17	−23·15
	B.A.C. 4462		13 15 0·23	5	59·30	36·09	−23·21
	τ Virginis	W.	13 56 2·98	4	1·68	38·58	−23·10
	κ Virginis		14 7 0·53	5	59·27	36·26	−23·01
	λ Virginis		14 13 7·90	3	6·65	43·68	−22·97
	υ² Virginis		14 16 18·23	5	16·95	53·90	−23·05
	Lalande 31210	W.	17 4 31·57	5	30·39	7·29	−23·10
	37 Ophiuchi		17 7 19·27	5	17·96	54·85	−23·11
	B.A.C. 5890		17 20 47·11	5	45·88	22·96	−22·92
	51 Ophiuchi		17 24 37·83	5	36·70	13·70	−23·00
	Rumker 6386	E.	18 13 52·20	3	51·28	27·98	−23·30
	21 Sagittarii		18 18 44·03	5	43·28	20·03	−23·25
	B.A.C. 6388		18 41 19·65	5	18·79	55·52	−23·27
	30 Sagittarii		18 44 9·53	5	8·79	45·57	−23·22
June 20	58 Virginis	E.	13 11 40·43	5	38·81	16·14	−22·67
	m Virginis		13 35 49·55	5	47·90	25·16	−22·74
	86 Virginis		13 40 3·37	3	1·79	39·09	−22·70
	p Virginis		13 49 3·09	5	1·35	38·62	−22·73
	ι Virginis	W.	14 10 14·31	5	12·35	49·78	−22·57
	λ Virginis		14 13 8·36	4	6·48	43·66	−22·82
	υ Virginis		14 16 18·69	5	16·69	53·88	−22·81
	φ Virginis		14 22 32·33	5	30·33	7·57	−22·76
	Lalande 30831	W.	16 52 24·19	5	22·41	59·62	−22·79
	30 Ophiuchi		16 55 15·61	5	13·71	50·97	−22·74
	40 Ophiuchi		17 14 21·21	5	19·49	56·69	−22·80
	Lalande 31606		17 18 3·87	5	2·14	39·45	−22·69
	B.A.C. 6111	E.	17 58 21·43	5	19·98	57·05	−22·93
	Lalande 33262		18 2 5·19	5	3·30	40·62	−22·68
	μ Sagittarii		18 7 7·19	3	5·68	43·12	−22·56
	Lalande 33596		18 10 34·85	4	33·03	10·20	−22·83
	Rumker 6386		18 13 52·59	5	50·71	28·01	−22·70

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
June 21	54 Virginis	E.	13 7 31·33	5	30·90	8·27	−22·63
	58 Virginis		13 11 39·45	5	38·75	16·13	−22·62
	B.A.C. 4462		13 14 59·83	5	58·64	36·05	−22·59
	66 Virginis		13 18 48·03	5	47·15	24·52	−22·63
	h Virginis		13 27 8·39	5	7·73	45·12	−22·61
	m Virginis		13 35 48·45	5	47·66	25·15	−22·51
	κ Virginis	W.	14 6 59·69	5	58·71	36·24	−22·47
	υ^2 Virginis		14 16 17·63	5	16·40	53·88	−22·52
	B.A.C. 4773		14 18 43·31	4	41·84	19·20	−22·64
	φ Virginis		14 22 31·35	5	30·14	7·58	−22·56
	ν Aquilæ	W.	19 20 53·44	4	52·15	29·64	−22·51
	e Aquilæ		19 24 54·05	5	52·86	30·24	−22·62
	47 Aquilæ		19 37 25·79	5	24·11	1·65	−22·46
	υ Aquilæ		19 40 20·38	3	18·84	56·23	−22·61
	51 Aquilæ		19 44 41·33	5	40·41	17·82	−22·59
	α^2 Capricorni	E.	20 11 54·09	5	53·54	30·91	−22·63
	ρ Capricorni		20 22 31·31	5	30·95	8·19	−22·76
	Washington 8892		20 24 51·09	5	50·63	28·04	−22·59
	ε Delphini		20 27 58·97	5	57·62	35·10	−22·52
June 22	66 Virginis	E.	13 18 47·83	5	46·87	24·52	−22·35
	72 Virginis		13 24 39·51	3	38·59	16·27	−22·32
	h Virginis		13 27 8·25	5	7·45	45·11	−22·34
	m Virginis		13 35 48·21	5	47·36	25·14	−22·22
	κ Virginis	W.	14 6 59·53	5	58·48	36·23	−22·25
	λ Virginis		14 13 6·96	3	6·03	43·65	−22·38
	υ^2 Virginis		14 16 17·57	5	16·23	53·87	−22·36
	B.A.C. 4773		14 18 43·01	4	41·41	19·19	−22·22
	φ Virginis		14 22 31·17	5	29·86	7·56	−22·30
	37 Ophiuchi	W.	17 7 18·91	5	17·28	54·87	−22·41
	Lalande 31606		17 18 2·23	5	1·75	39·47	−22·28
	B.A.C. 5890		17 20 46·33	3	45·27	23·00	−22·27
	51 Ophiuchi		17 24 36·59	5	36·25	13·75	−22·50
	Lalande 33262	E.	18 2 4·31	5	3·08	40·64	−22·44
	μ^1 Sagittarii		18 7 5·75	5	5·56	43·14	−22·42
	Lalande 33596		18 10 33·67	5	32·64	10·22	−22·42
	Rumker 6386		18 13 51·61	5	50·41	28·04	−22·37
June 27	72 Virginis	W.	13 24 39·17	5	36·31	16·23	−20·08
	h Virginis		13 27 7·77	5	5·17	45·06	−20·11
	89 Virginis		13 43 49·66	4	47·67	27·64	−20·03
	p Virginis		13 49 1·69	5	58·48	38·57	−19·91
	υ^2 Virginis	E.	14 16 16·71	5	13·91	53·83	−20·08
	B.A.C. 4773		14 18 42·65	5	39·30	19·16	−20·14
	φ Virginis		14 22 30·39	5	27·60	7·53	−20·07
	Lalande 26492		14 25 14·65	5	11·35	51·24	−20·11
1882.							
Feb. 13	υ Orionis	W.	5 27 14·64	3	13·15	15·34	−57·81
	ι Orionis		5 30 35·11	5	33·56	35·91	−57·65
	σ Orionis		5 33 50·67	3	48·97	51·38	−57·59
	b Orionis		5 37 24·19	5	22·30	24·54	−57·76
	γ Leporis		5 40 32·89	5	32·15	34·50	−57·65
	W.B. VIII–486	E.	8 20 56·75	4	55·52	57·36	−58·16
	B.A.C. 2868		8 27 14·25	5	13·55	15·35	−58·20
	δ Hydræ		8 32 27·17	5	25·25	27·20	−58·05
	6 Hydræ		8 35 27·81	5	26·75	28·62	−58·13
	B.A.C. 2954		8 38 54·75	5	53·43	55·30	−58·13

Date.	Name of Star.	Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1882.			h m s		s	s	m s
Feb. 14	7 Monocerotis	E.	6 15 5·29	5	4·08	3·90	−1 0·18
	8 Monocerotis		6 18 35·17	5	33·39	33·22	−1 0·17
	15 Monocerotis		6 35 33·45	5	31·42	31·21	−1 0·21
	18 Monocerotis		6 42 46·77	5	45·08	44·84	−1 0·24
	ε Canis Minoris	W.	7 20 16·97	5	14·88	14·45	−1 0·43
	B.A.C. 2470		7 23 23·05	5	21·88	21·19	−1 0·69
	o Puppis		7 44 14·24	5	13·75	13·33	−1 0·42
	9 Argûs		7 47 22·39	5	21·32	20·88	−1 0·44
Feb. 15	7 Monocerotis	W.	6 15 7·55	5	6·24	3·89	−1 2·35
	8 Monocerotis		6 18 37·49	5	35·59	33·21	−1 2·38
	15 Monocerotis		6 35 35·73	5	33·57	31·20	−1 2·37
	18 Monocerotis		6 42 48·99	5	47·19	44·83	−1 2·36
	B.A.C. 2433	E.	7 17 6·45	5	4·96	2·68	−1 2·28
	ε Canis Minoris		7 20 18·77	5	16·84	14·44	−1 2·40
	B.A.C. 2470		7 23 24·49	5	23·56	21·18	−1 2·38
	o Puppis		7 44 15·84	5	15·70	13·32	−1 2·38
	9 Argûs		7 47 24·13	5	23·33	20·88	−1 2·45
Feb. 17	υ Orionis	W.	5 27 22·81	5	21·54	15·28	−1 6·26
	c Orionis		5 30 43·47	5	42·06	35·85	−1 6·21
	σ Orionis		5 33 59·13	5	57·61	51·32	−1 6·29
	b Orionis		5 37 32·49	5	30·74	24·48	−1 6·26
	γ Leporis		5 40 41·07	5	40·66	34·43	−1 6·23
	W.B. VIII–486	E.	8 21 4·75	5	3·77	57·35	−1 6·42
	δ Hydræ		8 32 35·49	5	33·71	27·19	−1 6·52
	6 Hydræ		8 35 35·85	5	35·07	28·61	−1 6·46
	B.A.C. 2954		8 39 2·81	5	1·73	55·30	−1 6·43

SECTION V.—TABLE 9.

DETERMINATION OF COLLIMATION ERROR OF THE SMALL TRANSIT AT THE CAPE BY MR. PETT.

Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Aberration. Lamp W.	Lamp E.	Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Aberration. Lamp W.	Lamp E.
1882.	rev.	rev.	s	s	1883.	rev.	rev.	s	s
May 22	10·563	10·500	−0·255	+0·221	Jan. 10	10·651	10·627	−0·107	+0·073
					Jan. 12	10·657	10·627	−0·126	+0·092
May 27	10·550	10·550	−0·017	−0·017	Jan. 20	10·663	10·650	−0·066	+0·032

SECTION V.—TABLE 10.

DETERMINATION OF LEVEL ERROR OF THE SMALL TRANSIT AT THE CAPE BY MR. PETT.

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1882.		d	s
May 22	E.	+ 5·14	+0·447
	E.	+ 4·46	+0·389*
	W.	+ 6·45	+0·561
May 27	E.	+ 1·55	+0·132
	W.	+ 1·91	+0·176
	W.	+ 2·23	
1883.			
Jan. 10	E.	− 2·99	−0·260
	E.	− 4·04	−0·351*
	E.	− 4·04	−0·351
	W.	− 3·14	−0·273
	W.	− 2·89	−0·251
	W.	− 1·53	−0·133

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1883.		d	s
Jan. 12	W.	− 1·49	−0·130
	W.	− 0·80	−0·070*
	W.	− 1·00	−0·087
	E.	− 0·48	−0·042
	E.	− 1·71	−0·149*
	E.	− 2·85	−0·248*
Jan. 20	E.	+ 0·88	+0·066
	E.	+ 0·65	
	W.	+ 3·39	+0·295
Jan. 22	E.	− 1·73	−0·150
	W.	− 0·13	−0·011
	W.	0·00	0·000

SECTION V.—TABLE 11.

DETERMINATION OF AZIMUTH ERROR OF THE SMALL TRANSIT AT THE CAPE BY MR. PETT.

Date.	Position of Lamp.	Name of Star.	Observed Transit corrected for Collimation and Level.	Tabular Time of Transit.	Azimuth Error.
1882.			h m s	h m s	s
May 22	E.	τ Octantis S.P. - -	11 11 7·57	11 9 31·05	− 1·142
		Lacaille 4865 - -	11 35 50·50	11 34 53·35	
	W.	Lacaille 634 S.P. -	13 45 22·76	13 44 1·37	− 1·368
		Lacaille 5802 - -	14 9 25·67	14 8 27·68	
May 27	E.	Lacaille 4991 - -	11 56 51·15	11 56 39·58	− 0·233
		Lacaille 9745 S.P. -	12 2 30·03	12 2 12·91	
	W.	Lacaille 248 S.P. -	12 39 51·53	12 39 31·59	− 0·411
		ι Octantis - - -	12 43 9·38	12 42 58·30	
1883.					
Jan. 10	E.	Lacaille 6727 S.P. -	4 16 3·47	4 15 31·62	+ 2·078
	W.	Lacaille 1752 - -	4 59 23·67	4 58 36·93	+ 2·007
Jan. 12	W.	Lacaille 1222 - -	3 32 24·53	3 31 33·42	+ 1·717
		Lacaille 6727 S.P. -	4 16 9·17	4 15 31·85	
	E.	Lacaille 1752 - -	4 59 27·07	4 58 36·81	+ 1·809
		Lacaille 7088 S.P. -	5 10 8·92	5 9 33·53	
Jan. 20	W.	Lacaille 3238 - -	7 58 5·81	7 56 58·97	+ 0·835

SECTION V.—TABLE 12.

OBSERVATIONS WITH THE SMALL TRANSIT AT THE CAPE BY MR. PETT.

