

V. *On the Parallax of α Centauri.* By THOMAS HENDERSON, Esq.,
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Read January 3, 1839.



THE two stars which are designated α^1 and α^2 *Centauri*, are situate within 19 seconds of space of each other.* On comparing the observations of LA CAILLE with those of the present time, it has been found that, although the stars have not sensibly changed their relative positions, each has an annual proper motion of $3''.6$ of space. It thus appears that they form a binary system, having one of the greatest proper motions that have been observed; and, from this circumstance, and the brightness of the stars, it is reasonable to suppose that their parallax may be sufficiently sensible to powerful instruments.

On reducing their declinations from my observations made at the Cape of Good Hope, a sensible parallax appeared; but I delayed communicating the result till it should be seen whether it was confirmed by the observations of Right Ascension made by Lieutenant MEADOWS, with the transit instrument; for, as DELAMBRE has remarked, “*il semble qu'on ne sera jamais bien sûr de la parallaxe des étoiles, tant que les ascensions droites ne confirmeront pas les résultats tirés des déclinaisons.*”† I now find that the observations of right ascension also indicate a sensible parallax.

It must be premised that the observations both of right ascension and of declination were not made for the purpose of ascertaining the parallax, but of determining the mean places of the stars with a proper degree of accuracy. It was only about the termination of my residence at the Cape, that I learned from Mr. JOHNSON the fact of the great proper motion, which first

* α *Centauri* seems to have been first recognised as a double star by FEUILLÉE, in 1709. See his “*Journal des Observations Physiques, Mathématiques,*” &c. Tome i. p. 425. Paris, 1714.

† *Astronomie, Théorique et Pratique.* Tome iii. p. 142.

made me suspect that there might be a sensible parallax. Had I been aware of the proper motion at an earlier period, a much greater number of observations, and of such as would have been better adapted for ascertaining the parallax, would have been made, so that a greater degree of probability would have attended the result.

The stars under consideration are always above the horizon at the Cape, and, at their superior meridian transit, have a zenith distance of 26° . They are, therefore, favourably placed for being accurately observed at all seasons; and the excellence of the meridian instruments at the Cape Observatory,—DOLLOND's Transit-Telescope, and JONES's Mural Circle,—has given great precision to the observations already made.

The right ascensions and declinations have been determined by comparisons with such of the principal, or standard stars, as were observed on the same day. It is consequently assumed that the stars of comparison have no sensible parallax, or that the mean of their parallaxes in right ascension, or declination, is insensible. The mean places of the standard stars, or rather their relative positions with regard to each other, are also assumed to be known; for the absolute places of the stars, whose parallaxes are to be determined, are not required, but only the variations of these places.

In reducing the observations, the coefficient of aberration has been assumed $= 20''.5$; that of Lunar nutation $= 9''.25$. Recent investigations make the coefficient of aberration less. By introducing a term in the equations of condition, the effect of a change in the aberration is immediately obtained.

Let p = the parallax of the star, expressed in angular space, or
the angle under which the semidiameter of the earth's
orbit is seen at a distance equal to that of the star.

$20''.5(1+f)$ = the coefficient of aberration.

$- 0^s.46 + m$ = the star's annual proper motion in right ascension.

$+ 0''.83 + m'$ = the star's annual proper motion in declination.

Then, on reducing the observations to the beginning of 1833, by applying the corrections for precession, nutation, proper motion, and aberration, we obtain the following equations:

Parallax of α Centauri.

