KG
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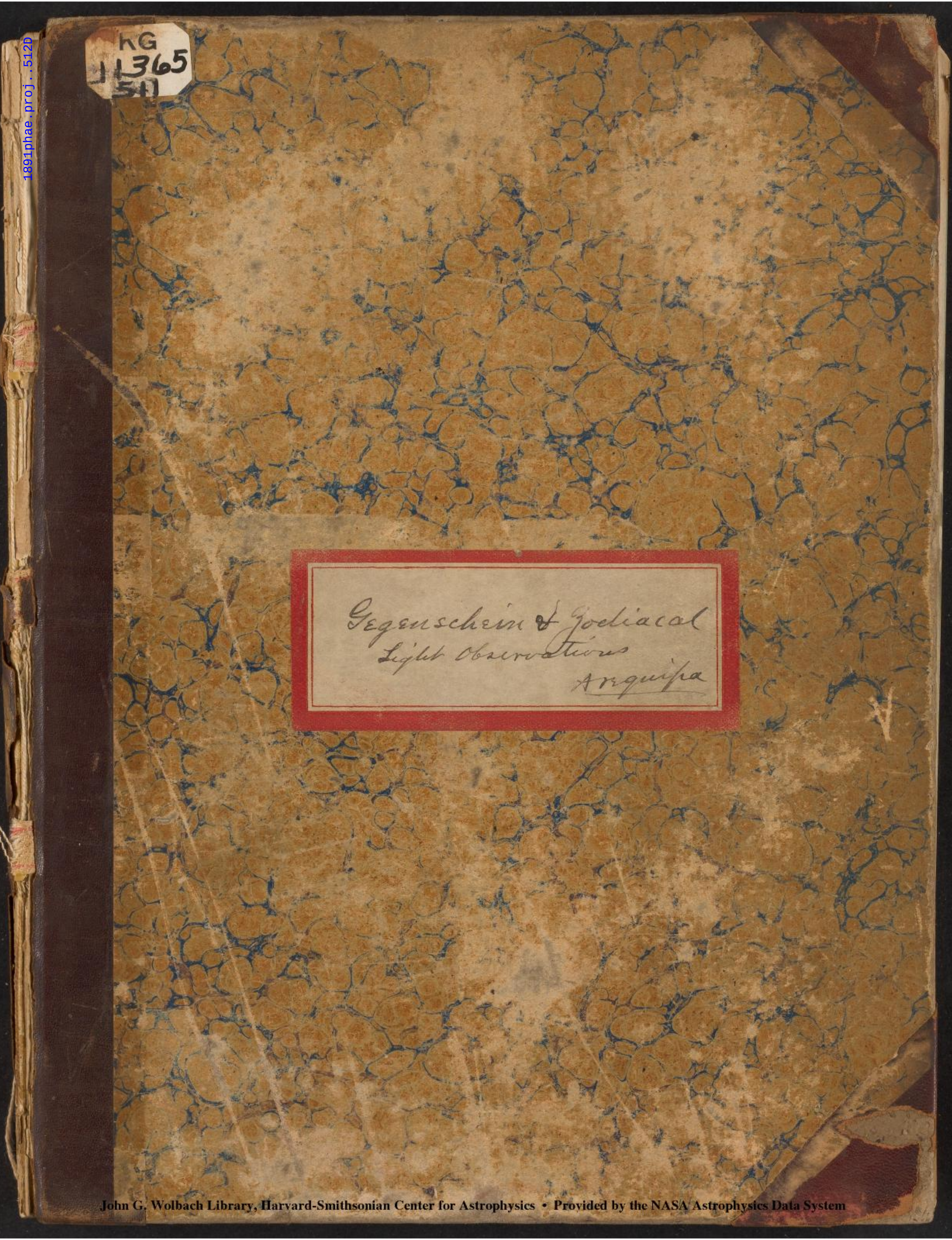


Gegenschein & Zodiacal
Light Observations
Arequipa

KG 11365.5/11

Focus of Lowell $6^{\underline{in}}$ is 87.0^{in}

Harvard College Observatory.

Book No.

~~Variable Stars~~ ★

and Zodiacal Light.

~~Variable Stars – page 1.~~ ★
Zodiacal Light – page 150.

★ Variable Stars Observations are transferred to another book & this will be devoted exclusively to zodiacal light observations.

KG11365.5 /1

HARVARD
UNIVERSITY
LIBRARY
MAY 8 1956

Observations on Variable Stars 1891

Old Observations.

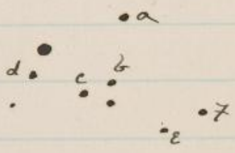
Copied into another Book.

R Doradus. Feb. 13. 9.30 P.M.

V - 0 - c   Chart in D's Journal, thus:-

ε - 1 - V

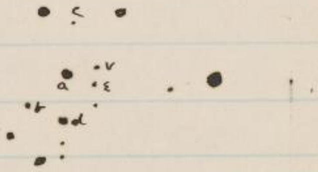
V - 2 7.



L₂ Puppis. Feb. 13. 8.45 P.M.

V - 1 - C   Chart in D's old Journal. thus:-

ε - 1 - V



R Centauri. July 9. 10.48. P.M.

C - 1 - V

V - 3 - D

Summary of work on Zodiacal Light. &c. to September 9th 1891.
As sent by letter to Prof. E.C. Pickering under date of Sept 8, 1891.

Prof. E.C. Pickering.

Dear Sir.

With the advice of your brother I send you a summary of the work done here thus far on the Zodiacal light and its accompanying phenomena.

From the interesting paper on that subject which Professor Searle prepared, I gather that the existance of the Zodiacal Band & the Gegenshein has not been considered a matter of certainty. Therefore my observations here have been so much beyond my expectations that I write this largely in hope of receiving suggestions as to special observations to be made on these phenomena in addition to those sent by Prof Searle - and of procuring cooperative observations, if practicable.

My observations have begun about the first of August and have been made at irregular intervals during the month.

Taking ~~up~~ Mr. Searle's paper

on this subject, I will answer his questions in order so far as the "Record book of Zodiacal Light" gives information.

His first topic is the Zodiacal Cone

1. Course of the axis. The western Cone was observed August 4./91. 8. p.m as follows:

R. A.	Dec.	Dec of Ecliptic at same RA	Distance fr. Cc.
10 „ 02	+12.5	+12.0	0°5 N
12 „ 14	−1.0	−1.5	0°5 N
13 „ 18	−7.8	−8.2	0°4 N
14 „ 45	−16.6	−16.0	0°6 S
15 „ 55	−21.0	−20.3.	0°7 S
Eastern Cone observed Aug. 30/91.			
3 „ 50	+22.5	+20.1	2°4 N
5 „ 29	+22.0	+23.3	1°3 S
(about) 7 „ 14	+22.0	+22.4.	0°4 S.

2. Symmetrical diminution of brightness to N & S. The diminution is probably symmetrical. Three observations have been made on this point two by myself and one by Prof. W. H. Pickering. But my two disagreed with each other and the Prof.'s taken at the same time as the of mine, disagreed with ~~them~~ it. a difference has been repeatedly looked for, but none observed except the above.

3. As to the existance of two Cones one within the other

On Aug. 21. 7.30, was observed a Cone more or less distinct with a sheath about it, continuing into the Zodiacal Band.

It may be described as follows:

"At 13° above horizon (at RA 12^h40^m)
"Width of inner cone 23°3
"Distance of axis from Ecliptic
at R.A. 12„38 is 0°3 S.
"Width of sheath 65°
"Distance of axis from ecliptic
at RA. 12„40 is about 3°25.
"It is difficult to get the limits of this sheath as it is so faint. It extends into Scorpio. At an altitude of 49°
"Width of Sheath is 16.8
"Distance of axis from ecliptic
at R A 15^h00 is 0.3 N
"Slightly interfered with by "Milky Way"

4. Lines of equal brightness from base to vertex of Zodiacal cone. Probably such lines can be drawn, & only one observation on the contrary has been made (Aug. 21) and that was probably due to the light to which the eye had been subjected shortly before. Such lines, by the way, are probably slightly convex curves, and not straight lines.—

5. As to pairs of such lines one north & one south of the axis, they probably can be drawn.

6. Posible comparisons between such lines and specified portions of the "Milky way." Comparisons can be made

though only one or two have been made thus far. On this same date (Aug. 21) at 7.20 P.M. the Zodiacal light is recorded as more brilliant than that brightest point in the Milky Way in ~~Scorpio~~ Sag. 7. The only variations that have been observed in short intervals are due to change in general illumination of the sky and to absorption. They may be described as follows:- As twilight deepens into night the brilliant Zodiacal Cone appears extending to 30° or 40°. As it gets darker it prolongs itself up to 60° and becomes slightly more indefinite as to its tip When every particle of twilight has disappeared, and not till then, can the full zodiacal band be seen. At this time at a point about 15° to 20° above the horizon the light spreads out to N + S. mingling with the natural horizon light, but forming a rich glow, which glow, by the way continues after the whole Cone is below the horizon. However as the Cone sinks into this glow it appears to shorten, and a blank space forms between its tip and the Zodiacal Band. This of course varies greatly on different nights. In the East the prolonging of the cone as it emerged from the horizon light has been observed but it has, had a considerable inclination to North +

has been interfered with by the mountains, nearly 11° in altitude and by the "Milky Way" just rising, so its diminution with increase of daylight has not been observed. No variations of different kind have been observed during the month.

8.— Determination of these variations by comparisons can probably be made, but have not yet been attempted.

9.— ¿Does the Cone extend farther from the Sun at one time than at another? For short intervals there is no evidence in favour of the affirmative. For long intervals a month or two more will be necesary: the recorded positions of the tip are however as follows:

Aug. 3.	10„50 p.m	W. Z. L.	$6^h 18^m$	fr.	Sun.
	11„30	E	9	"	"
" 4.	8„10	W	4.53	"	"
" 28.	7„30	W	3.23	"	"
" 30	15„00	E	7.00	"	"
Sep. 6	14„40	E	6.03	"	"

The great variations here shows the uncertainty in estimating position of tip probably the estimation depends in some way of the time of night.—

In addition to the above I might say that the "Milky way" has interfered greatly with observations on the eastern cone and it will soon interfere with the western. The Zodiacal light here is so remarkably brilliant that there seems almost a probability of obtaining photographs of it, which we propose to attempt within 2 or 3 weeks, in the 2½ in Doublet. By exposing one or two hours for several successive evenings on practically the same region, a sufficiently long exposure can be obtained, if it seems desirable.

Furthermore, if photographs prove succesful, a spectrum might be obtained in such a spectroscope as the one constructed shortly before we left Cambridge: for by exposing successive evenings an almost indefinite length of exposure could be obtained.

During the month the western cone has been nearly perpendicular and consequently, in a good position for observation. The eastern has been considerably inclined.

The Zodiacal Band & Gegenshein are of so much interest, that I quote the first observation made on them at this observatory.

"Aug. 3. 10.57 P.M. On looking for a continuous band across the sky from E to W, I should say that such a band is visible. The Milky way about Scorpio interferes with W. observations, & Jupiter in the East makes it difficult to observe limited portion.

"11„45" The band across the sky is probably helped by (if not due to) some outlying portions of the milky way. –

11.50. – The brightest point (from Klein's star atlas) is located at RA. 20.52. Dec –17. – This may be Gegenshein.

From the nautical almanac I get the position of the sun, as RA 8h15 – Dec 17°20".

Therefore the point absorved is probably Gegenshein. The axis of this band was observed aug. 4. as follows.

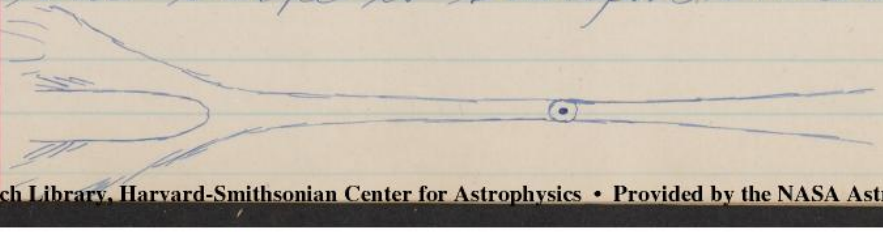
R.A.	Dec.	Dec of Ecliptic at same R.A.	Dist. from Ecliptic
20h50	–17°8'	–17.1	0°7 S
21h35	–15°	–14.4	0°6 S
22.20	–10.	–10.4	0°4 N
22.40	–8,	–8.3	0°3 N
23.10	–8	–5.5	2°5 S Near Jupiter
23.55	–2	–0.4	1°6 S. near horizon
3.50	+22.5	+20.1	2°4 N " "

Aug. 30 at 14h20m this band was visible from 15° above western horizon to within 5° o 10° of eastern entering the "milky way" and E.Q. Cone.

The width of the Band seems to vary somewhat as follows:

Greatest width of sheath on W cone	– 65°	Aug 21.
—— " on Cone, near tip.	— 25°	" 4
—— " off " " "	— 17°	" 21
" at Gegenshein –	— 15°	" 30

The shape is therefore somethin of this sort:



though it is possible that immediately
outside the Gegenshein it has a width of less than
15°

The brilliancy of the Zodiacal Band seems to vary somewhat with its width. From just off the cone its brightness decreases regularly until it reaches the Gegenshein. So that in one or two nights less favourable for observation, there has seemed to be an interval on each side of the Gegenshein. — One test of its brilliancy was as follows: The record book was lightened by a dark lantern. After recording for two or one minute, on looking up, the band could be distinguished in less than 20 seconds. In general, its brilliance is rather less than that portion of the Milky way in Capricornus. or the area between Orion & Sirius and the bright Milky way.

The Gegenshein as before stated. was first observed Aug. 3d. its shape was then put down as a circular disc possibly surrounded by a ring. This has since been corroborated in part. There seem to be two concentric circular areas but whether the outer is a ring separated from the inner by a dark space or not has not been determined. This much has been observed independantly three times and observation by the Prof. supports it. The diameter of this outer circle has been given once as 25°, while the inner has been recorded as 7° (Aug 4) (~~Aug 4~~) 3° or 4° (by the Professor Aug. 4.) 4° to 6° (Aug 8) 7° (Aug 30 The brilliancy of the Gegenshein is about the same as that part of the Milky Way in Capricornus. The certainty of its position may be derived from the following:

Table of observations on the Gegenshein.