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
			h m s		s	s	m s
1882. May 22	79 Leonis - - -	E.	11 19 8·79	5	8·67	1·42	−1 7·25
	κ Crateris - - -		11 22 22·39	5	22·57	15·39	−1 7·18
	B.A.C. 3925 - - -		11 28 57·31	5	57·37	50·19	−1 7·18
	θ Crateris - - -		11 31 51·35	5	51·46	44·32	−1 7·14
	τ Virginis - - -	W.	13 56 49·31	5	48·64	41·62	−1 7·02
	95 Virginis - - -		14 1 39·39	5	39·00	31·70	−1 7·30
	κ Virginis - - -		14 7 47·01	5	46·65	39·47	−1 7·18
	υ^2 Virginis - - -		14 17 4·75	5	4·20	56·95	−1 7·25
May 27	η Crateris - - -	E.	11 50 17·09	5	17·21	2·80	−0 14·41
	12 Virginis - - -		12 7 42·45	5	42·38	28·01	−0 14·37
	Lalande 23006 - -		12 11 15·27	5	15·34	1·03	−0 14·31
	6 Corvi - - - -		12 17 29·91	5	30·01	15·64	−0 14·37
	ψ Virginis - - -	W.	12 48 30·17	5	30·13	16·01	−0 14·12
	44 Virginis - - -		12 53 51·91	5	51·83	37·74	−0 14·09
	Lalande 24277 - -		12 57 44·33	5	44·38	30·11	−0 14·27
	B.A.C. 4382 - - -		13 0 30·77	5	30·78	16·53	−0 14·25
1883. Jan. 20	Stone 2031 - - -	E.	4 39 6·61	5	6·66	4·11	−1 2·55
	Stone 2081 - - -		4 44 19·84	5	20·02	17·40	−1 2·62
	Stone 2113 - - -		4 47 32·13	4	32·16	29·39	−1 2·77
	Stone 2145 - - -		4 51 47·10	5	47·34	44·82	−1 2·52
	Stone 2772 - - -	W.	6 1 3·79	2	4·07	1·27	−1 2·80
	Stone 2806 - - -		6 4 1·46	5	1·61	59·03	−1 2·58
	Stone 2839 - - -		6 7 25·47	5	25·70	23·15	−1 2·55
	Stone 2880 - - -		6 12 31·30	5	31·61	29·02	−1 2·59
Jan. 22	Stone 2268 - - -	E.	5 7 22·49	5	22·21	15·30	−1 6·91
	Stone 2335 - - -		5 10 46·31	5	46·14	39·06	−1 7·08
	Stone 2300 - - -		5 14 24·89	5	24·74	17·69	−1 7·05
	Stone 2362 - - -		5 18 6·94	5	6·99	0·03	−1 6·98
	Stone 2515 - - -	W.	5 33 48·08	5	48·12	41·10	−1 7·02
	Stone 2562 - - -		5 38 19·06	5	18·99	12·11	−1 6·88
	Stone 2595 - - -		5 42 41·63	5	41·42	34·59	−1 6·83
	Stone 2622 - -		5 45 12·18	5	12·11	5·38	−1 6·73

SECTION VI.

OBSERVATIONS AT DURBAN.

SECTION VI.—TABLE 1.

DETERMINATION OF COLLIMATION ERROR OF THE SMALL TRANSIT AT DURBAN BY MR. FINLAY.

Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Aberration.		Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Aberration.	
			Lamp W.	Lamp E.				Lamp W.	Lamp E.
1881.	r	r	s	s	1881.	r	r	s	s
June 16	10·250 10·248	10·300	+0·173	−0·209	June 23	10·328	10·300	−0·123	+0·087
17	10·242 10·271	10·300	+0·147	−0·183	24	10·324	10·300	−0·108	+0·072
18	10·287	10·300	+0·031	−0·067	27	10·335	10·300	−0·149	+0·113
21	10·330 10·310	10·300	−0·095	+0·055	30	10·343 10·326	10·300	−0·145	+0·109
22	10·305 10·315	10·300	−0·055	+0·019	Nov. 25	10·322	10·300	−0·100	+0·064

SECTION VI.—TABLE 2.

DETERMINATION OF LEVEL ERROR OF THE SMALL TRANSIT AT DURBAN BY MR. FINLAY.

Date.	Hour.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1881.	h m		d	s
June 17	8 0	E.	+0·96	+0·065
	9 15	E.	+0·89	
	9 30	W.	+1·19	+0·131
	12 0	W.	+2·10	+0·244
	13 30	W.	+2·71	
	13 30	E.	+1·62	+0·106
	14 30	E.	+1·13	
21	6 0	W.	+0·70	+0·088
	7 0	W.	+0·75	
	9 0	E.	+0·98	+0·071
	10 0	E.	−0·31	−0·049*
	13 30	E.	−1·69	−0·193
	14 15	E.	−2·04	
	14 30	W.	−1·64	−0·132
	15 30	W.	−0·20	+0·002*
22	6 0	E.	+0·85	+0·059
	6 30	E.	−0·48	−0·065*
	8 30	W.	−1·28	−0·089
	9 30	W.	−1·09	
	11 15	W.	−1·88	−0·154
	12 15	W.	−0·21	0·000*
	12 30	E.	−0·18	−0·037*
	13 30	E.	−1·06	−0·119
23	8 45	E.	−0·74	−0·089
	9 45	E.	−2·00	−0·206*
	10 0	W.	−2·84	−0·244
	11 0	W.	−1·60	−0·128*

Date.	Hour.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1881.	h m		d	s
24	6 0	W.	−0·24	−0·002
	6 30	W.	−0·25	
	9 30	E.	−0·88	−0·102
	10 30	E.	−1·40	−0·151*
27	7 30	W.	−0·83	−0·057
	8 45	W.	−0·20	+0·001*
	8 45	E.	−0·26	−0·045
	9 30	E.	−0·76	−0·091*
28	10 15	E.	−1·25	−0·152
	11 15	E.	−1·56	
30	8 45	W.	−1·89	−0·155
	9 30	W.	−0·70	−0·045*
Nov. 20	10 30	E.	+0·85	+0·059
	11 30	E.	−0·90	−0·104*
	11 45	W.	−0·95	−0·044
	12 45	W.	−0·45	
21	12 0	W.	−0·52	−0·021
	13 45	W.	−0·36	
	13 45	E.	−0·35	−0·053
	15 0	E.	−1·51	−0·161*
26	11 0	E.	−2·24	−0·229
	13 0	E.	−3·53	−0·349*

SECTION VI.—TABLE 3.

DETERMINATION OF AZIMUTH ERROR OF THE SMALL TRANSIT AT DURBAN BY MR. FINLAY.

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Apparent Time of Transit.	Azimuth Error.
1881.			h m s	h m s	s
June 17	E.	z Octantis	8 47 48·41	8 47 35·16	−1·392
	W.	Lacaille 6484 Lacaille 1592 S.P.	9 59 24·92 10 20 25·68	9 58 47·58 10 19 24·23	−1·580
	W.	ζ Mensæ S.P. Lacaille 7751	13 5 17·35 13 10 31·17	13 4 24·74 13 10 1·14	−1·500
	E.	A Octantis S.P. Lacaille 8257	14 21 22·16 14 29 21·06	14 19 47·97 14 28 49·00	−1·436
		Instrument moved in Azimuth.			
June 21	W.	β Hydri S.P. Brisbane 4091	6 20 3·61 6 36 49·27	6 19 30·99 6 35 39·04	+0·598
	E.	Lacaille 6484 Lacaille 1592 S.P.	9 43 42·15 10 4 10·12	9 43 3·86 10 3 40·90	+0·594
	E.	Lacaille 3238 S.P. Lacaille 8257	13 56 7·81 14 13 47·28	13 55 34·64 14 13 6·08	+0·529
	W.	Lacaille 8570	14 49 40·29	14 49 2·48	+0·481
June 22	E.	Lacaille 4991 Lacaille 9745 S.P.	5 53 23·51 5 58 59·69	5 52 38·24 5 58 30·70	+0·655
	W.	Lacaille 6216 Lacaille 1222 S.P.	9 12 43·27 9 27 39·02	9 12 2·31 9 27 2·41	+0·350
	W.	Brisbane 6058 Lacaille 2296 S.P.	11 41 45·87 11 48 36·67	11 41 1·24 11 48 2·49	+0·339
	E.	ζ Mensæ S.P. Lacaille 7751	12 45 20·40 12 51 3·35	12 44 44·95 12 50 22·19	+0·379
June 27	W.	z Octantis Lacaille 972 S.P.	8 8 53·34 8 27 43·15	8 8 12·87 8 27 12·15	+0·384
	E.	Lacaille 6484 Lacaille 1414 S.P.	9 20 1·61 9 21 38·04	9 19 28·20 9 21 10·74	+0·434
Nov. 20	E.	Lacaille 972 Lacaille 6216 S.P.	10 51 45·49 11 18 5·56	10 51 19·55 11 16 4·99	−8·081
	W.	Lacaille 1592 Lacaille 6727 S.P.	12 3 49·25 12 16 35·98	12 4 32·65 12 15 5·79	−8·564
Nov. 21	W.	Lacaille 1444 Lacaille 6727 S.P.	12 4 14·64 12 12 40·09	12 4 0·58 12 11 9·90	−8·701
	E.	Lacaille 2296 Lacaille 7751 S.P.	13 48 24·06 14 52 39·95	13 48 50·29 14 50 26·41	−8·253
		Instrument moved in Azimuth.			
Nov. 26	E.	Lacaille 1592 Lacaille 6727 S.P.	11 41 34·78 11 52 16·52	11 40 56·94 11 51 30·47	−0·526
Nov. 27	W.	z Octantis S.P. Lacaille 972 Lacaille 1444	10 5 6·70 10 24 28·40 11 41 5·23	10 4 4·69 10 23 47·96 11 40 25·06	−0·600

SECTION VI.—TABLE 4.

OBSERVATIONS WITH THE SMALL TRANSIT AT DURBAN BY MR. FINLAY.

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
June 17	30 Sagittarii	W.	12 59 11·02	5	11·23	27·52	−43·71
	19 Aquilæ		13 18 37·10	5	36·57	52·60	−43·97
	20 Aquilæ		13 21 39·64	5	39·45	55·50	−43·95
	d Sagittarii		13 26 5·94	5	6·05	21·92	−44·13
	υ Sagittarii		13 30 19·60	5	19·63	35·54	−44·09
	β Aquilæ	W.	14 4 48·06	5	47·12	2·76	−44·36
	63 Sagittarii		14 10 37·56	5	37·06	52·63	−44·43
	τ Aquilæ		14 13 38·22	5	37·26	52·74	−44·52
	B.A.C. 7014		14 32 32·44	5	31·53	47·00	−44·53
	ρ Capricorni		14 37 18·98	5	18·59	33·90	−44·69
June 21	ε Corvi	W.	6 4 42·00	5	42·08	6·69	−35·39
	Piazzi XII–111		6 26 9·60	5	9·84	34·51	−35·33
	B.A.C. 4238		6 29 5·04	3	5·38	30·04	−35·34
	ψ Virginis		6 48 44·50	5	44·70	9·32	−35·38
	44 Virginis		6 54 5·40	5	5·65	30·22	−35·43
	κ Libræ	E.	9 35 14·18	5	14·44	38·64	−35·80
	48 Libræ		9 51 37·54	5	37·76	1·96	−35·80
	50 Libræ		9 54 27·54	5	27·81	52·05	−35·76
	51 Libræ		9 57 54·34	5	54·58	18·84	−35·74
	η Aquilæ	E.	13 45 52·20	4	52·36	16·38	−35·98
	β Aquilæ		13 48 55·04	5	55·25	19·21	−36·04
	ξ Capricorni		14 5 12·62	5	12·65	36·76	−35·89
	α^1 Capricorni		14 10 26·94	5	26·97	50·87	−36·10
	η Capricorni	W.	14 56 54·22	5	54·14	18·03	−36·11
	ν Aquarii		15 2 21·88	5	21·87	45·68	−36·17
	α Equulei		15 9 6·14	5	6·28	30·25	−36·03
June 22	6 Corvi	E.	6 13 56·36	5	56·47	18·00	−38·47
	B.A.C. 4200		6 18 31·10	5	31·39	52·81	−38·58
	Piazzi XII–111		6 22 16·58	4	16·86	38·61	−38·26
	χ Virginis		6 29 50·18	5	50·39	12·11	−38·28
	ι^1 Libræ	W.	9 1 46·38	5	46·30	8·36	−37·94
	3 Serpentis		9 5 35·22	5	35·29	57·33	−37·96
	ζ^3 Libræ		9 20 14·60	5	14·54	36·59	−37·95
	37 Libræ		9 23 56·60	5	56·58	18·72	−37·86
	Lalande 33262	W.	11 57 27·36	5	27·47	49·93	−37·54
	μ Sagittarii		12 2 29·30	5	29·25	51·61	−37·64
	Lalande 33596		12 5 55·60	5	55·69	18·12	−37·57
	21 Sagittarii		12 14 4·16	4	4·14	26·67	−37·47
	d Sagittarii	E.	13 6 19·94	4	19·94	42·47	−37·47
	υ Sagittarii		13 10 33·54	5	33·56	56·09	−37·47
	ν Aquilæ		13 16 3·28	5	3·40	26·04	−37·36
	e Aquilæ		13 20 3·26	5	3·36	25·98	−37·38

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
June 27	12 Libræ	W.	8 24 3·10	5	2·85	30·91	−31·94
	δ Libræ		8 31 12·72	5	12·69	40·78	−31·91
	110 Virginis		8 33 28·50	5	28·55	56·66	−31·89
	ν Libræ		8 36 34·58	5	34·51	2·58	−31·93
	37 Libræ	E.	9 4 11·04	5	11·25	39·14	−32·11
	41 Libræ		9 8 33·72	5	33·87	1·78	−32·09
	κ Libræ		9 11 35·14	5	35·27	3·16	−32·11
	48 Libræ		9 27 58·37	3	58·53	26·48	−32·05
Nov. 20	94 Ceti	E.	11 7 38·40	5	34·57	44·75	−49·82
	ζ Eridani		11 10 57·92	5	55·02	5·19	−49·83
	Lalande 6476		11 24 50·44	5	47·99	58·45	−49·54
	τ^5 Eridani		11 29 21·56	4	20·28	30·56	−49·72
	μ Tauri	W.	12 9 51·94	5	46·48	57·16	−49·32
	44 Eridani		12 23 7·12	5	2·63	13·42	−49·21
	45 Eridani		12 26 30·90	5	26·61	37·25	−49·36
	W.B. IV-585		12 29 11·45	4	8·30	19·02	−49·28
Nov. 21	44 Eridani	W.	12 19 10·94	5	6·39	17·52	−48·87
	45 Eridani		12 22 34·54	5	30·19	41·35	−48·84
	Lalande 8935		12 35 6·10	5	2·85	13·92	−48·93
	Lalande 9045		12 38 57·34	5	55·27	6·39	−48·88
	B.A.C. 1994	E.	14 2 34·10	5	30·74	41·47	−49·27
	5 Monocerotis		14 5 32·31	4	28·90	39·75	−49·15
	7 Monocerotis		14 10 26·98	5	23·75	34·63	−49·12
	8 Monocerotis		14 13 57·32	5	52·54	3·26	−49·28
Nov. 26	24 Eridani	E.	11 15 34·12	5	33·66	50·00	−43·66
	30 Eridani		11 23 53·52	5	53·09	9·61	−43·48
	Lalande 7273		11 26 44·38	5	43·99	0·43	−43·56
	Lalande 9293		12 28 26·68	5	26·17	42·78	−43·39
	64 Eridani		12 31 17·28	5	16·81	33·38	−43·43
	ι Orionis		12 38 17·14	5	16·55	33·02	−43·53
	λ Eridani		12 40 19·12	4	18·62	35·09	−43·53
	τ Orionis		12 48 40·32	5	39·80	56·36	−43·44
	o Orionis		12 52 31·44	5	30·88	47·40	−43·48
	Lalande 10145		12 55 23·94	5	23·37	40·02	−43·35
Nov. 27	ρ^3 Eridani	W.	10 31 41·28	5	40·82	58·38	−42·44
	94 Ceti		10 39 56·32	5	55·82	13·40	−42·42
	ζ Eridani		10 43 16·68	5	16·24	33·84	−42·40
	Lacaille 1051		10 46 19·16	5	18·83	36·45	−42·38
	o Tauri		10 51 37·44	5	36·87	54·30	−42·57
	Lalande 6476		10 57 10·00	5	9·59	27·27	−42·32
	τ^5 Eridani		11 1 41·68	5	41·34	59·23	−42·11
	20 Eridani		11 4 1·74	5	1·37	19·16	−42·21
	22 Eridani		11 7 54·22	5	53·75	11·59	−42·16

SECTION VI.—TABLE 5.