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Date of Observation.	Mean R.A. of α^1 Centauri $-14^h 28^m =$
1832.	
April 16	+18,29 ^s $-0.03 p - 2.5 f + 0.7 m$
26	+18,12 $-0.01 p - 2.6 f + 0.7 m$
May 11	+18,27 $+0.03 p - 2.5 f + 0.6 m$
21	+18,38 $+0.05 p - 2.4 f + 0.6 m$
June 5	+18,52 $+0.07 p - 2.1 f + 0.6 m$
6	+18,16 $+0.08 p - 2.1 f + 0.6 m$
19	+18,06 $+0.10 p - 1.7 f + 0.5 m$
22	+18,15 $+0.10 p - 1.6 f + 0.5 m$
July 21	+18,34 $+0.12 p - 0.5 f + 0.4 m$
Aug. 10	+18,19 $+0.13 p + 0.4 f + 0.4 m$
16	+17,93 $+0.12 p + 0.6 f + 0.4 m$
Sept. 20	+18,25 $+0.08 p + 1.9 f + 0.3 m$
1833.	
April 8	+18,41 $-0.04 p - 2.4 f - 0.3 m$
12	+18,22 $-0.04 p - 2.5 f - 0.3 m$
17	+18,23 $-0.03 p - 2.5 f - 0.3 m$
18	+18,27 $-0.02 p - 2.5 f - 0.3 m$
19	+18,28 $-0.02 p - 2.6 f - 0.3 m$
22	+18,18 $-0.02 p - 2.6 f - 0.3 m$
24	+18,21 $-0.01 p - 2.6 f - 0.3 m$
25	+18,37 $-0.01 p - 2.6 f - 0.3 m$
26	+18,59 $-0.01 p - 2.6 f - 0.3 m$
29	+18,28 $+0.00 p - 2.6 f - 0.3 m$
May 3	+18,40 $+0.01 p - 2.6 f - 0.3 m$
16	+18,33 $+0.04 p - 2.5 f - 0.4 m$

On resolving the equations by the method of *minimum* squares, we obtain :

$$p = +0''.82 - 15.5 f - 4.6 m : \text{Weight } 0.0753.$$

And, if the coefficient of aberration be assumed $= 20''.36$, and $m = 0$,

$$p = +0''.92.$$

Date of Observation.	Mean R.A. of α^2 Centauri $-14^h 28^m =$
1832 .	
April 16	+19,84 ^s $-0.03 p -2.5 f +0.7 m$
17	+19,60 $-0.03 p -2.6 f +0.7 m$
26	+19,68 $-0.01 p -2.6 f +0.7 m$
May 11	+19,69 $+0.03 p -2.5 f +0.6 m$.
21	+20,13 $+0.05 p -2.4 f +0.6 m$
June 5	+19,87 $+0.07 p -2.1 f +0.6 m$
6	+19,79 $+0.08 p -2.1 f +0.6 m$
19	+19,76 $+0.10 p -1.7 f +0.5 m$
22	+19,98 $+0.10 p -1.6 f +0.5 m$
July 21	+19,59 $+0.12 p -0.5 f +0.4 m$
Aug. 10	+19,78 $+0.13 p +0.4 f +0.4 m$
16	+19,46 $+0.12 p +0.6 f +0.4 m$
Sept. 20	+19,77 $+0.08 p +1.9 f +0.3 m$
1833.	
April 8	+19,99 $-0.04 p -2.4 f -0.3 m$
12	+19,81 $-0.04 p -2.5 f -0.3 m$
17	+19,68 $-0.03 p -2.5 f -0.3 m$
18	+19,82 $-0.02 p -2.5 f -0.3 m$
19	+19,89 $-0.02 p -2.6 f -0.3 m$
22	+19,81 $-0.02 p -2.6 f -0.3 m$
24	+19,65 $-0.01 p -2.6 f -0.3 m$
25	+19,94 $-0.01 p -2.6 f -0.3 m$
26	+19,79 $-0.01 p -2.6 f -0.3 m$
29	+19,86 $+0.00 p -2.6 f -0.3 m$
May 3	+19,80 $+0.01 p -2.6 f -0.3 m$
16	+19,98 $+0.04 p -2.5 f -0.3 m$

Whence, by the method of *minimum* squares,

$p = +0''.38 - 15.3 f - 4.0 m$: Weight 0.0789.

And assuming the coefficient of aberration = $20''.36$ and $m = 0$,

$p = +0''.48$.

Parallax of α Centauri.