Date	R. A	Dec.	- in R A	in Dec	Distance from		
Aug. 3	11.50-20.52	-17	8.. 55	+17.20	- 3m W 0°.8	- 0.20 N	AED
" 4	9.50-20.59	-18	9 0 0	+17.06	- 1m W 0°.3	54 S	AED
" "	10.40-20.59	-18	" —	"	" 0°.3	"	WHP.
" 8	11.00-21.09	-15.6	9.15	-15.. 57	-6m W 1°.5	20 N	AED
" 21	7.45-22.04	-12	10.02	+11.. 57	-2m E 0°.5	3 S	AED
" 30	14.30-22.31	-9	10.35	+8.. 57	-4m W 1°.0	3 S.	AED.

In each case the observation was made before the position of the sun was looked up. Finally to see if this whole Zodiacal path of light is inclused to the ecliptic the following table is arranged comprising all observations

	Dist. from - Sun -	Ecl. -	Date Aug.	132°		Remarks.
15°.5	1h.. 02m E	0°.5 N	4	Long Sun 148 8h	✓	On horizon at times of 0.60.
38.5	2.. 34	0.3 S	21 Long Sun	7.. 30		
39	2.. 36	3.2 S	"	7.30		0. mit. Sheath - very faint
48.5	3.. 14	0.5 N	4	8 -	✓	
64.5	4.. 18	0.4 N or .5	"	8 -	✓	
74.0	4.. 56	0.3 N	21	7.. 40		
86.2	5.. 45	0.6 S	4	8	✓	Near Milky way
180	12.. 00	0.4 N	3 Long Sun 131	11.50		Position of Gegenshein.

	Dist. from		Date		Remarks.
	Sun —	Ecl.	Aug		
180,0	12 "	0.°9 S	4. Long Sun 136	9 " 50	Position of Gegenshein
	12 "	0.°4 N	8. Long Sun 148	11 " 00	— " — " — " —
	12 "	0.0	21. Long Sun 157	7 " 45	— " — " — " —
	12 "	0.0	30. Long Sun 132	14 " 30	— " — " — " —
188,8	12 " 35	0.6 S	4.	10 " 00	
200,0	13 " 20	0.4 N	"	10 " 00	
205,5	13 " 42	0.3 N	"	10 " 00	
212,5	14 " 10	2.5 S	"	10 " 15	At RA of Jupiter
223,8	14 " 55	1.6 S	"	10 " 15	Near Hor. at time of obs.
228,2	15 " 13	2.4 N	30	15 " 00	Interfered with by milky way
253,0	16 " 52	1.3 S	"	15 " 00	— " — " — " —
279,2	18 " 37	0.4 S.	"	15 " 00	Near horizon

From the chart of these observations there appears a small inclination toward the North from 0h to 12h and a larger one f to the South from 12 to 24. This it the effect tha absorption would produce and is presumably due to it

In conclusion I may say that there can now be scarcely a doubt in our minds as to the existance of these phenomena. The case of seeing them must be largely due to dryness of atmosphere here which is even more pronounced it seems to me here at the observatory than in any other part of the city.

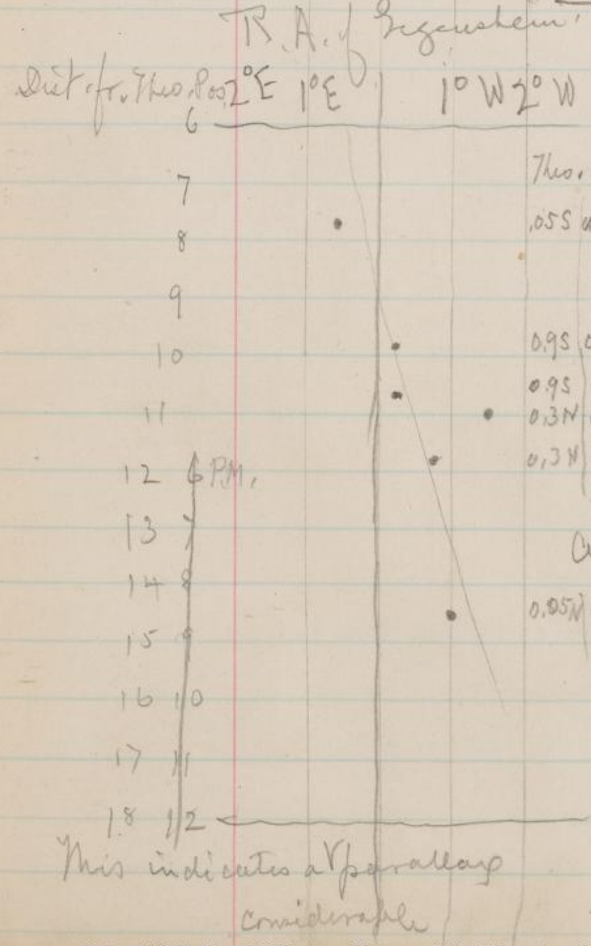
If it is thought advisable to make observations here in connection with any elsewhere I shall be very glad to give all the help I can in pursuing this interesting investigation.

Yours very sincerely.—

O.E.D.

"Nature" of July 23, 91, has communication on this subject from Lick Obs'y. See Astr. Journal. No 243. E.E. Barnard. As follows:- In the fall. G. is large & roundish. Afterwards elongates and is connected to zodiacal light by a narrow Z.B. Obsns prove (!) that G. is not in ecliptic. Mean of 16 Obsns assigns this position $\odot - \lambda = 180°.6;\ \beta = +1°.3$

Tues. Sept 22, 1891 9 P.M.



This indicates a parallax considerable

Actual distance of Ge. from Ecl. at observed position.

Theo. Obs.		Aug	3	20 „ 52	−17	−17.6	0.6 N
.05S	0.9S		4	„ 59	18	17.1	0.9 S
			"	„ 59	18	17.1	0.9 S
0.9S	0.9S		8	21 „ 09	15.6	16.4	0.8 N
0.9S 0.3N	0.9S 0.8N		21	22 „ 04	12	11.9	0.1 S
0.3N	0.6N		30	„ 31	9	9.3	0.3 N
							1.9 S
							1.7 N
							6 | .2 S
							.03 S

Av. Dist. fr. Theo. Pos.

0.05N	0.3N	20 N	54. S.
		20 N	54. S.

We may find a parallax which will account for errors in Dec.

If we could assume a hor. Par. of 1° it would place the G. at distance of the moon, which would

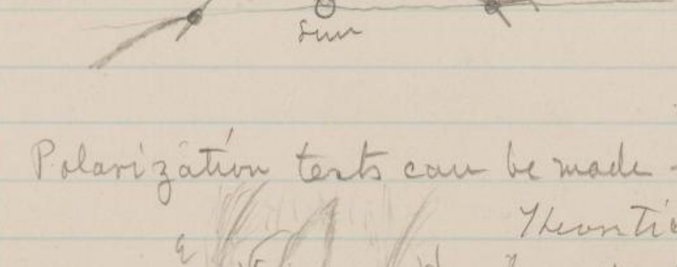
Tuesday Sept. 22, 91

If the G. is produced by reflection (at opposition) of sunlight on a group of Meteorites or other bodies, whether as a ring around the earth or the asteroids, then there should be no parallax for at whatever point on the earth a person stood, the G should be exactly opposite the sun. If there should prove to be a parallax there, this reflection theory can't explain the phenomena and some such Electrical theory as ~~that~~ one that could explain the direction of comets tails, would have to be brought into use.

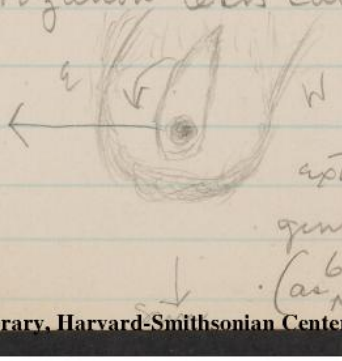
The importance of getting its spectrum is very evident for that would at once decide which theory was ~~un~~tenable

One might also imagine the earth surrounded by a nebulous envelope as is the head of a comet with the heaviest part towards the sun. Thence comes the question, is a comet's envelope thinner in the plane of its orbit, as is the Z L.?

From Chambers Astr. Vol I. pg 411, Comets tails change thus



Polarization tests can be made - See Chambers Ast. V-1 Pg 467



Theoretically then the E Z L should be slightly heavier or the E Z cone should extend farther from the sun & also the Gegenschein should be placed a little to the West (as 6 obs^{ns} tend to show it does) on this hypothesis

Tuesday, Sept. 22, 91

As the case at present stands here, the moon should be examined in different phases to see if its intensity of light is connected with Polarization phenomena, also all phenomena of Z.L. should be examined to see if any polarization occurs in any part of them;

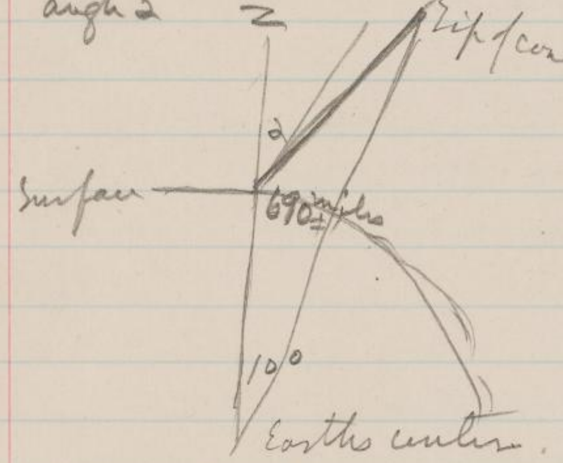
Also the G. should be examined in the 13in to see if minute luminous specks can be seen as of asteroids or other bodies. This should be done especially during ~~total~~ eclipses of the moon

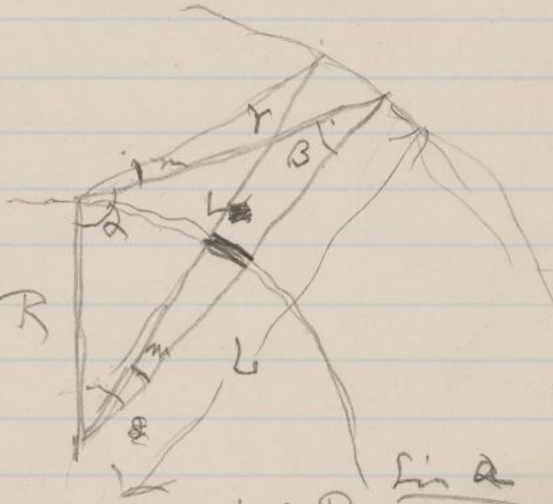
We want then
Moons phases tested for Polarization.
All parts of Z.L. " " "
Its spectrum photographed (Is there any poss. conn. with the Corona
The G. examined for asteroids or Meteoric bodies,
All parts of Z.L. fotographed for shape, position &c.
Shape of G at dif. hours of night to get Parall. or elongation.
Compare E & W tips of Z.L. cones to see which extends farthest fr. sun
N.B. Page 7. would tend to show that E. tip did extend farthest,
N.B. 2. See if Z.L. near sun has spec. of corona or a head of a comet & if Geg. has spectrum like tail of a comet.

As the earths shadow extends 4 times as far as the moon, a G. due to reflection simply could have a parallax of only 12′ to 15′. If the G is a long column as the spine in a comets tail, it might have a slight parallax, but should distinctly(?) change its shape during the night, being circular at midnight but elongated E & W towards sunrise or set.

Nov. 20. 1893

Call special attention to the obsd changes in tip of cone on page 161. By means of this change its parallax would be determined thus: when tip crossed the zenith its distance from the sun would be suns H.A, 40m later its ~~positions~~ distance from zenith would be angle a





$$L = R\frac{\sin a}{\sin\beta}$$

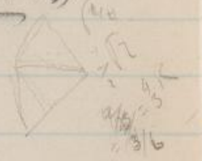
$$L = R\frac{\sin(a+n)}{\sin\gamma}$$

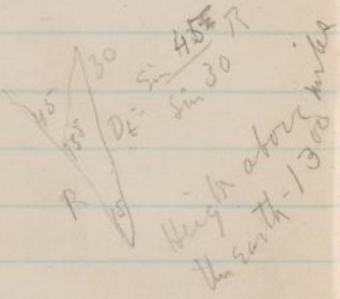
$$\gamma = 180-(180-(a+\beta)-m+a+n)$$
$$= +a+\beta+m-a-n$$
$$= \beta+m-n$$

angle a is known

$$\therefore \frac{\sin a}{\sin\beta} = \frac{\sin(a+n)}{\sin(\beta+m-n)}$$

$$\text{or } \frac{\sin(\beta+m-n)}{\sin\beta} = \frac{\sin(a+n)}{\sin a}$$





Height above the earth - 1300 miles

We could get a value of B from testing tables for different assumptions

Obsns on Tip of cone

available Obsns

Page		
152	Tip E of zenith at 7h15 Aug 3	
154	Aug 4. $8^h 10^m$ Spica 0.4 to α Librae	
159	Aug 28. 7 30 " " " "	
160	Aug 30. 14h40 g Z Aldib, or Aldeb 0.5 to Pleides	
161	" " 15 — " Pleides + farther west	
163	Sept 6 14h35 5^h R.A.	-99
167	" 24 7h30 α Librae 0.65 to δ Scorpii	= Long 235 Sun at 181 54
"	" " 7.41 no change.	
185	1892 April 18 7h45 Tip at zenith	
~~177~~ 180	Dec 17.91. 8^0 to 8h10 Several tips	
196	see notes	
201	Dec 22.92. Description of setting	

Mention of Outlying portions of M.W.

Page	1891	
165	Sept 6.	Betelgeuse, Sirius, Canopus, Big Mag Cloud,
166	" 7.	N + S of Capricornus,
167	" 24	across α + ξ Scorpii
153	Aug. 3.	E + W band
161	" 30	Map shows dark spaces bet. Pleides & Capella
163	Sept. 6.	dark space near 5h R.A.
"	"	Confused with Z.B., near same dark space
164	"	Branch from Aldebaran towards Pisces
	Here should follow the 3 above	
168	Sept 24,	N + S band nearly bet. γ Pegasi + β Ceti.
"	"	"Halo" around Zig. may be due to Milky Way
169	"	N + S band again noted.
171	" 27.	N + S band noted as in same place
172	" "	Mag. Cld branch pretty ~~fully~~ described
181	Dec 17	Mention of M.W. near Pleides,
		End of Arequipa Obsns on this topic.