DETERMINATION OF COLLIMATION ERROR OF THE SMALL TRANSIT AT DURBAN BY MR. MACLEAR.

Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Aberration. Lamp W.	Lamp E.
1881.	rev.	rev.	s	s
Aug. 13	10·326	10·300	−0·115	+0·079
Aug. 14	10·307	10·300	−0·044	+0·008
Aug. 18	10·317	10·300	−0·082	+0·046
Aug. 19	10·333	10·300	−0·141	+0·105
Aug. 23	10·318	10·300	−0·085	+0·049
Aug. 24	10·323	10·300	−0·104	+0·068
Aug. 29	10·326	10·300	−0·115	+0·079
Aug. 30	10·330	10·300	−0·130	+0·094
Sept. 1	10·322	10·300	−0·100	+0·064
Sept. 2	10·339	10·300	−0·164	+0·128
Sept. 9	10·336	10·300	−0·153	+0·117
Sept. 13	10·329	10·300	−0·126	+0·090
Sept. 19	10·315	10·300	−0·074	+0·038
Sept. 23	10·287	10·300	+0·032	−0·066
Sept. 24	10·295	10·300	+0·002	−0·036
Sept. 27	10·316	10·300	−0·078	+0·042
Oct. 11	10·305	10·300	−0·037	+0·001
Oct. 17	10·291	10·300	+0·016	−0·052
Oct. 24	10·289	10·300	+0·023	−0·059
Nov. 4	10·304	10·300	−0·033	−0·003
Nov. 11	10·310	10·300	−0·055	+0·019
Nov. 20	10·307	10·300	−0·044	+0·008
Nov. 21	10·309	10·300	−0·052	+0·016
Nov. 26	10·298	10·300	−0·010	−0·026
Dec. 9	10·302	10·300	−0·025	−0·011
Dec. 23	10·328 10·312	10·300	−0·093	+0·057
Dec. 29	10·302	10·300	−0·025	−0·011
1882.				
Jan. 8	10·315 10·314	10·300	−0·074	+0·038
Jan. 9	10·345	10·300	−0·186	+0·150
Jan. 13	10·377 10·369	10·300 10·300	−0·306 −0·276	+0·270 +0·240
Jan. 14	10·376 10·391	10·300 10·300	−0·302 −0·358	+0·266 +0·322
Jan. 17	10·379	10·300	−0·314	+0·278
Jan. 20	10·371 10·363	10·300	−0·269	+0·233
Jan. 21	10·388 10·358	10 [illegible]	−0·291	+0·255
Jan. 25	10·357	10·300	−0·231	+0·195
Jan. 26	10·374 10·387	10·300	−0·321	+0·285
Jan. 27	10·370 10·368	10·300	−0·276	+0·240

SECTION VI.—TABLE 6.

DETERMINATION OF LEVEL ERROR OF THE SMALL TRANSIT AT DURBAN BY MR. MACLEAR.

Date.		Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1881.			div.	s
August	18	W.	−1·28	−0·099
		W.	−1·89	−0·156*
		E.	−1·56	−0·166
		E.	−3·75	−0·369*
		E.	−4·49	−0·424
		E.	−4·19	
		W.	−4·03	−0·354
		W.	−2·59	−0·220*
August	19	W.	−0·93	−0·046
		W.	−0·48	
		E.	+0·17	−0·005
		E.	−1·58	−0·167*
		E.	−3·13	−0·298
		E.	−2·86	
		W.	−2·66	−0·220
		W.	−2·51	
August	20	W.	−0·48	−0·024
		W.	−1·03	−0·075*
		E.	−0·86	−0·100
		E.	−1·70	−0·179*
		E.	−3·06	−0·310
		E.	−3·15	
		W.	−3·01	−0·259
		W.	−2·20	−0·184*
August	21	W.	−0·94	−0·063
		W.	−0·83	
		E.	−1·15	−0·127
		E.	−2·44	−0·247*
August	23	W.	−1·30	−0·119
		W.	−1·68	
		E.	−0·93	−0·107
		E.	−2·69	−0·271*
		E.	−4·65	−0·447
		E.	−4·53	
		W.	−4·16	−0·366
		W.	−3·28	−0·285*
August	24	E.	+0·20	−0·002
		E.	−1·09	−0·121*
		W.	−0·94	−0·063
		W.	−0·83	
August	29	E.	−1·20	−0·132
		E.	−1·83	−0·191*
		W.	−2·40	−0·186
		W.	−2·03	
		W.	−2·58	−0·218
		W.	−2·53	
		E.	−2·39	−0·243
		E.	−3·15	−0·313*
September	1	W.	−0·83	−0·057
		E.	−1·20	−0·132
September	2	E.	−1·53	−0·163
		E.	−2·11	−0·217*
		W.	−2·50	−0·212
		W.	−3·20	−0·277*
1881.			div.	s
September	8	W.	−3·31	−0·287
		E.	−3·29	−0·327
September	9	E.	−3·28	−0·326
		W.	−4·20	−0·364
September	13	W.	−1·80	−0·147
		W.	−2·35	−0·198*
		E.	−1·99	−0·206
		E.	−4·40	−0·430
September	17	E.	−2·63	−0·265
		W.	−4·79	−0·426
September	18	W.	−2·68	−0·236
		W.	−2·81	
		E.	−2·49	−0·252
		E.	−3·70	−0·365*
September	19	E.	−3·74	−0·368
		E.	−4·34	−0·424*
		W.	−4·90	−0·435
		W.	−4·89	
		W.	−5·00	−0·444
		W.	−4·05	−0·356*
		E.	−4·63	−0·451
		E.	−5·25	−0·509*
September	20	W.	−4·16	−0·370
		W.	−4·24	
		E.	−3·56	−0·351
September	22	E.	−4·01	−0·401
		E.	−4·16	
		W.	−4·51	−0·392
		W.	−4·36	
		W.	−5·99	−0·528
		W.	−5·79	
		E.	−6·20	−0·612
		E.	−6·53	
September	23	E.	−3·48	−0·344
		E.	−4·66	−0·454*
		W.	−5·04	−0·430
		W.	−4·64	
		W.	−6·20	−0·551
		W.	−6·08	
		E.	−5·23	−0·529
		E.	−5·70	
September	26	W.	−4·66	−0·408
		W.	−4·56	
		E.	−4·39	−0·429
		E.	−5·34	−0·517*
		E.	−6·47	−0·626
		E.	−6·55	
		W.	−7·00	−0·610
		W.	−6·56	

Date.	E. or W.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
		div.	s
1881. September 27	E.	−4·43	−0·432
	E.	−5·08	−0·493*
	W.	−5·46	−0·488
September 28	W.	−3·64	−0·318
	W.	−4·96	−0·441*
	E.	−4·24	−0·415
	E.	−5·48	−0·530*
October 14	W.	−6·81	−0·613
	E.	−7·49	−0·717
October 16	E.	−5·41	−0·524
	W.	−6·39	−0·574
		Level altered.	
October 17	E.	−2·44	−0·286
	E.	−3·25	
	W.	−3·40	−0·288
	W.	−3·23	
October 18	W.	−2·15	−0·205
	W.	−2·69	
	E.	−2·73	−0·306
	E.	−3·41	
October 19	E.	−2·53	−0·310
	E.	−3·68	
	W.	−3·93	−0·320
	W.	−3·38	
October 21	W.	−1·60	−0·128
	E.	−1·09	−0·122
October 24	W.	−0·86	−0·060
October 25	W.	−0·21	+0·001
October 29	E.	−1·65	−0·174
	W.	−1·70	−0·137
November 8	E.	−2·24	−0·229
	W.	−2·40	−0·202
November 9	W.	−2·78	−0·239
	E.	−2·53	−0·256
November 14	W.	−2·15	−0·180
	E.	−2·14	−0·220
November 15	E.	−2·89	−0·289
	W.	−3·11	−0·268
November 20	E.	+0·16	−0·012
	E.	+0·02	
	W.	−0·29	+0·004
	W.	−0·08	
1881. November 21	W.	−0·49	−0·016
	W.	−0·31	
	E.	−0·18	−0·037
	E.	−1·20	−0·132*
November 27	W.	−2·16	−0·208
	W.	−2·75	
December 23	W.	−2·79	−0·216
	W.	−2·29	
	E.	−1·79	−0·210
	E.	−2·26	
	E.	−3·83	−0·361
	E.	−3·51	
	W.	−3·98	−0·333
	W.	−3·61	
December 29	W.	−2·74	−0·234
	W.	−3·60	−0·314*
	E.	−2·84	−0·285
	E.	−3·39	−0·336*
1882. January 8	W.	−5·44	−0·486
	E.	−5·39	−0·522
January 13	E.	−5·71	−0·559
	E.	−5·86	
	W.	−6·30	−0·545
	W.	−5·86	
January 14	E.	−4·63	−0·451
	E.	−6·55	−0·630*
	W.	−6·45	−0·580
	W.	−6·44	
January 17	E.	−5·75	−0·556
	W.	−6·16	−0·553
January 20	E.	−5·70	−0·551
	W.	−6·46	−0·581
January 21	W.	−4·85	−0·424
	W.	−4·69	
	E.	−4·46	−0·435
	E.	−5·46	−0·528*
January 25	W.	−5·73	−0·513
	E.	−5·33	−0·517
January 26	W.	−6·18	−0·561
	W.	−6·31	
	E.	−6·15	−0·592
	E.	−6·79	−0·652*
January 27	E.	−5·64	−0·545
	E.	−6·70	−0·644*
	W.	−6·64	−0·589
	W.	−6·45	
	W.	−6·80	−0·615
	W.	−6·86	
	E.	−6·60	−0·634
	E.	−7·23	−0·693*

SECTION VI.—TABLE 7.

DETERMINATION OF AZIMUTH ERROR OF THE SMALL TRANSIT AT DURBAN BY MR. MACLEAR.

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Tabular Apparent Time of Transit.	Azimuth Error.
1881.			h m s	h m s	s
Aug. 18	W.	Lacaille 1752 S.P. -	7 9 58·75	7 9 46·13	+4·444
		Lacaille 7078 - -	7 36 51·32	7 35 38·66	
	E.	Lacaille 2426 S.P. -	8 31 35·58	8 31 36·05	+4·492
		σ Octantis - - -	8 45 46·55	8 40 10·61	
	E.	β Octantis - - -	11 33 17·62	11 26 48·10	+4·416
		Lacaille 3981 S.P. -	11 38 27·97	11 38 23·76	
	W.	C Octantis - - -	12 20 47·55	12 19 19·25	+4·279
		Lacaille 4510 S.P. -	12 47 31·22	12 47 51·64	
Aug. 19	W.	Lacaille 1752 S.P. -	7 6 1·19	7 5 50·31	+4·571
		Lacaille 7078 - -	7 32 55·18	7 31 42·54	
	E.	σ Octantis - - -	8 41 53·76	8 36 13·76	+4·560
		Lacaille 3274 S.P. -	9 33 43·01	9 34 27·82	
	E.	Lacaille 4169 S.P. -	11 53 23·51	11 53 47·43	+4·493
		C Octantis - - -	12 16 53·52	12 15 23·40	
	W.	Lacaille 4578 S.P. -	12 52 24·32	12 53 1·47	+4·412
		τ Octantis - - -	13 18 49·14	13 16 30·46	
Aug. 20	W.	Lacaille 6817 - -	6 30 24·40	6 29 43·18	+4·465
		Lacaille 1752 S.P. -	7 2 3·99	7 1 54·47	
	E.	Lacaille 7078 - -	7 28 58·48	7 27 46·43	+4·629
		Brisbane 6058 - -	7 50 53·49	7 48 51·71	
		σ Octantis - - -	8 37 56·36	8 32 16·85	
	E.	Lacaille 8570 - -	10 53 52·71	10 53 10·36	+4·595
		ζ Octantis S.P. - -	11 15 35·98	11 15 58·93	
	W.	τ Octantis - - -	13 14 51·79	13 12 34·80	+4·327
		Lacaille 4784 S.P. -	13 25 30·25	13 25 45·65	
Aug. 23	W.	Lacaille 6817 - -	6 18 34·16	6 7 55·21	+4·637
		Lacaille 1839 S.P. -	6 25 4·96	6 25 49·99	
	E.	Lacaille 2138 S.P. -	7 37 52·16	7 37 56·76	+4·650
		σ Octantis - - -	8 26 5·09	8 20 25·88	
	E.	Lacaille 4169 S.P. -	11 37 35·80	11 38 3·81	+4·496
		C Octantis - - -	12 1 6·05	11 59 39·96	
	W.	Lacaille 4510 S.P. -	12 27 42·01	12 28 11·82	+4·563
		Lacaille 4578 S.P. -	12 36 37·81	12 37 17·53	
		τ Octantis - - -	13 3 9·43	13 0 47·76	
Aug. 29	E.	Lacaille 7088 - -	6 37 59·28	6 37 23·48	+4·624
		Lacaille 7078 - -	6 53 19·12	6 52 21·33	
		Lacaille 2066 S.P. -	6 52 50·73	6 53 17·95	
	W.	✻ S.P. - - -	7 37 25·07	7 39 31·06	+4·559
		σ Octantis - - -	8 2 7·04	7 56 41·93	
	W.	B Octantis - - -	10 49 56·56	10 43 29·53	+4·599
		Lacaille 3981 S.P. -	10 54 56·73	10 55 9·00	
		Lacaille 8798 - -	11 0 47·67	11 0 2·50	