Date of Observation.	Mean Declination of α^1 Centauri from Direct Observations $+60^\circ 8' =$
1832.	
May 23	$-37''.1 + 0.57 p + 9.9 f + 0.6 m'$
June 11	$-36.1 + 0.39 p + 13.1 f + 0.6 m'$
Aug. 19	$-35.4 - 0.42 p + 12.6 f + 0.4 m'$
Sept. 23	$-34.7 - 0.69 p + 5.7 f + 0.3 m'$
Oct. 11	$-33.6 - 0.74 p + 1.0 f + 0.2 m'$
Nov. 9	$-34.1 - 0.67 p - 6.7 f + 0.1 m'$
Dec. 15	$-34.9 - 0.35 p - 13.5 f + 0.0 m'$
1833.	
Jan. 12	$-34.1 + 0.01 p - 15.3 f - 0.0 m'$
April 8	$-37.0 + 0.75 p - 0.9 f - 0.3 m'$
10	$-36.1 + 0.75 p - 0.4 f - 0.3 m'$
13	$-35.8 + 0.75 p + 0.4 f - 0.3 m'$
21	$-36.5 + 0.73 p + 2.6 f - 0.3 m'$
28	$-36.1 + 0.72 p + 4.3 f - 0.3 m'$
30	$-35.4 + 0.71 p + 4.8 f - 0.3 m'$
May 2	$-36.5 + 0.70 p + 5.3 f - 0.3 m'$
9	$-36.2 + 0.66 p + 6.9 f - 0.4 m'$
16	$-35.3 + 0.62 p + 8.2 f - 0.4 m'$

Whence, by the method of *minimum* squares,

$p = +1''.40 - 3.72 f + 0.33 m'$: Weight 5.62.

And assuming the coefficient of aberration $= 20''.36$ and $m' = 0$,

$p = +1''.42$.

Date of Observation.	Mean Declination of α^2 Centauri from Direct Observations $+60^\circ 8' =$
1832.	
May 22	$-21''.3 + 0.58 p + 9.7 f + 0.6 m'$
28	$-21.8 + 0.52 p + 10.9 f + 0.6 m'$
July 6	$-20.7 + 0.10 p + 15.2 f + 0.5 m'$
16	$-21.3 - 0.03 p + 15.3 f + 0.5 m'$
Sept. 12	$-19.6 - 0.63 p + 8.2 f + 0.3 m'$
24	$-19.5 - 0.70 p + 5.4 f + 0.3 m'$

Date of Observation.	Mean Declination of α^2 Centauri from Direct Observations $+60^\circ 8' =$
1832.	
Oct. 30	$-20''.1 - 0.72 p - 3.9 f + 0.2 m'$
Nov. 12	$-19.9 - 0.65 p - 7.4 f + 0.1 m'$
Dec. 13	$-20.3 - 0.37 p - 13.3 f + 0.0 m'$
1833.	
Jan. 9	$-21.1 - 0.03 p - 15.3 f - 0.0 m'$
14	$-21.7 + 0.04 p - 15.3 f - 0.0 m'$
April 9	$-21.9 + 0.75 p - 0.6 f - 0.3 m'$
12	$-21.3 + 0.75 p + 0.2 f - 0.3 m'$
20	$-21.2 + 0.74 p + 2.3 f - 0.3 m'$
25	$-21.3 + 0.73 p + 3.6 f - 0.3 m'$
29	$-21.6 + 0.72 p + 4.5 f - 0.3 m'$
May 1	$-21.7 + 0.71 p + 5.0 f - 0.3 m'$
4	$-21.0 + 0.69 p + 5.7 f - 0.3 m'$
11	$-20.8 + 0.65 p + 7.4 f - 0.4 m'$
20	$-20.4 + 0.59 p + 9.3 f - 0.4 m'$

Whence, by the method of *minimum* squares,

$$p = +1''.02 - 5.01 f + 0.33 m': \text{Weight } 6.07.$$

And assuming the coefficient of aberration $= 20''.36$ and $m' = 0$,

$$p = +1''.05.$$

Date of Observation.	Mean Declination of α^1 Centauri from Reflected Observations $+60^\circ 8' =$
1832.	
July 27	$-37''.0 - 0.16 p + 14.9 f + 0.4 m'$
Sept. 5	$-35.9 - 0.58 p + 9.6 f + 0.3 m'$
14	$-36.5 - 0.64 p + 7.7 f + 0.3 m'$
21	$-36.0 - 0.68 p + 6.1 f + 0.3 m'$
25	$-36.2 - 0.70 p + 5.2 f + 0.3 m'$
Oct. 3	$-37.7 - 0.73 p + 3.1 f + 0.2 m'$
7	$-35.8 - 0.74 p + 2.1 f + 0.2 m'$
31	$-37.1 - 0.72 p - 4.2 f + 0.2 m'$
Nov. 8	$-35.8 - 0.68 p - 6.4 f + 0.1 m'$
1833.	
Jan. 28	$-38.6 + 0.22 p - 14.6 f - 0.1 m'$