~~Rope - long~~
~~30 ft. [illegible]~~
~~Cong [illegible] & [illegible]~~
~~[illegible] bring type -~~
~~[illegible] D [illegible]~~

Nov. 20, 1893 Gegenschein Observations

Directly from Original Records.

Copy of Gegenschein Obsns made at Arequipa, 1891-2

Positions from Klein's Star Atlas.

Page	Date, 1891	Hour	Position	Obs Diam	Remarks.
153	Aug. 3	11.50	20.52 × -17		Dense center (surrounded by disc or ring)
156	" 4	9.48	20 59 × -18	D = 7°	(position of center was obsd)
156	" "	10.40	" (P)	D = 3.5	do
157	" 8	11.00	21.09 × -15.6	D = 5.°0	do
158	" 21	7.45	22.04 × -12	diam	(do of brightest Point)
-160	" 30	14.20	22.31 × - 9	7°	(do of center do)
168	Sept 24	8.10	00.08 × +0.3	9°	Acometed Obsn (do)
169	" "	10.20	00.22 × - 0.2	—	" " " (do)
"	" "	10.40	00.13 × +0.6	—	" " " (do)
"	" "	10.47	00.22 × - 0.2	—	" " " (do)
"	" "	11.00	00.14 × +1.0	—	" " " (do) ⟨at 11.20 larger⟩
"	" "	12.48	00.07 × .0	—	" " " (do)
170	" 25	12.26	00.20 × +0.4	—	(bright) do
"	" "	12.45	00.25 × +0.5	4°	opera glasses do
"	" "	13.30	00.20 × 0.0	8	with eye do
"	" "	13.40	00.21 × 0.0	—	(probably small) do (check this R.A.)
171	" 27	7.42	00.30 × -0.7	12½°	long [i.e. E & W] do
"	" "	9.05	00.23 × -0.6	7½°	long do
"	" "	10.08	00.30 × +1.3		more centralized do
172	" "	11.18	00.29 × +0.7	mean diam 8°	but still elongated.
"	" "	11.25	00.20 × 0.0	11°	circular
"	" "	12.22	00.28 × -1.2	11°	seeing worse
173	" "	13.05	00.24 × +2.1	3°	(condensed center) is ~~circular~~ outside
"	" "	14.20	00.23 × +1.0	9°	circular
"	" "	15.10	00.19 × +1.4		seeing ~~not~~ worse

See note page 177 !!

25 Obsns

Nov. 21, 1893

Gegenschein Observations

Copy, Directly from Original Records,
Positions in pencil from Kleins star atlas.

Page	1891	Hour	Position		Per	Diam	Part	Remarks,	
176	Sept 29	8 „ 30	00 „ 25 x	− 0,3	P		B.P.?	(= brightest point) seeing	
"	" "	8 „ 30	00 „ 15 x	+ 1,0	D		whole?	1/2 to 1	
"	" "	12 „ 10	00 „ 33 x	+ 2,0	D	14.4	" ?	— condensed on N side	
"	" "	12 „ 14	00 „ 24 x	+ 1.7	D	5.4	B and P	—	
See note 177	" "	12 „ 25	00 „ 24 x	+ 1.7	D	6,0	B and P	— towards N side of band	
178	" 30	10 „ 30	00 „ 38 „	+ 0.6	D	19° x 8°	center	2 to 3) of band	
"	" "	10 „ 45	00 „ 22 x	+ 0,8	D	9	center?	2 to 3? nearly circular	
~~182~~	1892								
182	Feb. 21	8 „ 38	10 „ 15 x	+ 15.7	D	—	BP?	—	153.8 "Put down as probably Geg"
183	" 22	12 „ 10	10 „ 20 x	+ 15.3	D	10°	center?	—	155.0
184	March 29	12 „ ~~42~~ 33	12 „ 42 x	− 4.2	D orig. obsn	3	BP	—	On S side of 2nd contour ~~[illegible]~~ 190.5
"	" 30		192.6	+1.4	D	8°	C	—	Orig. Obsn in Bache Rec. Bk.
185	April 18	08 „ 33	{207.5 13 „ 52	−11.7 −11.5	D	8,3	C	good	208.0 extends 35° to W & very little to E
186	" 19	08 „ 44	208.9 13 „ ~~50~~ 57	− 9.8 −10.	D	—	B P	good?	207.5
"	" "	08 „ 47	207.3	−11.5	D	9.0	BP ?	" ?	
187	" "	09 „ 18	206.5	−10.6	D	2 ?	BP	" ?	
188	" 20	08 „ 50	13 „ 58	−11.3	D	—	BP	" ?	209.5
"	" "	09 „ 13	13 „ 57	−12.1	D	2,6	BP	" ?	209.2+
189	" "	09 „ 44	13 „ 59	−10,2	P	—	BP ?	—	209.8−
"	" "	09 „ 52	210.0	−12,2	D	2,6	" ?	—	
190	" "	11 „ 56	209.1	−10.6	D	2.6 ?	BP	hard	
191	" 21	09 „ 06	14 „ 05	−12.5	D	2.0°	B P	good?	211.2+
special sheet	" 23	15 „ 50	214.7	− 9.5	D	9 —	" ?	—	
193	" 26	10 „ 00	217.6	−11,0	D	2,5	B.P.	" ?	
"	" "	15 „ 30	215,8	−11,6	D	3,2	" ?	" ?	
"	" "	15 „ 35	215,4	−11,6	D	—	" ?	" ?	
"	" "	15 „ 55	215,0	−11,9	D	—	BP	" ?	
"	" "	16 „ 03	215.0	−8.5	D	354°	" ?	hard	
"	" "	16 „ 23	216,2	−11.4	D	—	" ?	hard	

Jan 24 1894 copied

Jan 24, 1894

Gegenschein Observations

BP = DP = densest part.

Page	1892	Hour	Position		Diam	Part observed	Seeing	Obsr	Remarks.
194	May 2	—	224.0	-15.2	2.2?	DP?	good?	D	
"	" 4	14.25	223.6	-14.5	5.8	DP?	" ?	D	
"	" "	14.40	15.00	-15.9	—	DP	" ?	D	225.0 Elongated κ Virg. to ζ Lib. 10° wide
"	" "	14.56	224.6	-15.2	6.0	DP	" ?	D	D Portion symmetrical Out. P. elongated
195	" "	15.40	14.59	-15.3	7.2	" ?	" ?	D	224.8-
"	" "	16.09	227.0	-13.0	9.2	" ?	—	D	
197.	Aug 19	09.10	21.55	-15.0	3.0	B.P.	good?	D	329.8- Other contours 9° & 12° in diam.
"	" "	12.05	22.04	-12.3	3.0	B.P.	" ?	D	331.0 diam less dense part 7°
"	" "	14.10	22.10	-11.8	8.0	B.P.	poor	D	332.5 elongated E & W
"	" "	15.22	22.10	-11.8	10.0	B.P.	poor	D	332.5 " "
198	" 20	08.03	22.08	-12.0	—	" ?	hard	D	332.0 " to W
"	" "	12.03	22.05	-12.0	—	BP?	good?	D	331.2+
"	" "	14.54	22.11	-12.0	3.0	" ?	—	D	332.8- outer part 12° in diam
199	" 21	10.19	22.18	-14.1	5.0	BP	good?	D	334.5 " round & large 16° " "
"	" "	11.57	22.10	-11.8	4.0	" ?	" ?	D	332.5 " " as last obs.
"	" "	14.24	22.04	-12.1	3.5	BP	" ?	D	331.0 tail to East to κ Aquarii
200	" 29	14.12	22.36	-9.7	3.0	BP?	" ?	D	339.0 Circular

Note. All of the above positions expressed in Hours & Mins. are from Klein's Atlas (Epoch 1880) All positions expressed in degrees are from Heis. This latter does not refer to statement of R.A. in degrees under head of remarks, which is merely a reduction of hours already given into degrees. Epoch of Heis atlas 1855.

Hypotheses Nov. 22. 1893

1. Obsns on rapid change of position of tip of cone indicate a parallax
if we assume that the tip held a constant angular distance from sun, as seen from center of earth ~~for~~ for an hour or two in succession,

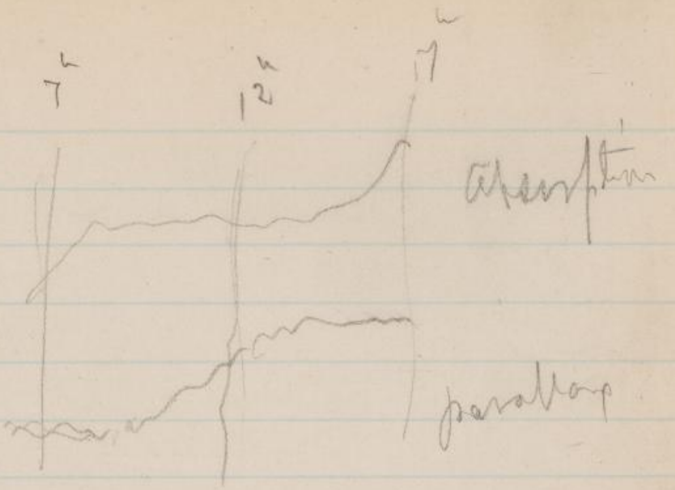
2nd. Obsns on "spreading out" of Gg. & Z. B. followed by appearance of cirrus clouds & thicker horizon ~~and~~ Indicate that atmospheric conditions affect these lights in some other way than by merely obscuring them
and the "spreading out" of the Z. L. on the horizon ~~may~~ may come under the same head
Querie: could this "spreading out" be an electrical illumination, or a variation in an electrical phenomenon causing or preceding atmospheric change

New Moon

1891
Aug $3^d.7$ 29.4
Sept 2.1 29.5
Oct 1.6 29.6
Oct 31.2

1892
Jan. 28.6 29.7
Feb. 27.3 29.6
Mar. 27.9 29.4
Apr. 26.3 29.3
May 25.6
June 23.9
July 23.2 29.4
Aug 21.6
Sept 20.1

1893
Jan. 17.1
Feb. 15.9
Mar. 17.6
Apr. 16.2
May 15.6
June 13.9
July 13.2
Aug. 11.5
Sept. 9.9
Oct. 9.4
Nov. 8.0
Dec 7.8



0
4
0 – 6 27
4 25
1 + 9 12
3 + 21
5
5 + 2 32
6 + 3 27
7 + 4 10
8 + 3 11
9 + 10 12
10 + 1 13
11 1 14
12 1 17
13 1 31.5
14 1 6
17 51 51 Sept 30.2

Lunation in Roman numeral
Night in Arabic "
Obsn in " in parentheses

Copy of Reduced Positions of the Arequipa Gegenschein Observations.

4 × 5 } 24 } Searle
4
−16

Reduced by Prof. Searle. – copied from his book – pg 38-9 &c

use '96 almanac →

	Obsr	Date 1891.	A.M.T.	G.M.T.	λ	Δλ	β	Loc. app Solar Time		Lunar Time	1.7	2.0
(1)	✓ 1 D	Aug 3.	11..50	16..35 ✓	310° 53'	+0° 15'	+0° 35'	11 44		+0.0	+.4	.0
(2)	✓ I 2 D	" 4	9..48	14..33 ✓	312 15	−0 07	−0 52	4 9 42		+0.9	−1.1	−1.4
	✓ 3 P	" "	10..40	15..25	312 15	−0 09	−0 52	10 34		+ "	−1.1	−1.4
(3)	✓ 4 D	" 8	11..00	15..45 ✓	316 03	−0 11	+0 30	10 55		+5.0	+0.5	−0.1
(4)	✓ ~~5 D~~	~~" 21~~	~~7..45~~	~~12..30 ✓~~	~~328 59~~	~~+0 22~~	~~−0 07~~	~~7 42~~		~~−11.6~~		
(5)	II 6 D	" 30	14..20	19..05 ✓	336 18	+0 18	+0 18	2 14 20		−2.3	+0.8	+0.6
(6)	✓ 7 D	Sept 24	8..10	12..55 ✓	2 07	+0 26	−0 31	8 18		−7.1	+0.7	+0.6
	✓ 8 D	" "	10..20	15..05	5 09	+3 23	−2 22	10 28		−6.9	−1.2	−1.2
	✓ 9 D	" "	10..40	15..25	3 20	+1 33	−0 43	10 48		"	+0.5	+0.5
	✓ 10 D	" "	10..47	15..32	5 09	+3 22	−2 22	10 55		"	−1.2	−1.2
	✓ 11 D	" "	11..00	15..45	3 46	+1 59	−0 28	11 08		"	+0.7	+0.7
	✓ 12 D	" "	12..48	17..33	1 49	−0 03	−0 43	12 56		"	+0.5	+0.4
(7)	✓ 13 D	" 25	12..26	17..11 ✓	4 55	+2 04	−1 37	12 35	~~2.6~~	−5.9	−0.4	−0.4
	III ✓ 14 D	" "	12..45	17..30	6 03	+3 13	−2 00	12 54	"	"	−0.8	−0.7
	✓ 15 D	" "	13..30	18..15	4 45	+1 53	−1 59	13 39	2.5	−5.8	−0.8	−0.8
	✓ 16 D	" "	13..40	18..25	4 56	+2 03	−2 04	13 49	"	"	−0.9	−0.9
(8)	✓ ~~17 D~~	" 27	~~7..42~~	~~12..27 ✓~~	~~6 46~~	~~+2 10~~	~~−3 38~~	~~7 51~~		~~−4.1~~		
	✓ 18 D	" "	9..05	13..50	5 15	+0 36	−2 52	9 14	2.6	−4.0	−1.7	−1.7
	✓ 19 D	" "	10..08	14..53	7 34	+2 53	−1 48	10 17	2.5	"	−0.5	−0.5
	✓ 20 D	" "	11..18	16..03	7 03	+2 18	−2 13	11 27	2.6	−3.9	−0.9	−0.9
	✓ 21 D.	" "	11..25	16..10	4 45	0 00	−1 59	11 34	"	"	+0.8	−0.8
	✓ 22 D	" "	12..22	17..07	6 07	+1 21	−3 53	12 31	"	"	−2.7	−2.6
	✓ 23 D	" "	13..05	17..50	6 30	+1 41	−0 28	13 14	"	"	+0.7	+0.8
	✓ 24 D	" "	14..20	19..05	5 53	+1 01	−1 24	14 29	2.7	−3.8	−0.2	−0.1
	✓ 25 D	" "	15..10	19..55	5 08	+0 14	−0 38	15 19	"	"	+0.6	+0.6

25 Obsns

Copy of Reduced Positions of Arequipa [illegible] observations.