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.			Tabular Apparent Time of Transit.			Azimuth Error.
			h	m	s	h	m	s	s
1881. Aug. 29	E.	C Octantis	11	37	20·23	11	36	4·57	+4·550
		Lacaille 4510 S.P.	12	3	56·38	12	4	36·20	
			Instrument moved in Azimuth.						
Sept. 2	E.	Lacaille 1921 S.P.	6	24	40·34	6	24	30·71	−0·106
		Lacaille 7078	6	36	44·65	6	36	36·81	
	W.	Lacaille 7751	8	7	22·98	8	7	13·54	−0·011
		Lacaille 3274 S.P.	8	39	38·14	8	39	28·41	
	W.	Lacaille 3537 S.P.	9	42	58·92	9	42	49·39	−0·104
		Lacaille 8570	10	2	11·85	10	2	3·26	
	W.	B Octantis	10	27	45·73	10	27	43·52	−0·085
Sept. 13	W.	σ Octantis	6	58	20·26	6	57	21·49	+0·010
		ζ Mensæ S.P.	7	19	27·19	7	18	28·64	
	E.	τ Octantis	11	39	10·83	11	38	15·59	−0·108
Sept. 18	W.	σ Octantis	6	38	22·92	6	37	34·79	−0·050
		ζ Mensæ S.P.	6	59	41·57	6	58	49·74	
	E.	Lacaille 3274 S.P.	7	37	30·70	7	36	38·88	−0·013
		Lacaille 8094	7	44	2·02	7	43	10·49	
Sept. 19	E.	σ Octantis	6	34	27·52	6	33	37·33	−0·009
		ζ Mensæ S.P.	6	55	44·84	6	54	53·95	
	W.	Lacaille 3274 S.P.	7	33	34·48	7	32	43·32	−0·022
		Lacaille 8094	7	40	5·79	7	39	14·45	
		A Octantis S.P.	8	11	8·93	8	10	16·64	
		Lacaille 8257	8	20	3·76	8	19	13·73	
	W.	Lacaille 5325 S.P.	12	59	20·75	12	58	30·12	−0·030
		Lacaille 505	13	37	47·98	13	36	57·95	
	E.	Lacaille 5633 S.P.	13	45	24·66	13	44	33·88	−0·011
		Lacaille 637	14	0	54·65	14	0	4·99	
Sept. 22	E.	σ Octantis	6	22	25·90	6	21	44·48	−0·077
		ζ Mensæ S.P.	6	43	53·75	6	43	6·63	
	W.	Lacaille 3274 S.P.	7	21	43·43	7	20	56·66	−0·012
	W.	Lacaille 248	12	33	12·10	12	32	25·74	−0·002
		Lacaille 5268 S.P.	12	35	38·84	12	34	52·43	
	E.	Lacaille 5633 S.P.	13	33	33·22	13	32	45·80	−0·140
		Lacaille 634	13	37	27·85	13	36	42·79	
Sept. 23	E.	ζ Mensæ S.P.	6	39	57·26	6	39	10·86	−0·161
		Lacaille 8094	7	24	14·92	7	23	30·32	
	W.	A Octantis S.P.	7	55	15·67	7	54	35·79	+0·157
		Lacaille 8257	8	4	16·02	8	3	29·36	
	W.	Lacaille 4784 S.P.	11	12	49·56	11	12	4·16	+0·125
		Lacaille 9464	11	17	33·97	11	16	45·39	
	E.	Brisbane 4091 S.P.	12	23	30·80	12	22	33·30	−0·201
		Lacaille 248	12	29	12·88	12	28	29·88	

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Tabular Apparent Time of Transit.	Azimuth Error.
			h m s	h m s	s
1881. Sept. 26	W.	ζ Mensæ S.P. - -	6 28 5·88	6 27 23·53	−0·056
		Lacaille 7751 - -	6 33 26·38	6 32 46·72	
		Lacaille 3274 S.P. -	7 5 55·48	7 5 14·48	
		Lacaille 8094 - -	7 12 22·81	7 11 42·20	
	E.	Lacaille 8257 - -	7 52 22·27	7 51 41·04	+0·024
		Lacaille 3537 S.P. -	8 9 11·20	8 8 29·87	
		Lacaille 8570 - -	8 28 21·78	8 27 40·17	
		ζ Octantis S.P. - -	8 51 15·70	8 50 34·57	
	E.	Lacaille 235 - -	12 21 50·88	12 21 10·20	−0·043
		Lacaille 5325 S.P. -	12 31 39·79	12 30 58·27	
	W.	κ Octantis S.P. - -	12 59 4·87	12 58 23·48	−0·007
		Lacaille 505 - -	13 10 8·21	13 9 26·92	
Sept. 28	W.	Lacaille 7751 - -	6 25 33·01	6 24 54·45	−0·155
		Lacaille 3274 S.P. -	6 58 5·94	6 57 23·43	
	E.	A Octantis S.P. - -	7 35 41·36	7 34 59·95	−0·047
		Lacaille 8257 - -	7 44 28·20	7 43 48·84	
Nov. 20	E.	Lacaille 4991 S.P. -	7 59 8·09	7 56 53·24	−8·296
		Lacaille 9745 - -	8 1 50·12	8 3 1·75	
	W.	Lacaille 1752 - -	12 58 45·02	12 58 19·24	−8·503
		Lacaille 7088 S.P. -	13 10 36·11	13 8 57·63	
Nov. 21	W.	Lacaille 1444 - -	12 4 13·99	12 4 0·58	−8·742
		Lacaille 6727 S.P. -	12 12 39·80	12 11 9·90	
	E.	Lacaille 2296 - -	13 48 22·42	13 48 50·29	−8·442
		Lacaille 7751 S.P. -	14 52 41·98	14 50 26·41	
			Instrument moved in Azimuth.		
Nov. 26	E.	Lacaille 1592 - -	11 41 34·19	11 40 56·94	−0·571
		Lacaille 6727 S.P. -	11 52 16·63	11 51 30·47	
Nov. 27	W.	z Octantis S.P. - -	10 4 59·76	10 4 4·69	−0·550
		Lacaille 972 - -	10 24 27·98	10 23 47·96	
		Lacaille 1444 - -	11 41 4·75	11 40 25·06	
Dec. 23	W.	Lacaille 1105 - -	9 2 14·96	9 1 50·93	+0·643
		Lacaille 6216 S.P. -	9 6 40·20	9 6 24·52	
	E.	Lacaille 6484 S.P. -	9 33 55·41	9 33 36·55	+0·691
		Lacaille 1592 - -	9 55 13·30	9 54 43·88	
	E.	Lacaille 3238 - -	13 46 52·20	13 46 27·45	+0·660
		Lacaille 8257 S.P. -	14 3 41·15	14 3 26·40	
	W.	Lacaille 8570 S.P. -	14 39 54·66	14 39 35·27	+0·425
		ζ Octantis - -	15 3 22·89	15 2 57·47	
1882. Jan. 8	W.	Lacaille 9401 S.P. -	16 3 3·71	16 2 55·43	+0·351
		Lacaille 4784 - -	16 10 0·21	16 9 43·80	
	E.	Lacaille 9563 S.P. -	16 25 39·58	16 25 30·32	+0·471
		Lacaille 4974 -	16 39 58·54	16 39 43·17	
Jan. 14	E.	✳ S.P. - - -	9 20 8·79	9 20 13·07	+0·793
		Lacaille 1921 - -	9 36 3·88	9 35 48·43	
	W.	ζ Mensæ - - -	11 13 16·57	11 13 3·42	+0·598
		Lacaille 7751 S.P. -	11 18 10·72	11 18 6·56	

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for for Collimation and Level.	Tabular Apparent Time of Transit.	Azimuth Error.
1882.			h m s	h m s	s
Jan. 20	E.	Lacaille 5085 - -	16 10 19·81	16 10 10·86	+0·579
		β Hydri S.P. - -	16 18 9·96	16 18 5·81	
	W.	Lacaille 248 S.P. -	16 38 9·87	16 38 10·52	+0·514
		ι Octantis - -	16 41 36·46	16 41 25·50	
Jan. 21	W.	✳ S.P. - - -	8 52 39·14	8 52 44·69	
		✳ S.P. - - -	10 8 34·87	10 8 12·35	+0·560
		σ Octantis S.P. - -	10 22 18·06	10 22 48·48	
	E.	Lacaille 3274 - -	11 23 57·17	11 23 40·27	+0·704
		Lacaille 8094 S.P. -	11 29 36·02	11 29 34·32	
Jan. 27	E.	Lacaille 1752 - -	8 31 2·54	8 30 55·09	+0·562
		Lacaille 7088 S.P. -	8 41 43·24	8 41 40·62	
	W.	Lacaille 2210 - -	9 30 34·58	9 30 26·76	+0·490
		σ Octantis S.P. - -	9 58 51·75	9 59 19·56	
	W.	Lacaille 8570 S.P. -	12 22 1·48	12 21 57·98	+0·468
		ζ Octantis - -	12 45 33·91	12 45 23·76	
	E.	Lacaille 4169 - -	13 19 31·46	13 19 18·40	+0·566
		C Octantis S.P. - -	13 39 45·95	13 39 47·26	

SECTION VI.—TABLE 8.

OBSERVATIONS WITH THE SMALL TRANSIT AT DURBAN BY MR. MACLEAR.

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
Aug. 18	23 Ophiuchi - - -	W.	6 59 59·42	5	1·05	32·07	−28·98
	37 Ophiuchi - - -		7 18 32·26	5	35·03	5·89	−29·14
	41 Ophiuchi - - -		7 22 11·68	5	13·68	44·47	−29·21
	40 Ophiuchi - - -		7 25 35·28	5	35·78	6·68	−29·10
	μ^1 Sagittarii - - -	E.	8 18 13·38	5	13·97	44·72	−29·25
	Lalande 33596 - -		8 21 38·14	5	40·42	11·19	−29·23
	Rumker 6386 - -		8 24 54·94	5	57·55	28·45	−29·10
	B.A.C. 6388 - - -		8 52 19·14	5	20·83	51·69	−29·14
	ε Aquilæ - - -		9 5 36·76	5	39·85	10·73	−29·12
	ζ Aquilæ - - -		9 11 19·08	4	22·07	52·97	−29·10
	α Equulei - - -	E.	11 20 55·00	5	57·21	28·30	−28·91
	ξ Aquarii - - -		11 42 24·88	3	26·17	57·42	−28·75
	41 Capricorni - - -		11 46 14·92	5	15·03	46·16	−28·87
	46 Capricorni - - -		11 49 38·42	5	39·63	10·76	−28·87
	γ Aquarii - - -	W.	12 26 22·66	4	24·31	55·68	−28·63
	π Aquarii - - -		12 30 3·26	5	5·11	36·49	−28·62
	σ Aquarii - - -		12 34 12·34	4	13·38	44·60	−28·78
	κ Aquarii - - -		12 42 25·28	5	26·79	58·05	−28·74