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Whence, by the method of *minimum* squares,

$$p = +2''.02 + 8.39f + 0.20m' : \text{Weight } 0.91.$$

And assuming the coefficient of aberration = $20''.36$ and $m' = 0$,

$$p = +1''.96.$$

Date of Observation.	Mean Declination of α^2 Centauri from Reflected Observations $+60^\circ 8' =$
1832.	
Aug. 6	$-20''.8 - 0.28p + 14.2f + 0.4m'$
20	$-20.4 - 0.44p + 12.4f + 0.4m'$
Sept. 11	$-21.0 - 0.62p + 8.4f + 0.3m'$
22	$-20.8 - 0.69p + 5.9f + 0.3m'$
Oct. 14	$-21.3 - 0.75p + 0.3f + 0.2m'$
16	$-20.3 - 0.75p - 0.3f + 0.2m'$
29	$-21.0 - 0.73p - 3.7f + 0.2m'$
Nov. 7	$-20.0 - 0.68p - 6.2f + 0.1m'$
1833.	
Jan. 8	$-22.0 - 0.04p - 15.3f - 0.0m'$

Whence, by the method of *minimum* squares,

$$p = +1''.25 + 5.00f + 0.07m' : \text{Weight } 0.50.$$

And assuming the coefficient of aberration = $20''.36$ and $m' = 0$,

$$p = +1''.21.$$

From the foregoing observations I find the probable error of one observation of right ascension to be $= 0''.095$, and of declination $= 0''.38$. The probable error of declination at the zenith distance of 26° , adopted in the construction of my Catalogue of Declinations, is $0''.52$. The mean $0''.45$ is taken as the probable error of one observation of declination. The probable errors of the preceding results are found by dividing these quantities respectively by the square roots of the weights.

Assuming the coefficient of aberration to be $= 20''.36$, and m and $m' = 0$, we have,

Parallax of α^1 Centauri	$= +0''.92$; probable error $0''.35$.	From observations of right ascension.
.. .. .	$+1.42$; probable error 0.19 .	From direct observations of declination.
.. .. .	$+1.96$; probable error 0.47 .	{ From reflected observations of declination.

and = $+1''.38$, with a probable error of $0''.16$; by taking a mean of these three determinations, and assigning to each a weight proportional to the square of the reciprocal of its probable error.

Parallax of α^2 Centauri =	$+0''.48$; probable error $0''.34$.	From observations of right ascension.
.. .. .	$+1.05$; probable error 0.18 .	From direct observations of declination.
.. .. .	$+1.21$; probable error 0.64 .	{ From reflected observations of de- clination,

and = $+0''.94$, with a probable error of $0''.16$, the mean of these three determinations according to their weights.

If we suppose that the two stars are at the same distance, then the parallax = $+1''.16$, with a probable error of $0''.11$.

It therefore appears probable, that these stars have a sensible parallax of about one second of space.

It is desirable that observations should be made for the express purpose of determining the parallax with all the precision which the instruments can give. These observations may be of micrometrical measurements of the distances between the two stars, and other stars visible with them in the field of the telescope; of differences of right ascension and declination between the two stars and adjoining stars, observed with the meridian instruments; and of angular distances between the stars and their reflected images, observed with the mural circle: the observations to be made especially about the times when the parallax produces its greatest effects. In the last-mentioned mode, the effect of the absolute parallax in declination is doubled. If the parallax is one second, the variation of the angular distances between the stars and their reflected images observed in different seasons will amount to three seconds,—a quantity which the mural circle can determine with the greatest ease. I have no doubt that Mr. MACLEAR, if he has not already resolved the question, will soon set it at rest, or confine it within narrow limits.

T. HENDERSON.

EDINBURGH, December 24, 1838.