		Obsr		Date 1891.	A.M.T.	G.M.T.	λ	Δλ	β	Loc. app. Sidereal time	(1.7)	(2.0)	Lunar Time
(9)	✓	26	D	Sept 29	8..30	13..15 ✓	005° 44′	−0° 52′	−2° 44′	8 40	−1.5	−1.4	2.0
	✓	27	D	" "	8..30	13..15	4 03	−2 33	−0 36	8 40	+0.6	+0.6	"
III	✓	28	D	" "	12..10	16..55	8 30	−1 47	−1 25	12 20	−0.2	−0.5	1.9
	✓	29	D	" "	12..14	16..59	6 21	−0 22	−0 50	12 24	+0.4	+0.5	"
	✓	30	D	" "	12..25	17..10	6 21	−0 25	−0 50	12 35	+0.4	+0.5	"
(10)	✓	31	D	" 30	10..30	15..15 ✓	9 08	+1 28	−3 13	10 40	−1.9	−1.9	0.9
	✓	32	D	" "	10..45	15..30	5 32	−2 09	−1 27	10 55	−0.2	−0.1	"
				~~Feb 21~~ 1892		~~13..23~~	~~150 13~~	~~−0 42~~	~~+4 33~~				
				~~Feb 22~~		~~16..55~~	~~151 27~~	~~−2 38~~	~~+4 35~~				
											(1.7)	(2.0)	
(11)	✓	33	P	Oct. 1.	9..25	14..10 ✓✓	3 46	−4 50	−3 45	9 36	−2.6	−2.6	+ 0.0
	✓	34	D	" "	12..45	17..30	10 18	+1 32	−1 12	12 56	+0.1	+0.2	+ 0.1
	✓	35	J	" "	15.— prob. 00^m	19..45	12 53	+4 03	−2 04	15 11 ±	−0.7	−0.7	+ 0.2
(12)	✓	36	P	" 2	9..25	14..10 ✓	7 30	−2 05	−2 11	9 36	−0.9	−0.9	+ 1.0
	✓	37	D	" "	12.10 (or less)	16..45	8 59	−0 42	−0 45	12 21 or	+0.5	+0.5	+ 1.1
	• ✓	38	D	" "	12..50?	16..59	9 29	−0 13	−0 52	13 01 ?	+0.4	+0.4	"
	✓	39	J	" "	15. 00?	19..45	7 30	−2 19	−2 44	15 11 ?	−1.4	−1.4	+ 1.2
(13)	✓	40	P	" 3	9.30	14..15 ✓✓	8 19	−2 15	−0 48	9 41	+0.5	+0.5	+ 2.0
	✓	41	D	" "	12..45	17..30	11 50	+1 08	+0 06	12 56	+1.4	+1.5	+ 2.1
	✓	42	J	" "	15..00	19..45	14 51	+4 03	−1 43	15 11	−0.3	−0.2	+ 2.2
(14)	✓	43	D	" 4	8..15	13..00 ✓✓	15 24	+3 54	−2 30	8 26	−1.1	−1.0	+ 3.0
	✓	44	D	" "	9..00	13..45	11 27	−0 05	−1 03	9 11	+0.3	+0.4	"
	✓	45	P	" "	9..15	14..00	8 41	−2 52	−1 42	9 26	−0.4	−0.4	"
	✓	46	D	" "	10..30	15..15	13 31	+1 53	−1 35	10 41	−0.2	−0.1	+ 3.1
	✓	47	P	" "	10..42	15..27	10 38	−0 58	−0 55	10 53	+0.4	+0.5	"
	✓	48	D	" "	10..48	15..33	13 45	+2 08	−1 02	10 59	+0.4	+0.5	"
	✓	49	D	" "	12..28	17..13	12 25	+0 44	−2 06	12 39	−0.7	−0.7	"
	✓	50	P	" "	12.28	17.13	11 34	−0 07	−0 47	"	+0.5	+0.6	"
	✓	51	D	" "	14..37	19.22	11 26	−0 20	−2 08	14 48	−0.8	−0.7	+ 3.2
	✓	52	D	" "	15..30	20..14	7 54	−3 54	−2 02	15 41	−0.7	−0.7	3.3

51 | 23° 196′
60
1380 51 | 1576
Δλ = 31′

51 | 406° 1566′
357
49
60
2940 51 | 4206 426
88
λ = 8° 28′

Loc. app. β = 1° 43′

	III	Nr	Date 1891	A.M.T.	G.M.T.	(1.7)	λ	Δλ	β	Loc. app. Sol. Time	Lunar Time	(2.0)
√ (15)		53 D	Oct 5	12.00	16.45 √	-0.5	14° 19′	+1° 40′	-1° 56′	12 12	+ 4.1	-0.4
√ (16)		54 D	" 6	12.23	17.08 √	-1.4	13 58	+0 19	-2 46	12 35	+ 5.1	-1.3
√ (17)		55 D	" 7	11.50	16.35 √	-1.3	16 11	+1 34	-2 43	12 02	+ 6.1	-1.2
√ (18)		56 D	" 8	12.20	17.05 √	-0.5	14 19	-1 19	-1 56	12 33	+ 7.1	-0.4
√ (19)		57 D	" 11	14.10	18.55 √	+0.1	18 30	-0 10	-1 31	51 14 23	+ 10.2	+0.1
√ (20)	IV	58 D	" 19	8.05	12.50 √	+0.9	21 58	-4 24	-0 38	8 20	~~+7.9~~ -11.7	+1.0
√ (21)		59 D	" 21	9.50	14.35 √	+0.3	27 56	-0 29	-1 09	10 05	-9.6	+0.5
√ (22)		60 D	" 22	8.20	14.05 √	+0.4	28 53	-0 31	-1 05	3 8 36	"	+0.7
		~~D~~	~~" "~~	~~10.20~~			26			57′4		

1892.

√ (23)	V	61 D	Feb 21	8.38 √	13.23	+4.0	150° 13′	-0 42	+4 33	8 24	-5.7	+4.5
√ (24)		62 D	" 22	12.10 √	16.55	+4.0	151 27	-2 38	+4 35	2 11 56	-4.6	+4.5
√ (25)	VI	63 D	Mar 29	12.33 √√	17.18	+2.3	188 09	-1 50	+3 46	12 28	+1.8	+2.5
		64			17.18	-1.2	191 29	+1 30	+0 17	3		-1.1
√ (26)	#	65 D	" 30	15.14 √	19.59	+4.8	191 35	+0 30	+6 16	15 10	+2.9	+4.9
√ (27)	VII	66 D	Apr. 18	08.33 √	13.18	-2.2	210 14	+0 47	-0 21	8 34	-7.7	-2.2
√ (28)		67 D	" 19	8.44 √√	13.29	+0.1	210 51	+0 25	+1 55	8 45	-6.7	+0.1
√		68 D	" "	8.47	13.32	-2.0	209 58	-0 28	-0 14	8 48	"	-2.0
√		69 D	" "	9.18	14.03	-1.5	208 56	-1 31	+0 20	9 19	"	-1.5
√ (29)		70 D	" 20	8.50 √	13.35	-1.1	211 34	+0 10	+0 42	8 51	-5.7	-1.1
√		71 D	" "	9.13	13.58	-1.9	211 34	+0 09	-0 08	9 14	"	-1.9
√		72 (only P)	" "	9.44	14.29	+0.1	211 28	+0 02	+1 53	9 45	"	+0.1
√		73 D	" "	9.52	14.37	-1.8	212 41	+0 14	+0 02	9 53	"	-1.8
√		74 D	" "	11.56	16.41	-0.6	211 19	-0 13	+1 14	11 57	-5.6	-0.6
√ (30)		75 D	" 21	9.06 √	13.51	-0.2	213 32	+1 09	+1 34	9.07	-4.7	-0.2
√ (31)		76 D	" 23	15.50 √	20.35	+2.4	216 08	+1 31	+4 09	15 52	-2.4	+2.3
√ (32)		77 D	" 26	10.00 √	14.45	+1.8	219 17	+1 59	+3 37	10 02	+0.3	+1.7
√		78 D	" "	15.30	20.15	+0.7	217 51	+0 20	+2 30	15 32	+0.6	+0.6
√		79 D	" "	15.35	20.20	+0.6	217 28	-0 03	+2 22	15 37	"	+0.5
√		80 D	" "	15.55	20.40	+0.2	217 12	-0 20	+1 57	15 57	"	+0.1

Copy of Reduced Positions of Arequipa Gegen-schein Observations.

			Obs'd	Date 1892		A.M.T.	G.M.T.	λ	Δλ	β	Loc. Time	Lunar Time
(32)	✓	VII	~~81~~	~~Apr.~~	~~26~~	~~16.03~~	~~20h.48m~~	~~216° 05′~~	~~−1° 27′~~	~~+5° 10′~~	~~16 05~~ ✓	~~3~~ +0.6
	✓		~~82~~	~~″~~	~~″~~	~~16.23~~	~~21.08~~	~~218 09~~	~~+0 38~~	~~+2 49~~	~~16 25~~ ✓	~~—~~ ″
(33)	✓		~~83~~	~~May~~	~~2~~	16-(?) ✓	~~19.10~~	~~226 32~~	~~+3 14~~	~~+1 30~~	~~16 03~~ ✓	~~+6.5~~
(34)	✓		84	″	4	14.25 ✓	19.10	225 58	+0 44	+2 04	14 28 ✓	+8.5
	✓		85	″	″	14.40	19.25	227 19	+2 05	+1 06	14 43 ✓	″
	✓		86	″	″	14.56	19.41	227 06	+1 51	+1 40	14 59 ✓	″
	✓		87	″	″	15.40	20.25	226 57	+1 40	+1 38	15 43 ✓	+8.6
	✓		~~88~~	~~″~~	~~″~~	~~16.09~~	~~20.54~~	~~228 43~~	~~+3 25~~	~~+4 26~~ 23)	~~16 12~~ ✓	″
(35)	✓	VIII	89	Aug.	19.	9.10 ✓✓	13.55	326 51	−0 37	−2 32	9 07 ✓	−2.0
	✓		90	″	″	12.05	16.50	328 52	+1 17	−0 23	12 02 ✓	−1.9
	✓		91	″	″	14.10	18.55	330 25	+2 45	−0 26	14 07 ✓	−1.8
	✓		92	″	″	15.22	20.07	330 25	+2 42	−0 26	15 19 ✓	−1.7
(36)	✓		93	″	20	8.03 ✓✓	12.48	329 52	+1 29	−0 33	8 00 ✓	−1.1
	✓		94	″	″	12.03	16.48	329 10	+0 47	−0 10	12 00 ✓	−0.9
	✓		95	″	″	14.54	19.39	330 38	+1 58	−0 44	14 51 ✓	−0.8
(37)	✓		96	″	21	10.19 ✓✓	15.04	331 26	+1 59	−3 18	10 16 ✓	+0.0
	✓		97	″	″	11.57	16.42	330 25	+0 54	−0 26	11 54 ✓	+0.1
	✓		98	″	″	14.24	19.09	328 56	−0 41	−0 12	14 21	+0.2
(38)	✓		99	″	29	14.12 ✓	18.57	337 09	+0 11	−0 48 11	14 11	+8.2

19 obs
28
27
25
99 obs 38 nights

99

The copying of each number in above list has been checked.

Continued on page 54

1.7°	2.0°
+0.3	+0.1
−0.7	−0.9
−0.1	−0.3
−0.2	−0.4
−2.2	−2.5
−0.1	−0.3
0	−0.3
0	−0.3
~~+~~ −0.2	−0.5
+0.1	−0.1
−0.3	−0.6
−2.9	−3.2
0	−0.3
+0.1	−0.1
−0.2	−0.4

Long. 4h 44m 31s
Use 94 almanac

SST to Loc M T
add 15.5m

Blue Hill Observations. 1893.

from Heis.

	Obs	Date. 1893.	E.S.T.		G.M.T.		R.A.	Dec.	
			H	M	H	M			
9 ~~+13~~ +29	D	Oct. 10	12	21	17	21	15.0°	+ 5.6°	
	"	"	13	10	18	10	17.0	+ 5.0	
	D	" 11	9	50	14	50	14.0	+ 5.0	Early
~~+13~~ +29	"	"	10	15	15	15	21.0	+ 6.1	
	"	"	12	25	17	25	18.5	+ 5.0	
	"	"	13	20	18	20	17.2	+ 5.0	
	"	"	13	44	18	44	14.7	+ 5.3	
	"	"	14	55	19	55	14.7	+ 5.3	30 obns.
~~+14~~ +29	D	" 12	7	41	12	41	19.2	+ 5.3	
	"	"	8	06	13	06	14.2	+ 6.0	
	"	"	8	23	13	23	15.0	+ 5.0	
	"	"	9	09	14	09	15.0	+ 5.0	
	"	"	12	39	17	39	15.0	+ 5.0	
	"	"	12	40	17	40	15.5	+ 5.2	

14

See pages 54-7

λ	Δλ	β	Local Time off sol	Lunar Time	Hel Long
16.0°	-2.1	-0.7°	12 50	1.3	18.1
17.5	-0.7	-2.0	13 39	1.4	18.2
14.8	-4.2	-0.9	10 19	2.2	19.0
21.6	+2.6	-2.5	10 44	"	"
19.0	-0.1	-2.6	12 54	2.3	19.1
17.8	-1.4	-2.1	13 59	2.4	19.2
15.6	-3.6	-0.9	14 13	"	"
15.6	-3.6	-0.9	15 24	"	"
19.7	-0.2	-2.6	8 10	3.1	19.9
15.4	-4.5	-0.0	8 35	"	"
15.8	-4.2	-1.3	8 52	3.2	20.0
15.8	-4.2	-1.3	9 38	"	"
15.8	-4.3	-1.3	13 08	3.3	20.1
17.4	-2.7	+1.4 14	13 09	"	"
14) 97.8	14) 33.2	14) -17.7			
17.0	-2.4	-1.26	(cc)	(cc)	(cc)

Western Observations. 1894.