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
			h m s		s	s	s
1881. Aug. 19	20 Ophiuchi	W.	6 51 4·46	5	5·82	38·02	−27·80
	23 Ophiuchi		6 56 2·32	5	4·00	36·16	−27·84
	37 Ophiuchi		7 14 34·82	5	37·67	9·98	−27·69
	41 Ophiuchi		7 18 14·30	5	16·38	48·55	−27·83
	Lalande 33262	E.	8 9 11·86	5	14·78	47·01	−27·77
	μ^1 Sagittarii		8 14 15·62	5	16·39	48·81	−27·58
	Rumker 6386		8 20 57·40	4	0·23	32·53	−27·70
	B.A.C. 6279		8 29 58·36	5	59·62	32·21	−27·41
	ζ Aquilæ		9 7 21·68	5	24·90	57·06	−27·84
	B.A.C. 7665	E.	12 3 38·32	5	39·06	11·46	−27·60
	ι Aquarii		12 6 58·84	5	59·89	32·44	−27·45
	e Aquarii		12 11 13·38	5	14·60	46·84	−27·76
	γ Aquarii		12 22 25·40	5	27·35	59·79	−27·56
	2 Piscium	W.	13 0 9·96	5	11·85	44·46	−27·39
	h^1 Aquarii		13 5 45·60	5	46·89	19·45	−27·44
	c^2 Aquarii		13 9 54·54	4	54·83	27·47	−27·36
	κ Piscium		13 27 33·90	3	35·81	8·32	−27·49
	ι Piscium		13 40 31·02	5	33·23	6·02	−27·21
Aug. 20	14 Ophiuchi	W.	6 39 33·26	5	35·40	8·89	−26·51
	25 Scorpii		6 43 28·58	5	28·76	2·25	−26·51
	23 Ophiuchi		6 52 5·02	5	6·65	40·22	−26·43
	Lalande 31210		7 2 52·30	5	53·46	27·04	−26·42
	57 Ophiuchi	E.	7 35 6·68	5	8·40	41·97	−26·43
	ο Serpentis		7 38 27·60	5	28·96	2·50	−26·46
	γ Ophiuchi		7 45 37·04	5	39·52	12·95	−26·57
	Lalande 32923		7 56 58·08	4	0·00	33·47	−26·53
	μ^1 Sagittarii		8 10 18·74	5	19·40	52·89	−26·51
	η Capricorni	E.	11 0 49·94	5	50·54	24·28	−26·26
	ν Aquarii		11 6 17·10	5	18·36	51·95	−26·41
	α Equulei		11 13 0·50	5	2·97	36·49	−26·48
	ζ Capricorni		11 23 1·12	5	1·50	35·15	−26·35
	16 Piscium	W.	13 33 4·04	5	5·98	39·79	−26·19
	ι Piscium		13 36 34·04	5	36·22	10·11	−26·11
	i^1 Aquarii		13 40 47·00	5	47·51	21·36	−26·15
	22 Piscium		13 48 34·82	5	36·82	10·59	−26·23
Aug. 23	φ Ophiuchi	W.	6 16 24·48	5	25·40	2·07	−23·33
	25 Scorpii		6 31 37·66	5	37·84	14·49	−23·35
	20 Ophiuchi		6 35 16·26	5	17·62	54·33	−23·29
	30 Ophiuchi		6 46 45·83	4	47·66	24·38	−23·28
	51 Ophiuchi	E.	7 16 5·46	3	5·92	42·47	−23·45
	α Ophiuchi		7 21 16·14	5	19·32	56·01	−23·31
	ο Serpentis		7 26 36·90	5	38·22	14·74	−23·48
	γ Ophiuchi		7 33 46·20	5	48·63	25·18	−23·45
	μ^1 Sagittarii		7 58 27·86	5	28·45	5·11	−23·34
	B.A.C. 7649	E.	11 43 17·98	5	18·23	55·22	−23·01
	ι Aquarii		11 51 11·00	5	11·85	48·83	−23·02
	e Aquarii		11 55 25·19	4	26·20	3·23	−22·97
	γ Aquarii		12 6 37·34	5	39·09	16·18	−22·91
	2 Piscium	W.	12 44 21·94	5	23·86	0·86	−23·00
	h^1 Aquarii		12 49 57·60	5	58·89	35·86	−23·03
	c^2 Aquarii		12 54 6·50	5	6·76	43·89	−22·87
	κ Piscium		13 11 45·86	5	47·83	24·73	−23·10

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
Aug. 29	37 Ophiuchi - - -	E.	6 35 1·18	5	4·22	50·74	−13·48
	Lalande 31606 - -		6 45 46·30	5	46·96	33·70	−13·26
	o Serpentis - - -		7 2 51·20	5	52·50	39·21	−13·29
	γ Ophiuchi - - -		7 10 0·60	5	3·02	49·65	−13·37
	μ^1 Sagittarii - - -	W.	7 34 42·76	5	43·19	29·59	−13·60
	Rumker 6386 - -		7 41 24·24	5	26·74	13·32	−13·42
	B.A.C. 6279 - - -		7 50 25·44	5	26·37	13·00	−13·37
	61 Serpentis - - -		7 53 47·04	5	48·96	35·55	−13·41
	ζ Capricorni - - -	W.	10 47 25·08	5	25·33	11·99	−13·34
	ε Pegasi - - -		11 5 47·20	5	49·85	36·66	−13·19
	27 Aquarii - - -		11 8 38·80	5	40·93	27·69	−13·24
	Lalande 42574 - -		11 12 33·48	5	34·04	20·68	−13·36
	B.A.C. 7628 - - -		11 15 23·92	5	25·55	12·13	−13·42
	γ Aquarii - - -	E.	11 42 51·70	4	53·68	40·78	−12·90
	σ Aquarii - - -		11 51 41·44	5	42·73	29·71	−13·02
	υ Aquarii - - -		11 54 31·78	5	32·29	19·28	−13·01
	κ Aquarii - - -		11 58 54·50	5	56·25	43·15	−13·10
	λ Aquarii - - -		12 13 41·02	5	42·51	29·50	−13·01
Sept. 2	κ Ophiuchi - - -	E.	6 4 29·52	5	29·44	20·27	− 9·17
	η Ophiuchi - - -		6 15 59·30	5	59·21	50·16	− 9·05
	37 Ophiuchi - - -		6 19 16·16	5	16·06	7·04	− 9·02
	B.A.C. 5890 - - -		6 32 42·12	5	42·03	33·09	− 8·94
	μ^1 Sagittarii - - -	W.	7 18 55·50	5	55·08	45·90	− 9·18
	30 Sagittarii - - -		7 55 52·20	4	51·76	42·55	− 9·21
	θ Serpentis - - -		8 2 27·40	5	27·03	17·77	− 9·26
	δ Aquilæ - - -		8 31 34·52	5	34·14	24·75	− 9·39
Sept. 13	Lalande 33262 - -	W.	6 31 27·30	5	27·06	29·79	−58·27
	μ^1 Sagittarii - - -		6 36 29·12	5	28·83	30·74	−58·09
	Rumker 6386 - -		6 43 12·92	5	12·67	14·47	−58·20
	21 Sagittarii - - -		6 48 4·46	5	4·16	5·86	−58·30
	h^2 Sagittarii - - -	E.	7 59 4·70	5	4·56	6·79	−57·77
	γ Aquilæ - - -		8 10 10·50	5	10·36	12·38	−57·98
	α Aquilæ - - -		8 14 32·28	5	32·14	34·25	−57·89
	η Aquilæ - - -		8 15 58·39	3	58·25	0·17	−58·08
	β Aquilæ - - -		8 19 1·20	5	1·06	3·01	−58·05
Sept. 18	μ^1 Sagittarii - - -	W.	6 16 43·06	5	42·72	51·12	−51·60
	21 Sagittarii - - -		6 28 18·16	5	17·82	26·24	−51·58
	B.A.C. 6367 - - -		6 47 1·60	5	1·29	9·62	−51·67
	30 Sagittarii - - -		6 53 39·56	5	39·22	47·79	−51·43
	B.A.C. 6488 - - -		7 4 42·08	5	41·75	50·00	−51·75
	e Aquilæ - - -	E.	7 34 17·74	5	17·51	25·95	−51·56
	51 Aquilæ - - -		7 54 2·38	5	2·10	10·46	−51·64
	β Aquilæ - - -		7 59 15·20	5	14·95	23·42	−51·53
	63 Sagittarii - - -		8 5 5·58	5	5·27	13·41	−51·86
Sept. 19	Rumker 6386 - -	E.	6 19 29·94	5	29·67	38·92	−50·75
	η Serpentis - - -		6 21 14·68	4	14·38	23·68	−50·70
	λ Sagittarii - - -		6 26 42·98	5	42·60	51·90	−50·70
	B.A.C. 6488 - - -		7 0 45·26	5	44·88	54·07	−50·81
	ν Aquilæ - - -	W.	7 26 21·36	5	20·90	30·04	−50·86
	e Aquilæ - - -		7 30 21·46	5	20·99	30·02	−50·97
	γ Aquilæ - - -		7 46 28·14	5	27·69	36·85	−50·84
	η Aquilæ - - -		7 52 15·92	5	15·50	24·65	−50·85
	34 Ceti - - - -		13 10 39·78	5	39·34	48·64	−50·70
	39 Ceti - - - -		13 15 32·32	5	31·88	41·28	−50·60
	42 Ceti - - - -		13 18 41·26	5	40·83	50·23	−50·60

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
			h m s		s	s	s
1881. Sept. 19	o Piscium	E.	13 44 0·32	5	59·97	9·50	−50·47
	61 Ceti		14 2 33·24	5	32·85	42·34	−50·51
	Lalande 8979		14 7 56·50	5	56·04	5·59	−50·45
	ξ^1 Ceti		14 11 30·68	5	30·32	39·86	−50·46
	67 Ceti		14 15 50·96	5	50·54	0·16	−50·38
Sept. 22	B.A.C. 6367	E.	6 31 13·20	5	12·80	25·91	−46·89
	B.A.C. 6388		6 35 1·74	5	1·36	14·44	−46·92
	ε Aquilæ		6 48 20·68	5	20·35	33·44	−46·91
	ν Aquilæ	W.	7 14 29·66	5	29·29	42·26	−47·03
	e Aquilæ		7 18 29·58	5	29·20	42·25	−46·95
	h^2 Sagittarii		7 23 30·50	3	30·05	43·48	−46·57
	γ Aquilæ		7 34 36·42	5	36·09	49·09	−47·00
	η Aquilæ		7 40 24·08	5	23·71	36·80	−46·91
	Lalande 1994	W.	12 54 55·54	5	55·01	8·31	−46·70
	34 Ceti		12 58 48·10	5	47·61	0·95	−46·66
	39 Ceti		13 3 40·64	3	40·15	53·60	−46·55
	42 Ceti		13 6 49·59	4	49·11	2·54	−46·57
	θ Ceti		13 11 10·12	5	9·60	22·96	−46·64
	112 Piscium	E.	13 46 57·34	5	56·73	10·45	−46·28
	61 Ceti		13 50 41·56	5	40·94	54·67	−46·27
	α Arietis		13 53 26·66	5	26·12	39·92	−46·20
Sept. 23	B.A.C. 6367	E.	6 27 15·66	5	15·19	29·99	−45·20
	B.A.C. 6388		6 31 4·10	5	3·62	18·52	−45·10
	30 Sagittarii		6 33 53·88	5	53·39	8·16	−45·23
	ε Aquilæ		6 44 23·08	5	22·60	37·51	−45·09
	ζ Aquilæ		6 50 5·41	3	4·93	19·79	−45·14
	ω Aquilæ		7 2 21·11	3	20·60	35·33	−45·27
	63 Sagittarii	W.	7 45 19·76	5	19·40	33·80	−45·60
	τ Aquilæ		7 48 19·92	5	19·69	33·84	−45·85
	α^2 Capricorni		8 1 25·60	5	25·26	39·70	−45·56
	ρ Capricorni		8 12 1·44	4	1·06	15·33	−45·73
	ε Aquarii		8 31 7·70	5	7·37	21·78	−45·59
	κ Piscium	W.	11 10 17·80	5	17·42	31·84	−45·58
	ι Piscium		11 23 15·54	4	15·19	29·58	−45·61
	i^1 Aquarii		11 27 26·96	5	26·45	40·84	−45·61
	22 Piscium		11 35 16·14	4	15·77	30·10	−45·67
	12 Ceti	E.	12 13 15·03	4	14·39	29·49	−44·90
	13 Ceti		12 18 23·84	5	23·20	38·08	−45·12
	β Ceti		12 26 51·96	5	51·30	6·20	−45·10
	20 Ceti		12 36 9·12	5	8·49	23·39	−45·10
Sept. 26	d Sagittarii	W.	6 48 56·96	5	56·53	14·99	−41·54
	υ Sagittarii		6 53 10·60	4	10·18	28·64	−41·54
	δ Aquilæ		6 57 44·44	5	44·07	52·63	−41·44
	h^2 Sagittarii		7 7 41·77	4	41·31	59·78	−41·53
	γ Aquilæ		7 18 47·14	5	46·78	5·39	−41·39
	β Aquilæ		7 27 37·83	4	37·47	56·03	−41·44
	ε Delphini	E.	8 5 35·27	3	34·90	53·50	−41·40
	Lalande 40029		8 15 47·52	5	47·10	5·49	−41·61
	ε Aquarii		8 19 16·18	4	15·70	34·02	−41·68
	ω Capricorni		8 22 45·10	5	44·53	2·93	−41·60
	α Equulei		8 47 49·70	5	49·26	7·68	−41·58
	22 Ceti		12 27 24·88	5	24·22	42·92	−41·30
	ε Piscium		12 34 6·44	5	5·87	24·63	−41·24
	Lalande 1994		12 39 6·66	5	6·01	24·72	−41·29
	34 Ceti		12 42 59·44	5	58·82	17·37	−41·45

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
Sept. 26	θ^1 Ceti	W.	12 55 21·39	2	20·82	39·38	− 41·44
	o Piscium		13 16 19·94	5	19·46	38·25	− 41·21
	54 Ceti		13 21 45·68	5	45·20	3·93	− 41·27
	ξ Piscium		13 24 35·82	5	35·31	53·89	− 41·42
	56 Ceti		13 28 16·98	5	16·32	35·12	− 41·20
Sept. 28	19 Aquilæ	W.	6 33 33·54	5	33·08	53·66	− 39·42
	20 Aquilæ		6 36 36·54	5	36·05	56·67	− 39·38
	ω Aquilæ		6 42 35·54	5	35·07	55·71	− 39·36
	υ Sagittarii		6 45 16·66	5	16·16	36·79	− 39·37
	δ Aquilæ		6 49 50·60	5	50·11	10·79	− 39·32
	63 Sagittarii	E.	7 25 34·14	4	33·75	54·20	− 39·55
	τ Aquilæ		7 28 34·10	5	33·76	54·23	− 39·53
	ρ Capricorni		7 52 15·32	5	14·83	35·73	− 39·10
	ϵ Delphini		7 57 41·24	5	40·85	1·66	− 39·19
Nov. 20	B.A.C. 8311	E.	7 50 9·14	5	5·07	15·64	− 49·43
	ω Piscium		7 54 40·06	5	35·14	45·81	− 49·33
	d Piscium		8 15 53·39	4	48·30	59·03	− 49·27
	12 Ceti		8 25 19·80	5	16·25	26·75	− 49·50
	ι Orionis	W.	13 2 2·94	4	57·59	8·39	− 49·20
	λ Eridani		13 4 2·88	4	59·76	10·47	− 49·29
	τ Orionis		13 12 24·36	4	20·99	31·72	− 49·27
	o Orionis		13 16 16·22	5	12·00	22·75	− 49·25
Nov. 21	Lalande 8736	W.	12 28 22·31	4	18·25	29·69	− 48·56
	54 Eridani		12 31 56·29	4	54·60	6·05	− 48·55
	π^5 Orionis		12 45 46·86	5	42·15	53·51	− 48·64
	64 Eridani		12 51 4·24	5	1·52	12·86	− 48·66
	66 Orionis	E.	13 55 13·52	5	8·74	19·79	− 48·95
	B.A.C. 1965		13 58 1·93	4	0·79	11·84	− 48·95
	10 Monocerotis		14 18 32·10	5	28·42	39·50	− 48·92
	B Moncerotis		14 22 56·16	5	50·94	2·19	− 48·75
Nov. 26	Lalande 7384	E.	11 30 3·72	4	3·25	20·15	− 43·10
	ν Tauri		11 33 52·54	5	51·99	8·89	− 43·10
	45 Eridani		12 1 45·62	5	45·09	1·86	− 43·23
	W.B. IV–585		12 5 27·24	5	26·76	43·62	− 43·14
	Lalande 8736		12 8 33·64	5	33·11	50·20	− 42·91
	54 Eridani		12 12 9·80	5	9·37	26·56	− 42·81
	Lalande 9045		12 19 10·36	5	9·91	26·90	− 43·01
	π^4 Orionis		12 21 46·98	5	46·39	3·59	− 42·80
Nov. 27	ξ^1 Ceti	W.	9 40 5·92	5	5·38	22·78	− 42·60
	67 Ceti		9 44 25·96	5	25·52	43·05	− 42·47
	B.A.C. 737		9 50 27·58	5	27·26	44·78	− 42·48
	ρ Ceti		9 53 33·62	5	33·22	50·68	− 42·54
	τ^6 Eridani		11 14 51·50	5	51·17	8·83	− 42·34
	30 Eridani		11 19 56·76	5	56·31	13·70	− 42·61
	Lalande 7273		11 22 47·45	4	47·05	4·52	− 42·53
	Lalande 7384		11 26 7·22	5	6·77	24·25	− 42·52
	ν Tauri		11 29 55·01	4	55·49	12·99	− 42·50
Dec. 23	ρ^3 Eridani	W.	8 49 6·46	5	6·41	44·63	− 21·78
	94 Ceti		8 57 21·38	5	21·40	59·68	− 21·72
	ζ Eridani		9 0 41·90	5	41·84	20·11	− 21·73
	Lalande 6476		9 14 35·08	5	34·96	13·40	− 21·56
	Lalande 7273	E.	9 40 12·62	5	12·68	50·87	− 21·81
	Lalande 7384		9 43 32·30	5	32·45	10·61	− 21·84
	ν Tauri		9 47 20·86	5	21·15	59·38	− 21·77
	Lalande 7685		9 51 47·06	5	47·05	25·36	− 21·69

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
Dec. 23	9 Argûs	E.	13 36 9·16	4	9·05	47·44	− 21·61
	27 Monocerotis		13 43 39·88	5	39·91	18·23	− 21·68
	ζ Monocerotis		13 52 27·80	5	27·84	6·12	− 21·72
	β Cancri		13 59 53·58	5	53·76	32·08	− 21·68
	15 Hydræ	W.	14 36 27·38	5	27·15	5·58	− 21·57
	B.A.C. 3082		14 45 43·68	5	43·24	21·80	− 21·44
	κ Cancri		14 50 59·42	5	59·35	37·84	− 21·51
	θ Hydræ		14 57 50·46	5	50·32	28·88	− 21·44
1882. Jan. 8	β Crateris	W.	15 52 7·00	5	6·45	52·82	− 13·63
	φ Leonis		15 56 54·30	5	53·96	40·39	− 13·57
	θ Crateris		16 16 52·98	5	52·58	39·04	− 13·54
	Lalande 22102		16 20 3·52	5	3·06	49·50	− 13·56
	η Crateris	E.	16 36 8·10	5	7·72	54·19	− 13·53
	B.A.C. 4077		16 46 3·34	5	3·14	49·56	− 13·58
	ε Corvi		16 50 9·20	5	8·75	55·13	− 13·62
	η Virginis		16 59 55·90	5	55·72	42·03	− 13·69
Jan. 14	64 Eridani	E.	9 18 4·22	5	4·27	53·86	− 10·41
	Lalande 10145		9 42 10·92	5	11·17	0·69	− 10·48
	Lalande 10325		9 47 3·64	5	3·79	53·33	− 10·46
	υ Orionis		9 49 45·82	5	45·91	35·42	− 10·49
	18 Monocerotis	W.	11 5 3·30	5	2·83	52·36	− 10·47
	θ Canis Majoris		11 12 2·20	5	1·52	51·17	− 10·35
	20 Monocerotis		11 27 39·02	5	38·46	28·20	− 10·26
	26 Canis Majoris		11 30 39·48	5	38·55	28·17	− 10·38
	B.A.C. 2405		11 35 7·40	5	6·44	56·06	− 10·38
	B.A.C. 2433		11 39 15·32	5	14·82	4·51	− 10·31
Jan. 20	Lalande 22818	E.	16 2 50·38	5	50·51	43·55	− 6·96
	12 Virginis		16 6 12·74	5	12·95	5·80	− 7·15
	δ^2 Corvi		16 22 30·58	5	30·42	23·43	− 6·99
	Piazzi XII–111		16 24 19·23	4	19·21	12·06	− 7·15
	B.A.C. 4238		16 27 14·48	5	14·64	7·51	− 7·13
	44 Virginis	W.	16 52 14·90	5	14·34	7·45	− 6·89
	ε Virginis		16 54 57·36	5	56·69	50·26	− 6·43
	B.A.C. 4382		16 58 52·64	5	51·92	45·04	− 6·88
	θ Virginis		17 2 28·92	5	28·34	21·33	− 7·01
Jan. 21	π^5 Orionis	W.	8 44 10·00	5	9·65	3·13	− 6·52
	64 Eridani		8 50 29·60	5	29·06	22·44	− 6·62
	τ Orionis		9 7 52·54	5	52·08	45·54	− 6·54
	ν Orionis		9 56 42·24	5	42·04	35·41	− 6·63
	B.A.C. 2470	E.	11 17 57·46	5	57·52	50·66	− 6·86
	ο Puppis		11 38 46·32	5	46·12	39·37	− 6·75
	9 Argûs		11 41 53·28	5	53·25	46·36	− 6·89
	B.A.C. 2636		11 44 40·92	5	41·24	34·48	− 6·76
	6 Cancri		11 51 49·22	5	49·88	42·92	− 6·96
Jan. 27	λ Eridani	E.	8 35 54·64	4	54·52	48·73	− 5·79
	ο Orionis		8 48 7·12	5	7·10	1·11	− 5·99
	Lalande 10145		8 50 59·66	5	59·66	53·77	− 5·89
	Lalande 10325		8 55 52·52	5	52·44	46·42	− 6·02
	5 Monocerotis	W.	9 41 20·87	4	20·25	14·30	− 5·95
	7 Monocerotis		9 46 15·78	5	15·14	9·19	− 5·95
	10 Monocerotis		9 54 20·74	5	20·14	14·12	− 6·02
	γ Geminorum		10 3 4·92	5	4·58	58·63	− 5·95
	B.A.C. 2954	W.	12 9 43·32	5	42·65	36·79	− 5·86
	ε Hydræ		12 12 21·68	5	21·18	15·31	− 5·87
	15 Hydræ		12 17 35·92	5	35·26	29·28	− 5·98
	κ Cancri		12 33 7·90	5	7·46	1·63	− 5·83
	13 Sextantis	E.	13 29 38·44	5	38·44	32·56	− 5·88
	A Leonis		13 33 14·72	5	14·82	8·97	− 5·85
	25 Sextantis		13 49 2·32	5	2·20	46·36	− 5·84
	μ Hydræ		13 51 56·38	5	56·08	50·28	− 5·80

SECTION VI.—TABLE 9.

DETERMINATION OF COLLIMATION ERROR OF THE SMALL TRANSIT AT DURBAN BY MR. PETT.

Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Aberration.	
			Lamp W.	Lamp E.
1882.	r	r	s	s
July 10	10·312	10·313	−0·012	−0·024
July 13	10·301	10·313	+0·026	−0·062

SECTION VI.—TABLE 10.

DETERMINATION OF LEVEL ERROR WITH THE SMALL TRANSIT AT DURBAN BY MR. PETT.

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.	Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1882.		div.	s	1882.		div.	s
July 10	E.	−0·33	−·051	July 13	E.	−0·46	−·063
	E.	−1·38	−·148*		E.	−0·93	−·107*
	W.	−1·50	−·119		W.	−1·01	−·083
	W.	−0·91	−·064*		W.	−1·21	
	W.	−1·51	−·120		W.	−1·34	−·089
	W.	−0·66	−·041*		W.	−1·00	
	E.	−1·25	−·137		E.	−1·60	−·173
	E.	−2·01	−·208*		E.	−2·29	−·233*

SECTION VI.—TABLE 11.

DETERMINATION OF AZIMUTH ERROR OF THE SMALL TRANSIT AT DURBAN BY MR. PETT.

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Apparent Time of Transit.	Azimuth Error.
1882.			h m s	h m s	s
July 10	E.	Lacaille 972 S.P. -	7 37 42·39	7 37 2·48	+1·485
		Lacaille 6216 - -	8 3 22·03	8 2 24·72	
	W.	Lacaille 6484 - -	8 30 16·41	8 29 26·33	+1·230
		Lacaille 1592 S.P. -	8 50 16·77	8 49 45·44	
	W.	Lacaille 3274 S.P. -	12 12 47·79	12 12 21·89	+1·194
		Lacaille 8094 - -	12 20 26·58	12 19 34·85	
	E.	Lacaille 3238 S.P. -	12 42 22·09	12 41 44·75	+1·356
		Lacaille 8094 - -	13 4 22·15	13 3 29·10	
July 13	E.	Lacaille 1105 S.P. -	7 46 3·03	7 45 28·94	+1·465
		Lacaille 6216 - -	7 51 29·72	7 50 36·57	
	W.	Lacaille 1592 S.P. -	8 38 24·99	8 37 58·05	+1·233
		Lacaille 6727 - -	8 50 12·90	8 49 26·72	
	W.	Lacaille 3274 S.P. -	12 0 53·92	12 0 33·96	+1·320
		Lacaille 8094 - -	12 8 35·70	12 7 47·24	
	E.	Lacaille 3238 S.P. -	12 30 29·94	12 29 56·92	+1·357
		Lacaille 8360 - -	12 52 30·32	12 51 41·57	

SECTION VI.—TABLE 12.

OBSERVATIONS WITH THE SMALL TRANSIT AT DURBAN BY MR. PETT.

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1882.			h m s		s	s	s
July 10	110 Virginis - - -	E.	7 43 35·06	5	35·77	49·86	−45·91
	ν Libræ - - -		7 46 41·62	5	41·89	56·14	−45·75
	ι Libræ - - -		7 52 8·08	5	8·23	22·40	−45·83
	3 Serpentis - - -		7 55 56·04	5	56·78	10·91	−45·87
	50 Libræ - - -	W.	8 40 55·16	5	55·52	10·06	−45·46
	51 Libræ - - -		8 44 22·02	5	22·32	36·91	−45·41
	11 Scorpii - - -		8 47 32·08	5	32·36	46·91	−45·47
	ψ Ophiuchi - - -		9 8 38·62	5	38·77	53·23	−45·54
	15 Aquilæ - - -	W.	11 44 43·66	5	44·07	58·62	−45·45
	19 Aquilæ - - -		11 49 11·74	5	12·35	27·01	−45·34
	20 Aquilæ - - -		11 52 15·34	5	15·70	30·24	−45·46
	d Sagittarii - - -		11 56 42·14	5	42·28	56·93	−45·35
	Lalande 38458 - -	E.	12 47 38·16	5	38·52	52·92	−45·60
	ξ Capricorni - - -		12 51 40·44	5	40·67	55·24	−45·43
	α^1 Capricorni - - -		12 56 54·70	5	54·92	9·36	−45·56
	Washington 8892 - -		13 10 13·70	5	13·84	28·37	−45·47
July 13	37 Libræ - - -	E.	8 2 26·22	5	26·59	44·86	−41·73
	41 Libræ - - -		8 6 49·04	5	49·17	7·71	−41·46
	κ Libræ - - -		8 9 50·64	5	50·76	9·10	−41·66
	ψ Serpentis - - -		8 12 45·98	5	46·64	4·97	−41·67
	51 Libræ - - -	W.	8 32 30·16	5	30·52	49·16	−41·36
	18 Scorpii - - -		8 43 48·02	5	48·43	6·95	−41·48
	Lalande 29689 - -		8 46 55·88	5	56·17	14·86	−41·31
	χ Ophiuchi - - -		8 54 45·30	5	45·50	4·17	−41·33
	20 Aquilæ - - -	W.	11 40 23·44	5	23·89	42·53	−41·36
	d Sagittarii - - -		11 44 50·26	5	50·46	9·21	−41·25
	υ Sagittarii - - -		11 49 3·86	5	4·13	22·77	−41·36
	ν Aquilæ - - -		11 54 32·94	5	33·55	52·37	−41·18
	β Aquilæ - - -	E.	12 23 30·50	5	31·09	49·58	−41·51
	Lalande 38458 - -		12 35 46·40	5	46·68	5·23	−41·45
	ξ Capricorni - - -		12 39 48·76	5	48·91	7·55	−41·36
	α^1 Capricorni - - -		12 45 2·96	5	3·10	21·66	−41·44

SECTION VII.