	XI	Star	Locality	Date 1894	Loc. Time	G.M.T.	R.A.	Dec	Diam.
(57)		137 D	Halstead. Kan.	March 5.	8h 22m	14 52	171.0	+2.0	3°.5
(58)		138 D	Las Vegas N.M.	" 6	8 11	15 12	170.4	+3.6	2.5
		139 "	Blanchard "	= "	9 30	16 32	168.8	+4.3	Bright
(59)		140 D	Benson A.T.	" 7	8 41	16 02	171.2	+2.7	2.5
(60)		141 D	Tombstone "	" 8	10 20	17 40	172.8	+5.2	3.7
(61)		142 D	" "	" 9	10 24	17 44	172.4	+4.5	8°.0 Elong E-W
(62)		143 D	" "	" 10	11 05	18 25	171.–	+4.–	
(63)		144 D	Tucson "	" 11	10 06	17 30	171.–	+4.–	
(64)	XII	145 D	Phoenix "	" 26	10 52	18 20	187.2	–5.1	3.2
(65)		146 D	Prescott "	" 29	10 05	17 35	193.0	–3.6	4.6
(66)		147 D	" "	April 1	8 35	16 05	194.0	–4.8	9.1
(67)		148 D	Flagstaff "	" 6	9 58	17 25	195.7	–7.3	7.7
(68)		149 D	" "	" 7	9.28	16 55	198.5	–9.0	6.0
(69)	XIII	150 D	" "	" 29	8 21	15 48	217.0	–14.0	early 8.7
(70)		~~151 D~~	~~" "~~	~~May 4~~	~~8 20~~	~~15 47~~	~~207.7~~	~~–9.9~~	~~early 4.8~~
(71)		~~152 Rousse~~	~~" "~~	~~" 5~~	~~11 40~~	~~19 07~~	~~217.3~~	~~–9.3~~	~~E-W 12° N-S 5°~~
		~~"~~	~~" "~~	~~"~~	~~11 53~~	~~19 20~~	~~218.7~~	~~–10.0~~	~~8.0~~
		~~"~~	~~" "~~	~~"~~	~~"~~	~~"~~	~~208.0~~	~~–8.0~~	~~5.0~~
		~~"~~	~~" "~~	~~"~~	~~11 58~~	~~19 25~~	~~230.–~~	~~–21.–~~	~~4~~
		~~"~~	~~" "~~	~~"~~	~~"~~	~~"~~	~~212~~	~~–10~~	~~4~~
		~~"~~	~~" "~~	~~"~~	~~12 13~~	~~19 40~~	~~228.–~~	~~–17.5~~	~~5°~~
(72)		~~153 "~~	~~" "~~	~~" 6~~	~~11 53~~	~~19 20~~	~~218.7~~	~~–10.0~~	~~8°~~
		~~154 "~~	~~" "~~	~~" "~~	~~11 53~~	~~19 20~~	~~208.–~~	~~–8.–~~	~~5°~~
(73)		~~155 R~~	~~" "~~	~~" 9~~	~~11 58~~	~~19 25~~	~~230~~	~~–21~~	~~4~~
		~~156 "~~	~~" "~~	~~" "~~	~~11 58~~	~~19 25~~	~~212~~	~~–10~~	~~4~~
(74)		157 R	" "	" 10	12 13	19 40	228	–17.5	5

Halstead, Kan.	6h 30m W	38° 00′ N	Tucson A.T.	7h 24m W	32° 18′ N
Las Vegas N.M.	7 01 "	35 30	Tempe "	7 28	33 28
Blanchard. "	7 02 "	35 12	Phoenix "	7 28	32 28
Benson A.T.	7 21 "	31 58	Prescott "	7 30	34 32
Tombstone "	7 20 "	31 40	Flagstaff "	7 27	35 12

λ - 0°5	Δλ Scale	β	II Loc. app. Sol. time H M	IV Lunar Time d	III Hel. Long Earth	for absorp	1°7	2°0	
170.9 171.5	+ 5.~~8~~9 ✓	-1.6 1.7	8-10	-1.5	165.5°	✓	-2.7	-2.4	
169.8 ✓	+ 3.~~5~~8 ✓	-0.7 0.5	8 00	-0.5	166.5	✓	-1.8	-1.5	
168.1 ✓	+ ~~1.5~~ 2.0 ✓	-0.5 ✓	9-~~10~~ 19	-0.4	166.6	✓	-1.6	-1.3	
170.8 171.3	+ 3.~~2~~7 3.8	-1.0 ✓	8-30	+0.6	167.6	✓	-2.1	-1.8	
171.4 ✓	+ ~~2.8~~ 3.3 3.2	+1.9 ✓	10-09	+1.6	168.6	✓	+0.8	+1.1	
171.3 ✓	+ ~~1.7~~ 2.2 2.1	+1.1 ✓	10-13	+2.7	169.6	✓	0	+0.3	
170.1 ±	- ~~0.6~~ .1	+0.1 ±	10-55	+3.6	170.7	∼	-1.0	-0.7	
170.1 ±	- ~~1.1~~ 0	+0.1 ± 8	~~10~~ 9-56	+4.6	171.6	✓	-1.0	-0.7	
9, 188.6 188.7	+ 2.~~8~~5	-1.8 ✓	10-46	-9.9	186.6	✓	-3.3	-3.1	
193.4 ✓	+ ~~3.9~~ 4.4 ✓	+ 1.8 ✓	10-00	-7.0	189.5	✓	+0.2	+0.3	
194.8 ✓	~~+7.6~~ +2.~~8~~9 ✓	+ 1.1 ✓	8-31	-4.0	~~202~~ 192.4	✓	-0.5	-0.4	
197.3 ✓	~~-1.1~~ +0.4 ✓	-0.6 ✓	9-56	+1.0	197.4	✓	-2.2	-2.2	
200.5 ✓	+ 2.~~8~~7 ✓	-1.1 ✓ 5	9-26	+2.0	198.3	✓	-2.8	-2.7	
219.2 219.8	~~+1.3~~ -0.~~8~~1 0.0	+0.6 ✓	8-~~18~~ 24	-5.4	~~220.5~~ 219.8	✓	-1.2	-1.3	
~~209.3~~	~~-15.~~ 14.9	+1.4	8-~~17~~ 23	-0.4	224.7	Omit			X
217.9 218.5	- 7.~~8~~3 7.1	+5.1 45.2	11-~~37~~ 43	+0.7	225.7	✓			?
~~219.5~~		~~[illegible]~~							
			thus cor. just disc.						
219.5	- ~~7.8~~ 6.7 6.6	+4.9 ✓	11-~~49~~ 57	+1.7	226.7	✓			
208.9 ± ✓	-17.~~8~~3	+3.2 3.3 ±	11-~~49~~ 57	"	"	✓			
233.1 ±	+ ~~3.5~~ 4.0 ✓	- 2.6 5 ±	~~11-54~~ 12 02	+4.7	229.6	✓			
213.2 ±	- ~~16.7~~ 5.9 8	+2.8 ±	"	"	"	0			X
230.4 ✓	~~-0.8~~ +0.3	+0.3 ✓ ⑧6	12-~~09~~ 17	+5.7	230.6	✓	-1.5	-1.7	

New Moon 1894

Jan 6.6	May 5.1
Feb 5.4	June 3.4
Mar 7.1	July 2.7
Apr 5.7	Aug 1.0

for Flag. 7 27
we use 7 00
so subtract 27m

Flagstaff Observations. 1895.

m.st. 7, or r – 41

	Obs	Date 1895.	M. St. Time		G.M.T.		R.A.	Dec.	Diam.
			H	M	H	M			
	~~D~~	~~Feb. 21~~	~~8~~	~~58~~	~~15~~	~~58~~	~~137~~ ~~155.5~~	~~+17~~ ~~+11.0~~	~~as on Feb. 20.~~
	~~"~~	~~"~~	~~11~~	~~46~~	~~18~~	~~46~~	~~156.0~~	~~+14.0~~	
			~~"~~		~~"~~		~~155.5~~	~~+11.0~~	
			H.	M.	H.	M.			
(75) ~~XIV~~ 14	158 D	Feb 19	12	08 .41	19	08	154.0	+ 11.0	4°
(76)	~~159 D~~	~~" 21~~	~~8~~	~~58~~	~~15~~	~~58~~	~~137~~	~~+17~~	
	160 "	" "	"		"		155.5	+ 11.0	(as on ~~Feb. 20~~) omit.
	161 "	" "	11	46	18	46	156.0	+ 14.0	
	162 "	" "	"		"		155.5	+ 11.0	
(77) XV	~~163 D~~	~~March 17~~	~~11~~	~~17 .35~~	~~18~~	~~17~~	~~171.0~~	~~+5.4~~	~~13~~
	164 "	"	11	42	18	42	174.2	+ 3.0	4
(78)	165 "	19	11	56	18	56	178.0	+ 4.0	4
(79)	166 "	20	12	35	19	35	180.9	+ 1.3	6
(80)	167 "	21	11	53 -34	18	53	183.0	+ 0.6	9
	168 "	"	12	42	19	42	183.0	+ 0.6	9
(81)	169 "	22	11	31	18	31	181.7	+ 1.0	6
	170 "	"	12	11	19	11	182.7	+ 1.7	7
(82)	171 "	23	10	00	17	00	184.2	+ 2.0	4
	172 "	"	13	05	20	05	183.1	+ 0.5	3
	173 "	"	15	24 -33	22	24	182.5	− 0.3	6
	174 "	"	16	04	23	04	184.0	+ 3.0	5
(83)	175 "	24	10	33	17	33	185.5	− 1.6	5
	176 "	"	10	39	17	39	182.9	− 2.2	5
(84)	177 "	27	12	08	19	08	187.1	− 1.9	5
(85)	178 "	28	11	37 -32	18	37	187.6	− 2.0	4
(86)	179 "	29	11	01	18	01	189.5	− 3.5	6
(87)	180 "	30	11	20 -31	18	20	191.0	− 3.8	6
Godfrey Sykes	181	"	"		"		189.0	− 1.2	4
~~Stanley Sykes~~	181A	~~"~~	~~"~~				~~190.4~~	~~+9.0~~	~~2 prob. N. Co.~~

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New Moon ~~Times~~ 1895.

	d	h	m			G.M.T. d	h	Period d
Jan.	25	01	17	29	19½	Jan. 25.4	09.3	29.8
Feb.	23	20	34	29	18½	Feb. 24.2	04.6	29.8
Mar.	25	14	16	29	15½	Mar. 25.9	22.3	29.7
Apr.	24	05	02	29	11	Apr. 24.5	13.0	29.5
May	23	16	27			May 24.0	00.4	

λ − 0°.6	Δλ ~~[illegible]~~	β	Local app. Solar time		Lunar time days	(1°.7)	Hel. Long. Earth		(2°.0)
152.0	+ ~~0.6~~ 1.2	+0.2	11	27	−4.4	−0.5	151.4	✓	0.0
~~134.4~~	~~−18.4~~ 8.3	~~+0.5~~	~~8~~	~~17~~	~~−2.5~~		~~153.3~~	δ	✕
153.4	+ 0.~~4~~7	+0.8	″		″	+0.1	″	✓	+0.6
152.7	− 0.~~7~~1	+3.7	11	05	−2.4	+3.0	153.4	✓	+3.5
153.4	+ ~~0.0~~ 0.6	+0.8 ⑤4	″		″	+0.1	″	✓	+0.6
~~169.6~~	~~−7.9~~ 8	~~+1.4~~	~~10~~	~~42~~	~~−8.2~~		~~177.5~~	✓	
173.5	− ~~4.0~~ 3.4	+0.5	11	07	″	−0.7	″	✓	−0.4
176.6	− ~~2~~3.9	+2.9	11	21	−6.2	+1.6	179.5	✓	+1.9
180.3	~~−0.1~~ +0.5	+1.5	12	01	−5.2	+0.2	180.4	✓	+0.4
182.5	+ 1.~~4~~7	+1.7	11	19	−4.2	+0.3	181.4	✓	+0.5
182.5	+ 1.~~4~~7	+1.7	12	08	″	+0.3	″	✓	+0.5
181.2	− ~~1.2~~ 0.6	+1.6	10	57	−3.2	+0.2	182.4	✓	+0.5
181.8	− 0.~~6~~0	+2.6	11	37	″	+1.2	″	✓	+1.5
183.0	~~−~~+0.3	+3.5	9	27	−2.3	+2.1	183.3	✓	+2.3
182.6	− 0.~~8~~2	+1.7	12	32	−2.2	+0.3	183.4	✓	+0.5
182.4	− ~~1.1~~ 0.5	+0.7	14	51	−2.1	−0.7	183.5	✓	−0.5
182.5	− ~~1.1~~ 0.5	+4.3	15	31	−2.0	+2.9	183.6	✓	+3.1
185.7	+ ~~1.4~~ 2.0	+0.7	10	00	−1.5	−0.7	184.3	✓	−0.6
183.6	− 0.~~7~~1	−0.9	10	06	″	−2.3	″	✓	−2.1
187.3	~~−0.1~~ +0.5	+1.1	11	36	+1.9	−0.4	187.4	✓	−0.2
187.8	− 0.~~6~~0	+1.2	11	05	+2.9	−0.3	188.4	✓	−0.1
190.1	+ ~~0.7~~ 1.3	+0.5	10	29	+3.9	−1.0	189.4	✓	−0.9
191.6	+ 1.~~3~~9	+0.9	10	49	+4.9	−0.6	190.3	✓	−0.5
189.1	− ~~1.2~~ 0.6	+1.5	″		″	0	″	✓	+0.2
~~185.9~~		~~+11.3~~							
180.5	−3.7	+11.3							

-27^m

Flagstaff Observations, 1895.