OBSERVATIONS AT ADEN BY MR. FINLAY.

SECTION VII.—TABLE 1.

DETERMINATION OF COLLIMATION ERROR OF THE SMALL TRANSIT AT ADEN BY MR. FINLAY.

Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Aberration.	
			Lamp W.	Lamp E.
1881.	r	r	s	s
Aug. 20	9·388	9·400	+0·025	−0·065
21	9·391	9·400	+0·014	−0·054
23	9·386	9·400	+0·033	−0·073
24	9·397	9·400	−0·009	−0·031
25	9·407	9·400	−0·046	+0·006
26	9·393	9·400	+0·006	−0·046
27	9·406 9·405	9·400	−0·043	+0·003
29	9·363 9·367	9·400	+0·119	−0·159
Sept. 2	9·373	9·400	+0·082	−0·122
3	9·380	9·400	+0·055	−0·095
4	9·383	9·400	+0·044	−0·084
13	9·407	9·400	−0·046	+0·006

Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Aberration.	
			Lamp W.	Lamp E.
1881.	r	r	s	s
Sept. 14	9·407	9·400	−0·046	+0·006
15	9·417	9·400	−0·084	+0·044
18	9·414 9·416	9·400	−0·076	+0·036
19	9·416 9·414	9·400	−0·076	+0·036
22	9·400	9·400	−0·020	−0·020
23	9·404 9·401	9·400	−0·028	−0·012
24	9·406	9·400	−0·043	+0·003
25	9·406	9·400	−0·043	+0·003
26	9·404	9·400	−0·035	−0·005
27	9·406	9·400	−0·043	+0·003
28	9·398 9·402	9·400	−0·020	−0·020

SECTION VII.—TABLE 2.

DETERMINATION OF LEVEL ERROR OF THE SMALL TRANSIT AT ADEN BY MR. FINLAY.

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.	Temperature.
1881.		div.	s	
August 20	E.	−0·48	−0·017	
	E.	−1·33	−0·069*	
	W.	+0·30	+0·006	
	W.	+1·19	+0·060*	
	W.	+3·15	+0·180	
	W.	+2·01	+0·111*	
21	W.	+0·83	+0·038	
	W.	+1·30	+0·067	
	E.	+0·36	+0·034	
	E.	−1·06	−0·053*	
23	W.	+0·19	−0·002	
	W.	+0·73	+0·032	
	E.	−0·54	−0·021	
	E.	−2·03	−0·111*	

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.	Temperature.
1881.		div.	s	
August 26	W.	−1·99	−0·133	
	W.	−0·69	−0·054*	
	E.	−1·70	−0·092	
	E.	−3·11	−0·178*	
	E.	−1·99	−0·109	
	E.	−3·74	−0·216*	
	W.	−2·16	−0·144	
	W.†	+1·63	+0·087	
27	W.	−1·51	−0·104	
	W.	−1·23	−0·086	
	E.	−2·63	−0·148	
	E.	−3·84	−0·222*	
28	E.	+3·41	+0·220	
	E.	+2·69	+0·176	

† Different Axis Lamps were used between this determination.

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.	Temperature.
1881.		div.	s	°
August 29	E.	+1·95	+0·131	
	E.	+1·08	+0·077*	
	W.	+2·00	+0·110	
	W.	+3·13	+0·179*	
	W.	+3·85	+0·222	
	W.	+3·81		
	E.†	+2·76	+0·180	
	E.	+0·98	+0·072	
September 2	E.	+2·25	+0·149	
	E.	−0·86	−0·040*	
	W.	+0·90	+0·043	
	W.	+2·65	+0·150*	
		Level altered.		
3	E.	−4·81	−0·281	
	E.	−5·86	−0·345*	
	W.	−0·86	−0·064	
	W.	+1·40	+0·073*	
		Level altered.		
13	W.	−0·66	−0·043	91 F.
	W.	−0·34		89
	E.	−1·46	−0·077	
	E.	−3·40	−0·195*	
14	W.	+0·03	−0·007	88
	W.	+0·14		
15	W.	−0·60	−0·031	86
	W.	−0·03		86
	E.	−0·63	−0·026	86
	E.	−1·70	−0·092*	88
18	W.	−0·09	−0·010	90
	W.	+0·15		90
	E.	−0·49	−0·018	90
	E.	−1·75	−0·095*	88
	E.	−1·39	−0·073	86
	E.	−3·00	−0·171*	88
	W.	−2·23	−0·148	
	W.	−0·06	−0·016*	87
19	W.	−0·47	−0·041	92
	W.	+0·50	+0·019*	90
	E.	−0·40	−0·012	89
	E.	−1·94	−0·106*	89
	E.	−1·85	−0·121	86
	E.	−2·51		85
	W.	+0·81	+0·025	85
	W.	+0·43		85

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.	Temperature.
1881.		div.	s	°
September 22	W.	−0·40	−0·041	90 F.
	W.	−0·57		90
	E.	−0·99	−0·048	90
	E.	−2·15	−0·119*	
23	E.	−1·88	−0·103	89
	E.	−2·86	−0·162*	87
	W.	−1·85	−0·125	87
	W.	−0·46	−0·040*	87
	W.	−0·41	−0·020	85
	W.	+0·16		84
	E.	−1·15	−0·058	84
	E.	−2·39	−0·134*	85
24	E.	−0·76	−0·034	88
	E.	−1·60	−0·086*	88
	W.	−0·96	−0·068	89
	W.	+0·40	+0·012*	87
25	W.	−0·12	0·000	86
	W.	+0·48		86
	E.	−0·09	−0·025	88
	E.	−1·11		88
26	E.	−2·20	−0·116	86
	E.	−2·00		86
	W.	−0·83	−0·042	86
	W.	−0·16		87
27	E.	−0·89	−0·042	87
	E.	−1·86	−0·101*	87
	W.	−1·21	−0·086	
	W.	−0·30	−0·030*	
28	E.	−1·75	−0·105	86
	E.	−2·10		88
	W.	−1·49	−0·103	88
	W.	+0·24	+0·002*	87
	W.	+0·84	+0·046	87
	W.	+1·08		86
	E.	+0·03	+0·014	85
	E.	−1·13	−0·057	86

† Different Axis Lamps were used between this determination.

SECTION VII.—TABLE 3.

DETERMINATION OF AZIMUTH ERROR OF THE SMALL TRANSIT AT ADEN BY MR. FINLAY.

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Tabular Apparent Time of Transit.	Azimuth Error.
1881.			h m s	h m s	s
August 20	E.	35 Draconis - -	17 54 20·14	17 54 47·14	−7·843
	W.	Cephei 51 S.P. - -	18 47 10·28	18 44 26·93	−7·738
	W.	Groomb. 2784 - -	19 2 32·60	19 2 57·94	−7·740
	W.	Polaris - - -	1 10 53·43	1 16 9·14	−7·805
	W.	40 Cassiopeiæ - -	1 28 56·52	1 29 9·28	−7·750
			Instrument altered in Azimuth.		
August 23	W.	Cephei 51 S.P. - -	18 45 27·59	18 44 28·28	−0·386
	W.	Groomb. 2784 - -	19 3 47·02	19 2 57·70	−0·580
	E.	64 Draconis - -	20 1 7·31	20 0 16·14	−0·428
	E.	κ Cephei - - -	20 13 46·29	20 12 55·92	−0·401
August 26	W.	Cephei 51 S.P. - - Groomb. 2784 - -	18 45 14·56 19 3 32·67	18 44 29·53 19 2 57·46	−0·410
	E.	64 Draconis - - κ Cephei - - -	20 0 52·10 20 13 30·70	20 0 16·05 20 12 55·75	−0·463
	E.	Bradley 6 - Bradley 24 - -	0 10 13·75 0 20 16·41	0 9 38·38 0 19 41·98	−0·530
	W.	Cephei - - - Polaris - - -	1 2 48·40 1 16 29·05	1 2 13·10 1 16 13·05	−0·495
August 27	W.	Draconis - -	18 23 50·40	18 23 13·32	−0·529
	E.	11 Cephei - - -	21 40 53·08	21 40 15·48	−0·551
August 29	E.	χ Draconis - - Cephei 51 S.P. - -	18 23 54·41 18 45 19·91	18 23 13·18 18 44 30·75	−0·352
	W.	σ Draconis - - λ Ursæ Minoris - -	19 33 18·95 19 43 26·06	19 32 37·83 19 43 1·40	−0·370
	W.	Bradley 2993 - - 31 Cephei - - -	22 23 27·16 22 33 37·41	22 22 49·65 22 32 56·05	−0·453
	E.	κ Cassiopeiæ - -	0 27 2·70	0 26 20·69	−0·464
Sept. 2	E.	76 Draconis - - β Cephei - - -	20 51 59·58 21 28 0·83	20 51 11·62 21 27 11·91	−0·357
	W.	Bradley 3038 - -	22 48 51·51	22 48 5·13	−0·487
	The Level was altered here; and the Azimuth appears to have changed in consequence.				
Sept. 3	E.	β Cephei - - - 31 Cephei - - -	21 28 0·49 22 33 44·05	21 27 11·89 22 32 56·04	−1·318
	W.	50 Cassiopeiæ - -	1 54 14·64	1 53 26·10	−1·341

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.			Tabular Apparent Time of Transit.			Azimuth Error.
1881.			h	m	s	h	m	s	s
Sept. 13	W.	λ Ursæ Minoris	19	42	14·92	19	42	45·43	−1·480
		64 Draconis	20	0	58·94	20	0	15·41	
		κ Cephei	20	13	34·55	20	12	54·48	
	E.	76 Draconis	20	51	46·81	20	51	10·50	−1·514
		77 Draconis	21	8	35·10	21	7	55·40	
Sept. 18	W.	73 Draconis	20	33	46·39	20	33	6·49	−1·460
		76 Draconis	20	51	44·79	20	51	8·63	
	E.	11 Cephei	21	40	56·26	21	40	14·95	−1·550
		24 Cephei	22	8	17·34	22	7	36·25	
	E.	Polaris	1	16	4·83	1	16	26·59	−1·594
	W.	36 Hev. Cassiop.	2	27	34·65	2	26	54·22	−1·660
		Cephei	2	51	9·96	2	50	32·65	
Sept. 19	W.	73 Draconis	20	33	46·17	20	33	6·42	−1·537
		76 Draconis	20	51	44·67	20	51	9·80	
	E.	24 Cephei	22	8	17·00	22	7	36·22	−1·672
		Bradley 2993	22	23	12·25	22	22	48·17	
	E.	Cephei	2	51	10·56	2	50	32·75	−1·522
	W.	Camelopardi	3	38	38·86	3	37	57·86	−1·568
Sept. 22	W.	73 Draconis	20	33	45·61	20	33	6·19	−1·546
		76 Draconis	20	51	43·82	20	51	9·43	
	E.	11 Cephei	21	40	55·40	21	40	14·81	−1·586
		24 Cephei	22	8	16·47	22	7	36·13	
Sept. 23	E.	77 Draconis	21	8	32·08	21	7	54·71	−1·620
		β Cephei	21	27	51·63	21	27	11·24	
	W.	24 Cephei	22	8	15·99	22	7	36·09	−1·690
		Bradley 2993	22	23	11·25	22	22	47·69	
	W.	Cephei	1	2	51·46	1	2	14·89	−1·580
		Polaris	1	16	6·37	1	16	28·23	
	E.	50 Cassiopeiæ	1	54	7·08	1	53	27·18	−1·585
		36 Hev. Cassiop.	2	27	34·43	2	26	54·52	
Sept. 26	E.	77 Draconis	21	8	32·03	21	7	54·47	−1·580
		β Cephei	21	27	50·92	21	27	11·11	
	W.	24 Cephei	22	8	15·09	22	7	36·00	−1·720
		Bradley 2993	22	23	10·06	22	22	47·28	
Sept. 28	E.	β Cephei	21	27	50·72	21	27	11·02	−1·612
		11 Cephei	21	40	53·76	21	40	14·57	
	W.	31 Cephei	22	33	34·11	22	32	55·57	−1·770
		Bradley 3038	22	48	35·96	22	48	5·15	
	W.	36 Hev. Cassiop.	2	27	33·55	2	26	54·78	−1·676
		Cephei	2	51	9·13	2	50	33·81	
	E.	Camelopardi	3	38	38·00	3	37	58·48	−1·526
		Piazzi III–160	3	51	1·87	3	50	27·34	

SECTION VII.—TABLE 4.

OBSERVATIONS WITH THE SMALL TRANSIT AT ADEN BY MR. FINLAY.