	Obs	Date 1895		M. St. Time H	M	Sid. T. H	M	R. A.	Dec.	Diam &c	
(87) XV	182 D	(March)	(30)	14	15(?)	21	15	191.2°	-2.5°	3°	
(88)	183 "		31	12	37 -31	19	37	193.8	-3.4	8	
(89)	184 "	April	1	14	15	21	15	192.0	-2.2	+	
	185 "	"	"	14	28	21	28	192.0	-2.2	3	
J. C. Evans.	186	"	"	"		"		192.0	-2.2	—	
(90)	187 D	"	2	14	12 -30	21	12	194.1	-5.0	3	moon barely set
(91) XVI	188 "	"	14	10	10	17	10	204.0	-8.0	3	watch had been set ahead 5^m & now prob. 1^m slow.
(92)	189 "	"	15	11	39	18	39	208.2	-9.4	7	
	190 "	"	"	12	15 -27	19	15	206.2	-9.7	5	
(93)	191 "	"	16	10	12	17	12	208.1	-8.0	7	low in E
	192 "	"	"	11	12	18	12	208.8	-10.0	4	
	193 "	"	"	12	09 —	19	09	206.6	-10.0	7	
(94)	194 "	"	17	9	23 -26	16	23	209.3	-10.1	4	
	195 "	"	"	11	48	18	48	207.3	-10.0	6	
(95)	196 "	"	18	11	40	18	40	210.0	-10.0	8	
(96)	197 "	"	19	11	33	18	33	210.7	-10.0	4	
(97)	198 "	"	20	10	48	17	48	212.1	-10.2	6	
(98)	199 "	"	21	12	30 —	19	30	213.0	-11.0	10	
(99)	200 "	"	22	11	50 -25	18	50	212.1	-11.2	2	
	201 "	"	"	13	55	20	55	211.1	-12.8	2	
(100)	202 "	"	23	11	45	18	45	21[illegible].6	-12.6	3	
(101)	203 "	"	24	11	(11^h to 12^h) 30	18	30	213.6	-12.5	4	
(102)	204 "	"	25	10	10	17	10	214.4	-11.1	5	
	205 "	"	"	11	03	18	03	214.4	-11.1	5	
	206 "	"	"	11	03	18	03	214.9	-11.8	1	
(103)	207 "	"	26	11	32 —	18	32	217.5	-12.8	7	
(104)	208 "	"	27	11	00 -24	18	00	220.9	-9.5	4	
(105)	209 "	"	28	11	55	18	55	221.4	-11.1	5	

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λ−0°.6	Δλ [illegible]	β	Loc. app. Sidereal time			Lunar Time	(1.7)	Hel. Long.		(2°) n
191.3	+ 1.5 ~~0.9~~	+2.1		13	44	+ 5.0	+0.6	190.4	✓	+0.7
194.0	+ 3.3 ~~2.7~~	+2.3		12	06	+ 5.9	+0.8	191.3	✓	+0.8
191.9	+0.1 ~~−0.5~~	+2.7		13	44	+ 7.0	+1.2	192.4	✓	+1.3
191.9	+0.1 ~~−0.5~~	+2.7		13	57	"	+1.2	"	✓	+1.3
191.9	+0.1 ~~−0.5~~	+2.7		"		"	+1.2	"	✓	+1.3
194.9	+ 2.1 ~~1.5~~	+0.9	25	13	42	+ 8.0	−0.7	193.4	✓	−0.6
205.2	+ 8.8 ~~8.2~~	+1.8		9	43	−9.8	+0.1	205.0	✓	+0.1
209.5	+ 4.0 ~~3.4~~	+2.0		11	12	−8.7	+0.2	206.1	✓	+0.2
207.8	+ 2.3 ~~1.7~~	+1.0		11	48	"	−0.7	"	✓	−0.7
208.9	+ 2.6 ~~2.0~~	+3.3		9	45	−7.8	+1.5	206.9	✓	+1.5
210.3	+ 3.9 ~~3.3~~	+1.7		10	45	"	−0.1 ~~[illegible]~~	207.0	✓	−0.1
208.2	+ 1.8 ~~1.2~~	+0.9		11	42	−7.7	−0.8	"	✓	−0.9
210.8	+ 3.5 ~~2.9~~	+1.7		8	57	−6.8	−0.1	207.9	✓	−0.1
208.8	+ 1.4 0.8	+1.2		11	22	−6.7	−0.5	208.0	✓	−0.6
211.4	+ 3.0 ~~2.4~~	+2.1		11	14	−5.7	+0.3	209.0	✓	+0.3
212.0	+ 2.6 ~~2.0~~	+2.4		11	07	−4.7	+0.6	210.0	✓	+0.6
213.4	+ 3.2 ~~2.6~~	+2.6		10	22	−3.8	+0.8	210.8	✓	~~+0.8~~
214.5	+ 3.2 ~~2.6~~	+2.2		12	04	−2.7	+0.4	211.9	✓	+0.3
213.7	+ 1.4 ~~0.8~~	+1.6		11	25	−1.7	−0.2	212.9	✓	−0.2
213.4	+ 1.0 ~~0.4~~	−0.2		13	30	−1.6	−2.0	213.0	✓	−2.0
214.7	+ 1.4 ~~0.8~~	+0.5		11	20	−0.7	−1.3	213.9	✓	−1.4
215.5	+ 1.3 ~~0.7~~	+1.1		11	05 (10.5^h−11.5^h)	+0.3	−0.7	214.8	✓	−0.8
215.8	+ 0.7 ~~0.1~~	+2.6		9	45	+ 1.2	+0.8	215.7	✓	+0.7
215.8	+ 0.6 ~~0.0~~	+2.6		10	38	+ 1.3	+0.8	215.8	✓	+0.7
216.5	+ 1.3 ~~0.7~~	+2.0		"		"	+0.2	"	✓	+0.1
219.3	+ 3.1 ~~2.5~~	+1.8		11	07	+ 2.3	0	216.8	✓	−0.1
221.4	+ 4.2 ~~3.6~~	+6.0 !		10	36	+ 3.3	+4.2	217.8	✓	+4.1
222.3	+ 4.2 ~~3.6~~	+4.6	22	11	31	+ 4.3	+2.8	218.7	✓	+2.7

(c = 95) (c = 95)

$6^h\ 36^m\ 26^s{,}67$

Mexico Observations, 1895

~~XVII~~	Obsr	Date, 1895	Loc. Time	G.M.T.	R.A.	Dec	Diam &c
(106)	210 D	May 20	11 50	18 26	234°.1	-18°.0	- 4°
(107)	211 "	" 21	12 20	18 56	234.3	-20.0	7°

2

λ − 0°.6	Δλ − 0°.6	β	Sd. Time	Loc. App. Lunar Time	Hel. Long.	(1.7)	(2.0)
236.1	−3.~~2~~3	+ 1.3	11 54	−3.2	240.0 ✓	−0.5	−0.7
236.7	−~~4.2~~ 3.7	− 0.6	2 12 24	−2.2	240.9 ✓	−2.4	−2.6
				cc	cc		

Flagstaff Observations. 1896.

	Obsr	Date, 1896.		Mt. St. Time		G.M.T.		R.A.	Dec.	Diam &c	
XVIII				H	M	H	M				
(108)	212 D	Sept.	10	9	35	16	35	348°.3	-5°.9	5°	
	213 "	"	"	12	13	19	13	348.8	-6.9	7	
(109)	214 "	"	11	11	50	18	50	353.0	-3.2	3	
(110)	215 "	"	12	11	27	18	27	354.0	-1.7	7	
(111)	216 "	"	13	10	55	17	55	354.8	-2.5	6	
	217 Dr. T. J. J. See	"	"	"		"		351.5	-4.0	20°	
	218 W. A. Cogshall	"	"	"		"		351.8	-3.7	8	
	219 D	"	~~13~~ "	13	30	20	30	352.4	-2.4	6	
(112)	220 "	"	14	12	30	19	30	355.9	-3.2	6	
(113)	221 "	"	15	14	12	21	12	360.0	-3.5	5	
	~~222 "~~	~~"~~	~~"~~	~~16~~	~~42~~	~~23~~	~~42~~	~~362.1~~	~~-2.4~~	~~6~~	~~(late)~~
(114)	223 "	"	17	15	15	22	15	362.8	-2.2	5	
(115) XIX	224 "	Oct	1	11	15	18	15	9.4	+2.4	8	
(116)	225 "	"	2	10	40	17	40	13.5	+3.0	4	
(117)	~~226 "~~	~~"~~	~~3~~	~~9~~	~~50~~	~~16~~	~~50~~	~~18.2~~	~~+4.9~~	~~4~~	
	227 "	"	"	13	12	20	~~50~~ 12	13.2	+5.4	4	crescent moon.
	~~228 "~~	~~"~~	~~"~~	~~16~~	~~21~~	~~23~~	~~21~~	~~12.6~~	~~+2.8~~	~~—~~	Seg. very low.
(118)	229 "	"	4	11	32	18	32	15.0	+4.0	5	
	230 "	"	"	11	38	18	38	15.0	+4.0	—	

19

Total 207

Beg on pg 31

16
2~~17~~
99

117 9
108
Lat.
not D
D

Counting pg 48

Early Oct. 1896. Made chart for changing RA + Dec to Long. (λ) + Lat. (β) or the reverse, correct within 0°.1 on coördinate paper reckoning 1/10 in = 0°.2.

Oct 13. Have taken 1h 50m to change 109 RA + Dec^s into Long.^s & Lat^s. = one per 1m

λ − 0°.6	Δλ − 0.6	β	Local app. Sol. Time Hour.	M	Lunar time. days.	Hel. Long. Earth.		1.7	2.0
347.0	−1.~~8~~3	−0.8	9	11	+3.6	348.9	✓	0	−0.1
347.0	−~~2.0~~ 1.4	−1.9	11	49	+3.7	349.0	✓	−1.1	−1.2
352.3	+2.~~8~~9	−0.2	11	27	+4.7	350.0	✓	+0.8	+0.7
353.8	+~~2.8~~ 3.4	+0.8	11	04	+5.7	351.0	✓	+1.8	+1.7
354.3	+~~2.7~~ 3.0	−0.3	10	32	+6.6	351.9	✓	+0.7	+0.6
350.6	−~~1.3~~ 0.7	−0.3	″		″	351.9	✓	+0.6	+0.5
351.0	−0.~~8~~3	−0.2	″		″	351.9	✓	+0.7	+0.6
352.1	+0.~~1~~7	+0.8	13	07	+6.7	352.0	✓	+1.8	+1.7
355.0	+2.~~1~~7	−1.3	12	08	+7.7	352.9	✓	−0.3	−0.3
358.6	+~~4.6~~ 5.2	−3.2	13	50	+8.8	354.0	✓	−2.1	−2.1
~~361.0~~	~~+6.9~~ 7.5	~~−3.0~~	~~16~~	~~20~~	~~+8.9~~	~~354.1~~	~~✓~~		
361.6	+~~5.6~~ 6.2	−3.1	12 ~~7~~ 14	54	+10.8	356.0	✓	−1.9	−2.0
9.6	+0.~~2~~6	−1.5	10	59	−4.6	9.6	✓	−0.2	−0.1
13.6	+3.~~1~~7	−2.5	10	24	−3.6	10.5	✓	−1.1	−1.0
~~18.6~~	~~+7.1~~ 7	~~−2.5~~	~~11~~ 9	~~34~~	~~−2.6~~	~~11.5~~	✓		#
14.2	+~~2.6~~ 3.2	−0.2	12	56	−2.5	11.6	✓	+1.2	+1.3
~~12.6~~	~~+0.8~~ 1.4	~~−2.4~~	~~16~~	~~05~~	~~−2.4~~	~~11.8~~	✓		
15.4	+~~2.8~~ 3.4	−2.2	11	16	−1.6	12.6	✓	−0.8	−0.7
15.4	+~~2.8~~ 3.4	−2.2	11	22	″	12.6	✓	−0.8	−0.7

Flagstaff Observatory. 1896,

XIX	Obsr	Date 1896		M.St. time		G.M.T.		R.A.	Dec	Diam. &c
				H	M	H	M	°	°	
(119)	231 D	Oct.	5	9	17	16	17	17.8	+5.0	7°
	232 ✓ "	"	"	10	30	17	30	14.8	+4.9	7
	233 "	"	"	15	23	22	23	14.9	+5.0	5
~~(120)~~	~~234 "~~	~~"~~	~~6~~	~~16~~	~~45~~	~~23~~	~~45~~	~~18.5~~	~~+3.9~~	~~5 very low in W.~~
(121)	235 "	"	7	10	13	17	13	17.0	+4.1	6
(122)	236 "	"	8	10	07	17	07	19.0	+4.0	7
(123)	237 "	"	9	10	02	17	02	18.2	+4.6	7
	238 "	"	"	13	32	20	32	16.8 ? ~~+7.0~~	+5.4 ~~+4.3~~	6
(124)	239 "	"	10	10	48	17	48	15.8	+4.5	4
(125)	240 "	"	15	14	11	21	11	21.0	+7.8	4
(126)	241 "	"	17	15	58	22	58	21.9	+7.8	5 low in west Moon barely set.

cc 96

For study of [illegible] do the following :–

1/. Plot $\Delta\lambda$ & β in terms of local app. Sol. time. 2 curves.
Dif. Bet. ang. & N. of Equat.

2/ " $\Delta\lambda$ & $\overline{\beta}$? " " " lunar time. 2 curves.
Dif. Bet. ang. & N. of Equat.

3/ " $\Delta\lambda$ & β " " " Earth's ~~Lunar~~ Heliocentric Long. 2 curves.
Dif. Bet. ang. & N. of Equat.

Continued on page 58

λ − 0°.6	Δλ − 0°.6	β.	Local app. Sun Time H. m	Lunar time days	(1.7)	Hel. Long Earth	(2.0)
18.3	+ ~~4.8~~ 5.4	−2.3	~~11. 05~~ 9 02	− 0.7	−0.9	13.5	✓ −0.7
15.5	+ 2.~~8~~ 6	−1.3	10. ~~18~~ 15	〃	+0.1	13.5	✓ +0.2
15.7	+ 2.~~8~~ 6	−1.3	15. ~~01~~ 08	− 0.5	+0.1	13.7	✓ +0.2
~~18.6~~	~~+ 3.9~~ 4.5	~~−3.6~~	~~16. 23~~ 30	~~+ 0.6~~		~~14.7~~	✓
17.3	+ ~~1.9~~ 2.5	−2.8	9. ~~51~~ 58	+ 1.3	−1.4	15.4	✓ −1.2
19.0	+ ~~2.6~~ 3.2	−3.7	9. ~~55~~ 53	+ 2.3	−2.2	16.4	✓ −2.1
18.5	+ 1.~~2~~ 7	−2.8	~~13. 14~~ 9 58	+ 3.3	−1.4	17.4	✓ −1.2
~~17.3 ?~~ 16.8	− 0.~~8~~ 2	~~−2.6 ?~~ −1.3 ?	13. ~~10~~ 18	+ 3.5 —	+0.1	17.6	✓ +0.2
16.3	− ~~2.1~~ 1.5	−2.0	10. ~~27~~ 34	+ 4.3	−0.6	18.4	✓ −0.5
22.3	− ~~1.2~~ 0.6	−0.9	13 58	+ 9.5	+0.6	23.5	✓ +0.8
23.2	− ~~2.3~~ 1.7	−1.2	18 · 15 46	+ 11.6	−0.3	25.5	✓ +0.5

A test for parallax E & W or absorption. Make seperate curve for each 5 Day

A test for effect of moon. Make seperate curve for each hour

A test for N & S parallax and orbit of Eq. both its inclination to ecliptic and its rate of motion.

8.
oct 5.5
29.~~8~~ 9
~~35~~ 35.9
31
4.0
nov

1st Draft – See page 60

~~Summary by Lunations~~

	No. Obs.ns		d	L.W.T.	Mean λ	Δλ	β
1	4	1891	Aug ~~5~~ 4.8	11h	312.9 ~~[illegible]~~	−0°.08	−0°.~~6~~2
2	2	"	" 25.5	11	~~[illegible]~~ 332.6	+0.3	+0.~~2~~1
3	51	"	Sept 30.2	11±	8.5	+0.5	−1.7
4	3	"	Oct 20.7	9	26.3	−1.8	−1.0
5	2	1892	~~Oct 20.7~~ Feb. 21.5	10	150.8	−1.7	+4.6
6	3	"	Mar. 29.3	13	190.4	+0.08	+3.4
7	23	"	Apr. 25.1	12±	217.25	+0.7	+1.8
8	11	"	Aug. 20.7	11	330.4	+1.1	−0.9
IX	7			12	355.9	+4.2	+1.2
X	30			11+	18.6	−0.9	−0.3
~~9~~	~~14~~	~~1893~~	~~Oct. 11.3~~	~~11~~	~~17.0~~	~~−2.4~~	~~−1.3~~
10	8	1894	Mar. 7.8	9	170.~~3~~8	+2.~~2~~5	−0.1
11	5	"	Apr. 1.4	10	~~194.9~~ 195.4	+2.~~1~~6	−0.1
12	~~8~~6	"	May. 6.0	11	219.~~2~~5	~~−3.4~~ 2.9	+2.0
13	~~5~~4	1895	Feb. 20.6	11	149.~~2~~8	0.0 +0.6	+1.2
14	25	"	Mar. 25.3	11+	185.~~2~~8	~~−0.5~~ +0.1	+1.7
15	22	"	Apr. 20.5	11	213.~~4~~7	~~+1.5~~ +2.1	+2.~~2~~4
16	2	"	May. 20.5	12	~~236.4~~ 237.0	~~−4.0~~ 3.4	+0.4 (0.35)
17	12	1896	Sept. 13.0	12	~~353.7~~ 354.3	~~+1.7~~ 2.3	−1.1
18	16	"	Oct. 6.4	12−	~~16.7~~ 17.3	~~+1.7~~ 2.3	−2.0
	218						

2.3

2.1

18) 300.9 (16.7
18
120
108
129

18) 36.7
−2°.04

18) 116 (6.4
108
80
72

51) 60° 1647′
β = 1° 43′

51) 2187
43′

60
9
540

23

11
60
660

321
660
23) 981 (43′
92
61

23) 33 535
1 × 10
60
600
606
23) 1135 (49′
92
215
207
8

12) +20.7
+1.7

11) 328 359
329° 540
11) 899
82′

8° 262
480
11) 742
67′

5 −298
300
11) 598
54′

0 × 1
3 × 1
6 × 1
11 × 1
12 × 1
5) 32

Mar 26 + 6.4 = Apr 1.4

25) 208
8.3
17
25.3

18) +31.0
+1.7

25) 129.6
185.2

25) +42.5
+1.7

25) +38.3
+1.5

22) 45.1
20.5

~~5) 280.0~~
~~1.6~~

5) 245.9
149.2

0 ×
5 ×
6 ×
7 × 2
7
10
10
11
8) 56
7.0

8) 151.8
219.0

8) 15.7
+2.0

12) −12.7
−1.06

12) 156
13.0

22) 45.5
+2.2

22) 289.2
2 13.148

12) 644.3
353.7

5) 104
+ 2

25) −13.4
−0.5

8) 15.8
+2.0

6) 20.1
−3.4

Train to Mexico. Nov. 5, 1896

Epoch Heis Atlas 1855,
Precession = 50¼" per year
" in 41 yrs = 34'.3' = 0°.6

The λ's are for 1855 and therefore to be reduced to 96 should have 0°.6 added for 95 & 96 and 0°.5 added for 91-4
This increases the + error of the Eq. to 1°.2

Checked last three columns throughout.

Nov. 10. From work up to date on the 238 Obsns I find the following:—

1. Plotting 238 Obsns on 8 sheets – Δλ & β to each sheet, & each sheet extending over 3 days of lunar time (-12^d to $+12^d$) There is no evident effect of position of moon.
2. From same sheets there was a suggestion of evidence of parallax in Δλ between 11^h and 13^h & of absorption before 10^h & after 14^h, but on taking numerical means for each hour no effect of hour appears except very bad values before 8^h & after 16^h of App. Sol. time.

Again (3) I am inclined to think that locations more than 4 or 5° out are confused with stellar light – They might be ensured in separate counts and

and included or excluded according to
their affect.

(4). Observations more than 10° out and those
of (3) if not included in means
should all be given in a special list.

Sp. (5) A number of Obsns in ~~Oct~~ 93 are some
3½° too far north. After taking a number
about right the locations jump to this
northern position. It is difficult to
say whether the Gg. did actually jump
that amount or whether stars or faint
stellar had some psychologic affect and
drew the attention to them for a time.
? On such a supposition these Obsns might
be omitted, There is a band of stellar
light passing along here just north of the
ecliptic - seen in Sept. 96, & Autumn of 93.

NB {All regions should be examined for
such bands, both in this discussion
and special drawings should be made
of those regions when the Gg. is not
there.

(6). I think the former method of means
of lunations is good.

1893

IX

Observations Time of Gegenschein reported by A. E. Douglass.

			Gr. M.T. h m	α	δ	λ	β
~~100 Sept. 9 +3~~	~~Cambridge.~~	~~Heis~~	~~18 14~~	~~354.2°~~	~~+2.4~~	~~356.2~~	~~+4.5~~
(40) 101 Sept. 10 +3	" ~~4 44~~ 31 4 45	"	17 23	355.7	−2.5	355.6	−0.6
(41) 102 Sept. 11 +4	"	"	18 0	346.6	−6.4	345.7	−0.6
(42) 103 Sept. 12	"	"	16 1	352.7	−3.7	352.4	−0.5
(43) 104 Sept. 13	"	"	17 3	356.3	−2.3	356.2	−0.6
~~(44) 105 Sept. 17 +6~~	~~"~~	~~"~~	~~17 15~~	~~1.8~~	~~+3.9~~	~~4.0~~	~~+2.9~~
(45) 106 * Sept. 20 +7	"	"	18 39	359.5	+3.5	1.5	+3.4
(46) 107 Oct. 2 +11	East Wareham	"	15 3	10.7	+2.8	11.5	−1.6
X ~~108 BHD " "~~	~~"~~ 4 · 43	~~"~~	~~15 25~~	~~2.8~~	~~+5.7~~	~~5.4~~	~~+4.1~~

(9)

The last observation is by Dr. B. H. Douglass, and the September observations at Cambridge are chiefly mean results from several observations taken on the same evening.

Red ink results from letter of Oct. 21, 1896.

Cor to LT

Date 1893	Station.	Chart.	G.M.T.	α	δ	λ	β
(47) 109 Oct. 5 +12	Cambridge.	Arg.	16h 40m	12.5°	+5.7°	14.5°	+0.3°
(48) 110 Oct. 8 +13	" 4 45	Heis	18 6	16.9	+5.0	18.0	−2.0
(49) 111 Oct. 9	"	"	17 10	14.7	+3.7	15.5	−2.4
(50) 112 Oct. 10	Blue Hall. 4 45	"	15 12	15.9	+5.5	17.3	−1.2
113 " "	"	"	17 21	15.0	+5.5	16.5 (16.0)	−0.8 (−0.7)
114 " "	"	"	18 10	16.4	+4.8	17.5 (17.5)	−2.0 (−2.0)
115 " "	"	"	18 27	15.5	+5.8	17.1	−0.7
(51) 116 Oct. 11	"	"	14 50	14.4	+5.2	15.8 (14.8)	−0.9 (−0.9)
117 " "	"	"	15 15	19.8	+4.4	20.5 (21.6)	−3.7 (−2.5)
118 " "	"	"	17 25	18.1	+5.0	19.1 (19.0)	−2.5 (−2.6)

Cor to off. Sol. Time

Searles Paper

at 355.9

7⌊29.2

7⌊8.5

Loc. app. Sol. time		Lunar time d	Hel. long Earth	Δλ		(1.7)	(2.0)	
~~13~~	~~32~~	~~−0.1~~	~~347.8~~	~~+8.4~~ ✓	[Δλ] = +4°.2		[β] +1.2	✱?
12	41	+0.8	348.7	+6.9	7.0	+0.4	+0.4	
13	19	+1.9	349.7	−4.0	−3.9	+0.2	+0.1	
11	20	+2.8	350.6	+1.8	✓	+0.4	+0.3	
12	22	+3.8	351.6	+4.6	4.7	+0.4	+0.4	
~~12~~	~~36~~	~~+7.8~~	~~355.5~~	~~+8.5~~	✓			
14	01	+10.9	358.5	+3.0 ✓	✱	+4.6	+4.5	✱
10	31	−6.8	10.2	+1.3	1.4	−0.3	−0.2	
~~10~~	~~53~~	~~"~~	~~"~~	~~−4.8~~	✓			

~~7⌊41.6~~
~~355.9~~
~~1892~~
~~68.7~~
~~64~~
~~77~~
~~30⌊257.9~~
~~18.6~~
~~[λ]~~

4 44 } Searle
4 13
142

Blue Hill

445 } Cambridge
4223

4 43 } EW.
41 45

Loc. app. Sol. time		Lunar time d	Hel. long Earth	Δλ		(1.7)	(2.0)	
12	07	−3.7	13.1	+1.4	1.3 ✓	+1.7	+1.8	15.3 16.2 17.1
13	34	−0.6	16.2	+1.8	0 ✓	−0.6	−0.4	
12	38	+0.3	17.1	−1.6	✓	−1.0	−0.9	
10	40	+1.2	18.0	−0.7	✓	+0.2	+0.3	
12	49	+1.3	18.1	−1.6	✓	+0.6	+0.7	
13	38	+1.4	18.2	−0.7	0.6	−0.6	−0.4	
13	55	"	"	−1.1	✓	+0.7	+0.8	
10	18	+2.2	19.0	−3.2	✓	+0.5	+0.6	
10	43	"	"	+1.5	1.4	−2.1	−2.1	
12	53	+2.3	19.1	−0.0	✓ −7.7	−1.1	−0.9 13.4	

1
X

1893

Cor. to app. Sol. time

					G.M.T.	α	δ	λ	β
(51)	119	Oct. (11). (+13)	Blue Hill.	Heis	18 20 ~~(18 44)~~	16.4	+5.2	17.6 (17.8) (15.6)	−1.6 (−2.1) (−0.9)
	120	" "	" 4 4^5	"	19 55	14.8	+5.5	16.3 (15.6)	−0.8 (−0.9)
(52)	121	Oct. 12 +14	"	"	12 41	18.9	+5.3	20.0 (19.7)	−2.5 (−2.6)
	122	" "	"	"	13 6	14.4	+5.7	16.0 (15.4)	−0.4 (0.0)
	123	" "	"	"	13 23	15.0	+6.4	16.8 (15.8)	0.0 (−1.3)
	124	" "	"	"	14 9	15.2	+6.3	17.0 (15.8)	−0.2 (−1.3)
	125	" "	"	"	17 40	14.9	+5.9	16.6 (15.8)	−0.4 (−1.3)
	126	" "	"	"	17 40	15.3	+8.2	17.8 (17.4)	+1.5 (+1.4)
(53)	~~127~~	~~Oct. 14~~	~~Cambridge~~	~~"~~	~~17 15~~	~~14.1~~	~~+6.8~~	~~16.2~~	~~+0.7~~
	~~128~~	~~" "~~	~~" 4 4^5~~	~~"~~	~~17 15~~	~~27.0~~	~~+12.7~~	~~30.2~~	~~+1.5~~
	~~129~~	~~" "~~	~~"~~	~~"~~	~~18 15~~	~~14.4~~	~~+7.8~~	~~16.8~~	~~+1.5~~
	130	" "	"	"	18 15	20.0	+10.0	22.8	+1.4

		Date 1893. Cor	Station.	Chart.	G.M.T.	α	δ	λ	β
	131	Oct. 14. +14	Cambridge.	Heis.	$18^h 35^m$	18.0°	$+9.2^\circ$	20.6°	$+1.4^\circ$
	~~132~~	~~" "~~	~~" 4 4^5~~	~~"~~	~~18 35~~	~~27.3~~	~~+12.7~~	~~30.4~~	~~+1.4~~
(54)	133	Oct. 15		"	16 54	20.0	+9.2	22.5	+0.7
(55)	134	Oct. 16 +15	Onset Junction	"	17 38	22.7	+9.2	25.0	−0.3
	135	" "	" 4 4 3	"	18 3	18.7	+8.5	21.0	+0.5
(56)	136	Oct. 18	Cambridge 4 4^5	"	17 45	23.1	+10.0	25.6	+0.3

Continued on page 38

+4.7

+4.7
−13.4
8.7
30
0.3

Subtract 15' from 96 figures

30 | −27.4 at 18.6 [λ]