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
Aug. 20	γ Ophiuchi - -	E.	17 42 4·76	5	3·29	59·16	− 4·13
	Lalande 32633 - -		17 46 0·30	5	58·31	54·10	− 4·21
	B.A.C. 6060 - -		17 49 7·90	5	3·44	59·21	− 4·23
	Lalande 33262 - -		18 2 45·60	5	44·90	40·51	− 4·39
	μ^1 Sagittarii - -		18 6 52·32	5	47·50	43·12	− 4·38
	θ Serpentis - -	W.	18 50 28·22	5	27·10	22·09	− 5·01
	B.A.C. 6488 - -		18 54 58·68	5	54·94	49·83	− 5·11
	15 Aquilæ - - -		18 58 51·98	5	49·78	44·78	− 5·00
	d Sagittarii - -		19 10 54·38	5	50·14	44·80	− 5·34
	v Sagittarii - -		19 15 8·26	5	4·44	59·13	− 5·31
Aug. 23	B.A.C. 6488 - -	W.	18 55 41·42	5	41·25	49·80	−51·45
	15 Aquilæ - - -		18 59 36·22	5	36·13	44·75	−51·38
	d Sagittarii - -		19 11 36·66	5	36·47	44·77	−51·70
	v Sagittarii - -		19 15 50·92	5	50·74	59·11	−51·63
	ν Aquilæ - - -		19 21 21·66	5	21·60	29·93	−51·67
	η Aquilæ - - -	E.	19 47 20·80	5	20·60	28·76	−51·84
	β Aquilæ - - -		19 50 24·12	5	23·95	32·09	−51·86
	63 Sagittarii - -		19 56 15·38	5	15·06	23·04	−52·02
	ξ Capricorni - -		20 6 44·86	5	44·52	52·51	−52·01
Aug. 26	B.A.C. 6347 - -	W.	18 32 29·04	5	28·70	52·03	−36·67
	B.A.C. 6367 - -		18 37 43·38	5	43·14	6·49	−36·65
	B.A.C. 6488 - -		18 55 27·00	4	26·73	49·77	−36·96
	15 Aquilæ - - -		18 59 21·87	3	21·68	44·72	−36·96
	d Sagittarii - -		19 11 22·00	5	21·72	44·74	−36·98
	51 Aquilæ - - -	E.	19 44 55·34	4	55·00	18·26	−36·74
	η Aquilæ - - -		19 47 5·81	3	5·56	28·75	−36·81
	β Aquilæ - - -		19 50 9·20	5	8·98	32·08	−36·90
	63 Sagittarii - -		19 56 0·48	5	0·10	23·02	−37·08
	ξ Capricorni - -		20 6 29·74	5	29·34	52·49	−36·85
	ω Piscium - -	E.	23 53 53·73	3	53·51	16·29	−37·22
	2 Ceti - - -		23 58 20·38	5	19·93	42·77	−37·16
	d Piscium - -		0 15 10·12	5	9·86	32·82	−37·04
	13 Ceti - - -		0 29 49·16	5	48·77	11·46	−37·31
	15 Ceti - - -		0 32 41·16	5	40·79	3·59	−37·20
	26 Ceti - - -	W.	0 58 23·04	5	22·83	45·65	−37·18
	39 Ceti - - -		1 11 15·22	5	15·03	37·78	−37·25
	48 Ceti - - -		1 24 35·00	5	34·74	57·34	−37·40
	50 Ceti - - -		1 30 51·92	5	51·74	14·40	−37·34
Aug. 27	B.A.C. 6111 - -	W.	17 58 36·14	5	35·66	56·92	−38·74
	Lalande 33262 - -		18 2 19·16	5	18·98	40·41	−38·57
	μ^1 Sagittarii - -		18 7 22·12	5	21·67	43·04	−38·63
	Washington 6386 -		18 14 6·64	5	6·45	27·88	−38·57
	21 Sagittarii - -		18 18 59·12	5	58·68	20·06	−38·62
	B.A.C. 7649 - -	E.	21 52 49·66	5	49·16	10·16	−39·00
	e Aquarii - - -		22 4 59·64	5	59·22	20·16	−39·06
	θ Aquarii - - -		22 11 17·06	5	16·67	37·65	−39·02
	γ Aquarii - - -		22 16 14·32	5	13·98	34·95	−39·03
Aug. 29	B.A.C. 6324 - -	E.	18 29 12·30	5	12·11	29·58	−42·53
	B.A,C. 6347 - -		18 32 34·76	5	34·49	51·98	−42·51
	B.A.C. 6367 - -		18 37 49·08	5	48·89	6·46	−42·43
	θ Serpentis - -		18 51 4·57	3	4·45	21·98	−42·47
	B.A.C. 6488 - -		18 55 32·56	5	32·30	49·74	−42·56

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
Aug. 29	B.A.C. 6694	W.	19 28 9·90	5	9·90	27·51	−42·39
	η Aquilæ		19 47 10·99	4	11·18	28·72	−42·46
	Aquilæ		19 50 14·32	5	14·55	32·04	−42·51
	63 Sagittarii		19 56 5·54	5	5·65	23·00	−42·65
	τ Aquilæ		19 59 5·88	5	6·13	23·54	−42·59
	20 Piscis Australis	W.	22 39 48·04	5	48·05	5·27	−42·78
	τ Aquarii		22 44 4·54	5	4·65	21·87	−42·78
	λ Aquarii		22 47 11·36	5	11·53	28·75	−42·78
	ρ Pegasi		22 50 1·14	5	1·44	18·59	−42·85
	δ Sculptoris	E.	23 43 31·14	5	30·74	47·92	−42·82
	22 Piscium		23 46 39·48	5	39·38	56·56	−42·82
	ω Piscium		23 53 59·13	4	59·05	16·33	−42·72
	2 Ceti		23 58 26·01	2	25·70	42·82	−42·88
	Lalande 257		0 12 17·66	5	17·31	34·54	−42·77
Sept. 2	ν Aquarii	E.	21 4 1·21	3	1·06	11·10	−49·96
	ζ Capricorni		21 20 47·36	3	47·07	57·07	−50·00
	B.A.C. 7649		21 53 0·68	5	0·33	10·17	−50·16
	B.A.C. 7665		21 56 33·74	5	33·40	43·38	−50·02
	ι Aquarii		22 0 55·46	5	55·14	5·08	−50·06
	2 Piscium	W.	22 54 15·72	5	15·78	25·90	−49·88
	h^1 Aquarii		22 59 51·92	5	51·92	1·83	−50·09
	c^2 Aquarii		23 4 0·74	5	0·64	10·54	−50·10
	59 Pegasi		23 6 37·98	5	38·16	48·10	−50·06
Sept. 3	ι Aquarii	E.	22 0 57·98	5	56·98	5·08	−51·90
	π Aquarii		22 20 8·92	5	8·23	16·40	−51·83
	σ Aquarii		22 25 18·20	5	17·24	25·37	−51·87
	υ Aquarii		22 29 8·62	5	7·43	15·58	−51·85
	34 Ceti	W.	1 6 36·02	4	36·67	44·50	−52·17
	39 Ceti		1 11 30·48	5	30·13	37·94	−52·19
	ξ Piscium		1 48 20·06	3	19·91	27·75	−52·16
	61 Ceti		1 58 39·10	5	38·89	46·66	−52·23
Sept. 13	η Aquilæ	W.	19 47 15·26	5	14·86	28·54	−46·32
	β Aquilæ		19 50 18·40	5	18·14	31·88	−46·26
	63 Sagittarii		19 56 9·94	5	9·16	22·84	−46·32
	ξ Capricorni		20 6 39·48	5	38·73	52·33	−46·40
	η Capricorni	E.	20 58 29·72	5	28·74	42·46	−46·28
	ν Aquarii		21 3 58·10	5	57·34	11·03	−46·31
	16 Aquarii		21 15 41·10	5	40·49	54·28	−46·21
	ζ Capricorni		21 20 44·36	5	43·26	57·01	−46·25
Sept. 18	ε Aquarii	W.	20 42 4·34	5	3·68	18·26	−45·42
	ω Capricorni		20 45 34·36	4	33·21	47·75	−45·46
	ν Aquarii		21 3 57·10	5	56·39	10·99	−45·40
	α Equulei		21 10 42·24	5	41·95	56·59	−45·36
	41 Capricorni	E.	21 36 5·06	5	4·07	18·74	−45·33
	Lalande 42574		21 45 55·96	5	55·09	9·83	−45·26
	B.A.C. 7628		21 48 47·56	5	47·08	1·77	−45·31
	B.A.C. 7649		21 52 56·40	5	55·44	10·13	−45·31
	50 Ceti	E.	1 31 0·98	5	0·11	14·86	−45·25
	ν Piscium		1 36 4·26	5	3·95	18·73	−45·22
	ο Piscium		1 39 56·56	5	56·34	11·04	−45·30
	ξ Piscium		1 48 13·66	5	13·27	28·05	−45·22

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
			h m s		s	s	s
1881. Sept. 18	ρ Ceti	W.	2 21 2·12	5	1·18	16·05	−45·13
	δ Ceti		2 34 12·82	5	12·28	27·16	−45·12
	μ Ceti		2 39 20·38	5	20·14	34·94	−45·20
	Lalande 5211		2 43 3·84	5	2·96	17·77	−45·19
	τ^2 Eridani		2 46 28·48	5	27·36	42·17	−45·19
Sept. 19	ρ Capricorni	W.	20 22 51·70	5	53·76	8·67	−45·09
	Washington 8892		20 25 14·40	4	13·54	28·52	−45·02
	Lalande 40029		20 38 34·68	5	34·38	49·15	−45·23
	ε Aquarii		20 42 4·14	5	3·46	18·25	−45·21
	ω Capricorni		20 45 34·08	5	32·88	47·73	−45·15
	B.A.C. 7665	E.	21 56 29·14	5	28·25	43·34	−44·91
	ι Aquarii		22 0 50·94	5	50·16	5·04	−45·12
	e Aquarii		22 5 6·02	5	5·30	20·15	−45·15
	γ Aquarii		22 16 20·34	4	19·88	34·97	−44·91
	π Aquarii		22 20 1·76	5	1·37	16·39	−44·98
	δ Ceti	E.	2 34 12·58	5	12·16	27·18	−44·98
	μ Ceti		2 39 20·06	5	19·89	34·96	−44·93
	Lalande 5211		2 43 3·38	5	2·64	17·80	−44·84
	τ^2 Eridani		2 46 28·26	5	27·27	42·19	−45·08
	ο Tauri	W.	3 19 14·00	5	13·83	28·76	−45·07
	Lalande 6476		3 24 48·30	5	47·54	2·54	−45·00
	τ^5 Eridani		3 29 21·46	5	20·43	35·38	−45·05
	20 Eridani		3 31 41·68	5	40·78	55·68	−45·10
Sept. 22	ε Aquarii	W.	20 42 3·58	5	2·91	18·21	−44·70
	ω Capricorni		20 45 33·60	5	32·42	47·69	−44·73
	19 Capricorni		20 48 54·28	5	53·38	8·74	−44·64
	η Capricorni		20 58 28·05	4	27·09	42·36	−44·73
	ν Aquarii		21 3 56·38	5	55·66	10·95	−44·71
	41 Capricorni	E.	21 36 4·50	5	3·39	18·71	−44·68
	Lalande 42574		21 45 55·34	5	54·37	9·80	−44·57
	B.A.C. 7628		21 48 46·96	5	46·37	1·74	−44·63
	B.A.C. 7649		21 52 55·84	5	54·78	10·10	−44·68
Sept. 23	ν Aquarii	E.	21 3 56·13	3	55·31	10·94	−44·37
	16 Aquarii		21 15 39·29	4	38·64	54·19	−44·45
	ζ Capricorni		21 20 42·36	5	41·19	56·92	−44·27
	Lalande 41765		21 24 8·80	5	7·72	23·31	−44·41
	ξ Aquarii		21 32 14·40	5	13·63	29·33	−44·30
	ι Aquarii	W.	22 1 0·38	5	49·45	5·02	−44·43
	e Aquarii		22 5 5·40	5	4·55	20·13	−44·42
	θ Aquarii		22 11 22·75	4	22·02	37·63	−44·39
	γ Aquarii		22 16 19·84	5	19·31	34·95	−44·36
	26 Ceti	W.	0 58 30·82	4	30·44	46·10	−44·34
	39 Ceti		1 11 23·08	5	22·59	38·25	−44·34
	47 Ceti		1 21 48·72	5	47·95	3·54	−44·41
	50 Ceti		1 31 0·12	5	59·28	14·93	−44·35
	ν Piscium		1 36 3·30	5	3·03	18·80	−44·23
	67 Ceti	E.	2 11 52·06	5	51·41	7·05	−44·36
	B.A.C. 737		2 17 55·30	5	54·14	9·80	−44·34
	ρ Ceti		2 21 1·36	5	0·54	16·15	−44·39
	δ Ceti		2 34 12·04	5	11·54	27·26	−44·28
Sept. 26	η Capricorni	E.	20 58 27·26	5	26·23	42·32	−43·91
	ν Aquarii		21 3 55·68	5	54·89	10·90	−43·99
	16 Aquarii		21 15 38·60	5	37·99	54·16	−43·83
	ζ Capricorni		21 20 41·86	5	40·75	56·89	−43·86

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
Sept. 26	ι Aquarii - -	W.	22 0 49·70	5	48·81	5·00	−43·81
	e Aquarii - -		22 5 4·80	5	3·98	20·11	−43·87
	γ Aquarii - -		22 16 19·20	5	18·68	34·93	−43·75
	π Aquarii - -		22 20 0·54	5	0·10	16·36	−43·74
	υ Aquarii - -		22 29 0·52	5	59·41	15·56	−43·85
Sept. 28	41 Capricorni - -	E.	21 36 3·30	5	2·11	18·64	−43·47
	Lalande 42574 - -		21 45 54·24	5	53·20	9·75	−43·45
	B.A.C. 7628 - -		21 48 45·84	5	45·22	1·69	−43·53
	B.A.C. 7649 - -		21 52 54·66	5	53·54	10·05	−43·49
	υ Aquarii - -	W.	22 29 0·15	4	59·00	15·54	−43·46
	τ Aquarii - -		22 43 36·24	5	5·35	21·91	−43·44
	2 Piscium - -		22 54 9·78	5	9·37	25·94	−43·43
	h^1 Aquarii - -		22 59 46·00	5	45·34	1·88	−43·46
	δ Ceti - - -	W.	2 34 11·12	5	10·77	27·36	−43·41
	τ^2 Eridani - - -		2 46 26·88	5	25·88	42·38	−43·50
	ρ^3 Eridani - - -		2 59 14·02	5	13·44	29·96	−43·48
	Lalande 5759 - -		3 1 28·40	5	27·88	44·53	−43·35
	20 Eridani - - -	E.	3 31 40·16	5	39·32	55·90	−43·42
	22 Eridani - - -		3 35 32·74	5	32·22	48·91	−43·31
	τ^6 Eridani - - -		3 42 31·82	5	30·79	47·29	−43·50
	30 Eridani - - -		3 47 36·82	5	36·28	52·94	−43·34