[Δλ] −0.9

[β] = −0.3

Loc. App. Sid. Time		Lunar Time	Hel. Long Earth	Δλ	Scale	1.7	2.0
13	48	+2.4	19.2	−1.6	1.5	−0.2	~~0~~ 0.0
15	23	"	"	−2.9	✓	+0.6	+0.7
8	10	+3.1	19.9	+0.1	✓	−1.0	−0.9
8	35	"	"	−3.9	✓	+1.0	+1.1
8	52	+3.2	20.0	−3.2	3.1	+1.4	+1.5
9	38	"	"	−3.0	✓	+1.2	+1.3
13	09	+3.3	20.1	−3.5	0	+1.0	+1.1
"		"	"	−2.3	0	+2.9	+3.1
~~12~~	~~44~~	~~+5.3~~	~~22.1~~	~~−5.9~~	✓		
~~"~~		~~"~~	~~"~~	~~+8.1~~	✓		
~~13~~	~~44~~	~~+5.4~~	~~22.2~~	~~−5.4~~	5.3		
"		"	"	+0.6	✓	+2.9	+3.1
14	04	+5.4	"	−1.6	1.5	+2.9	+3.0
~~"~~		~~"~~	~~"~~	~~+8.2~~	~~8.3~~		
12	23	+6.3	23.1	−0.6	✓	+2.2	+2.3
13	10	+7.3	24.1	+0.9	✓	+1.2	+1.4
13	35	+7.4	24.2	−3.2	3.1	+2.0	+2.1
13	15	+9.3	26.1	−0.5	✓	+1.8	+2.0

−19.7 ✓
7.7
27.4

1896

Flagstaff Arizona

XX	Obs.	Date 1896	Mt St. Time	GMT.	R.A.	Dec	Diam, &c.
(127)	242	Oct 27	8 55	17 55	37.5	+11.3	6°
(128)	243	" 28	9 05	16 05	36.5	+ 9.7	5 Elongated,
	244	" "	10 25	17 25	36.5	+ 9.7	5 "
(129)	245	" 29	9 30	16 30	36.3	+12.9	7
(130)	246	" 30	10 39	17 39	39.4	+ 11.7	6 Limit. 7.
(131)	247	" 31	11 28	18 28	41.7	+13.2	6
(132)	248	Nov. 1	9 30±	16 30±	43.7	+14.0	8°
(133)	249	" 2	12 ±	19 ±	43.7	+13.7	4 Elong. Stellar light may interfere
(134)	250	" 3	11 ±	18 ±	40.0	+17.0	3½ Exp. cir
Near Ojo Caliente, Mexico.	251	" 5	8 50	15 50	40.0	+17.0	Doubtful
(135)	252	" 5	8 50	15 50	45.5	+12.3	2° Loose Nuc.
Near Cañitas. Mex (136)	253	" 6	8 25	15 25	45.5	+12.0	Doubtful! St Lig Int
Mexico City (137)	254	" 7	11 55	18 55	40.8	+14.8	3×6, Doubtful

New Moon Oct. 6.43 d

Nov 4.81

new moon Nov 4,0

λ	Δλ	β	Loc. App. Sol. Time	~~Lunar Time~~	Hel. Long Earth	(1,7)	(2,0)
39,4^c	+4,1	−3,3	8 44	− 8.1	35,3	−1,7	−1,4
37,9^c	+1,6	−4,5	8 54	− 7.1	36.3	−2,9	−2,6
37,9^c	+1,6	−4,5	10 14	− 7.1	36,3	−2,9	−2,6
38,8^c	+1,5	−1,4	9 19	− 6.1	37,3	+0,2	+0,5
41,2^c	+2,9	−3,5	10 28	− 5,1	38,3	−1,9	−1,6
43.9^c	+4.5	−2,7	11 17	− 4.3	39.4	−1,1	−0,8
45,9^c	+5,6	−2,6	9 19±	− 3,1	40.3	−1,0	−0,6
45,8^c	+4.4	−2,8	11 50±	− 2.0	41,4	−1,2	−0,8
43.5^c	+1,1	+1,3	10 50±	− 1,1	42,4	+2,9	+3,2
43,5^c	−0,8	+1,3	8 39	+ 1.0	44.3	+2,9	+3,2
47,1^c	+2,8	−4,7	8 39	+ 1,0	44,3	−3,1	−2,7
Light interferes 47,0^c	+1,8	−5,0	8 14	+ 1.8	45,2	−3,4	−3,0
43.6^c	−2,8	−1,0	11 44	+ 3.0	46,4	+0,6	+0,9

Revised. Nov. 10, 1896

~~Copy~~ of page 50 Corrections in ink (See pg 62 et seq)

Lunation	No. Obs'ns	Means Date of New Moon. ~~Mean Date~~	[λ]	[Δλ]	[β]
I	4	1891, Aug. ~~2.7~~ ~~4.8~~ ~~3.7~~ 4	313°	0.0 ✓	−0.2 ✓
II	~~2~~ 1	" Sept. ~~21.6~~ ~~2.1~~ 3	33~~3~~6	+0.3 ✓	+0.~~*~~3 ✓
III	~~51~~ 50	" ~~Sept~~ Oct. ~~30.2~~ ~~1.6~~ 2	8	+0.5 ✓	−1.~~1~~6 ✓
IV	3	" ~~Oct~~ Nov ~~20.7~~ ~~31.2~~ 1	26 ✓	−1.8 ✓✓	−1.0 ✓✓
V	2	1892, Feb. ~~21.5~~ ~~27.3~~ 28	151 ✓	−1.7 ✓✓	+4.6 ✓✓
VI	3	" Mar. ~~29.2~~ ~~27.9~~ 28	190 ✓	+0.1 ✓✓	+3.4 ✓✓
VII	~~23~~ 19	" Apr. ~~25.1~~ ~~26.3~~ 26	216 ✓	+0.6	+1.5 (−½) ✓
VIII	11 ✓ 99	" Aug. ~~20.7~~ ~~21.6~~ 22	330	+1.1 ✓	−0.9 ✓
IX	5 ✓	1893, Sept. ~~9.9~~ ~~10~~ ✓ 11	354 ✓	+2.5 ✓	+0.2 ✓
X	25 ✓	" Oct. ~~9.4~~ 9	19 ✓	−1.1 ✓	−0.7 ✓
XI	8 ✓	1894, Mar. ~~7.8~~ 7	171 ✓	+2.5 ✓	−0.1 ✓
XII	5 ✓	" Apr. ~~1.4~~ 5	195 ✓	+2.6 ✓	−0.1 ✓
XIII	2 ✓	" May ~~6.0~~ 5	225 ✓	+0.1 ✓	+0.4 ✓
XIV	4 ✓	1895, Feb. ~~20.6~~ 24	154 ✓	+0.6 ✓	+1.4 ✓
XV	24 ✓	" Mar. ~~25.3~~ 26	186 ✓	+0.4 ✓	+1.8 ✓
XVI	22 ✓	" Apr. ~~20.5~~ 25	214 ✓	+2.3 ✓	+2.1 ✓
XVII	2 ✓	" May ~~20.5~~ 24	237 ✓	−3.4 ✓	+0.4 ✓
XVIII	11 ✓	1896 Sept. ~~13.0~~ 7	354 ✓	+1.8 ✓	−0.9 ✓
139 obs XIX	15 ✓	" Oct. ~~6.4~~ 6	17 ✓	+1.9 ✓	−1.9 ✓
XX	13 ✓	" Nov. 5	43 ✓	+2.2 ✓	−2.6 ✓

Merc. Nov. 10.

Obsns before 8h & after 16h

omit these from means

5
17
81
82
83
88
222
228
234

Copy

Observations more than 10° out

				L.A.S.T.	λ	Δλ	β
151	D. Flagstaff	1894	May 4	823	209.8	−14.9	+1.4
156	Ross "	"	" 9	1202	213.7	−15.9	+2.8±
159	D "	1895	Feb. 21	817	135.0	−18.3	+0.5
(181 A.)	S. Sydn "	"	Mar. 30.	1049	186.6	−03.7	+11.3

from 2° β. curve & +1° in Δλ.

Observations more than 5° out in any direction. i.e. figure too large.

33 (— Straight out
58
62 (Diag ∓ over 5°)
~~65~~ ~~[illegible]~~
season ~~81~~ —
~~88~~
100 —
addit 101
102 Diag
105 —
106
108 (Diag)
122
127 —
128 —

129 —
132 —
137 —
~~151~~ —
152 —
153 —
154 —
~~155~~ Diag (Est)
~~156~~ —
~~159~~ —
163 —

208 Diag
~~209 (Diag)~~
211
~~221~~ Ht
~~222~~ —
223 —
226 —
~~231~~ Ht
~~234~~ (Diag)

9 omitted out of before 8 or after 16
3 " " " " being 10° out.
25 " " " " 5° " .

(37 omitted, being more than 5° from mean place, having 217)
up to Nov. 8. 96

Nov. 10.

The 5° limit cuts out	Error in each	5° to 6°	6° to 7°	7° to 8°	8° to 9°	Using a 6° limit omit 151, 156, 159, 181A, and
Nos 33	5,9	5				
58	5,5	5				
62	5,5	5				
100	9 ±				9	100
101	6,0	5				
102	5,1	5				105
105	8,5 ±				8	
106	5,4	5				108
108	7,8			7		
122	5,1	5				
127	7,4			7		127
128	7,8			7		128
129	7,2			7		129
132	7,7			7		132
137	5,4	5				
152	8,4 ±				8	152
153	8,2				8	153
154	8,3				8	154
155	6.4		6			155
163	8,4				8	163
208	5,2	5				
211	5,4	5				
222	6,7		6			~~222~~
223	5,4	5				
226	6,8		6			226

Σ = 25

together with
5, 17, 81, 82,
83, 88, 222,
228, + 234

Nov. 10. 86

In taking means omit the following numbers

I, Obs'ns too early or too late

5
17
81
82
83
88
222
228
234

II Locations more than 10° out, not used before

151
156
159
(181 A)

} See Copy page 62.

III Locations - all other - more than 6° out.

I 100
105
108
127
128
129
132
II 152
153

154
II 155
I 163
I II 226.
I

Av. Resid.

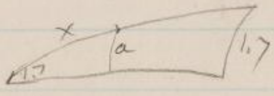
Mercury, Nov. 18, 1896

For getting Average Residual per Observation.

The two curves are

	I	II
Incli	1°.7	2°.0
☊	134.—	147.—
Excen. plane	0.13	0.0

1.7



$\sin x \sin 1.7 = \sin \alpha$

$$\sin x = \frac{\sin \alpha}{\sin 1.7}$$

For limits α = successively 0°.05, 0°.15, 0.25, &c

α	Log sin α	Log sin 1.7 = 8.4723	limit		
0.05	6.9409	8.4686	1.7	0 to 1	0
.15	7.3924	8.9200	4.8	2 - 4	.1
.25	7.6300	9.1577	8.3	5 - 8	.2
.35	7.7815	9.3092	11.8	9 - 11	.3
.45	7.8916	9.4193	15.2	12 - 15	.4
.55	7.9804	9.5081	18.8	16 - 18	.5
.65	8.0535	9.5812	22.4	19 - 22	.6
.75	8.1162	9.6439	26.1	23 - 26	.7
.85	8.1725	9.7002	30.1	27 - 30	.8
.95	8.2190	9.7467	3~~3.9~~4.1	31 - 34	.9
1.05	8.2625	9.7902	38.1	35 - 38	1.0
1.15	8.3021	9.8298	42.4	39 - 42	1.1
1.25	8.3385	9.8662	47.3	43 - 47	1.2
1.35	8.3720	9.8997	52.5	48 - 52	1.3
1.45	8.4030	9.9307	58.5	53 - 58	1.4
1.55	8.4320	9.9597	65.7	59 - 65	1.5
1.65	8.4590	9.9867	75.9	66 - 75	1.6

309
134
175

75 - 90 - 105

i = 1°.7

Curve for 1°.7 Inc.

λ	β	λ	β
133° - 135°	+ 0°.1	306 - 309	+ 0°.3
136 - 138	+ .2	310 - 312	+ 0.2
139 - 142	+ .3	313 - 315	+ 0.1
143 - 145	+ .4	316 - 318	± 0
146 - 149	+ .5	319 - 322	- 0.1
150 - 152	+ .6	323 - 325	- .2
153 - 156	+ .7	326 - 329	- .3
157 - 160	+ .8	330 - 332	- 4
161 - 164	+ .9	333 - 336	- .5
165 - 168	+ 1.0	337 - 340	- .6
169 - 172	+ 1.1	341 - 344	- .7
173 - 176	+ 1.2	345 - 348	- .8
177 - 181	+ 1.3	349 - 352	- .9
182 - 186	+ 1.4	353 - 356	- 1.0
187 - 192	+ 1.5	357 - 001	- 1.1
193 - 199	+ 1.6	2 - 6	- 1.2
200 - 209	+ 1.7	7 - 12	- 1.3
210 - 238	+ 1.8	13 - 19	- 1.4
239 - 248	+ 1.7	20 - 29	- 1.5
		30 - 58	- 1.6

Av. Resid.

Nov. 18.

	t	Log Sin. 2		Limits	0 = 147
2°.0	0,05	6,9409	8.3981	1.4	0 - 1
	,15	7.3924	8,8496	4,1	2 - 4
	,25	7,6300	9.0872	7,0+	5 - 7
	,35	7,7815	9,2387	10,0	8 - 9
	,45	7,8916	9,3488	12.9	10 - 12
	,55	7,9804	9.4376	15.9	13 - 15
	,65	8,0535	9.5107	18,9	16 - 18
	,75	8,1162	9,5734	22,0−	19 - 21
	,85	8,1725	9.62,97	25.2	22 - 25
	,95	8,2190×	9.6762	28,3	26 - 28
	1,05	8,2625	9.7197	31.6	29 - 31
	1.15	8.3021	9.7593	35.1	32 - 35
	1,25	8,3385	9.7957	38,7	36 - 38
	1,35	8,3720	9.8292	42,4	39 - 42
	1,45	8,4030	9.8602	46,4	43 - 46
	1,55	8,4320	9,8892	50,8	47 - 50
*	1,65	8,4590	9.9162	55,5	51 - 55
	1.75	8,4847	9.9419	61.0+	56 - 61
	1,85	8,5088	9.9660	67,6	62 - 67
	1,95	8,5317	9.9889	77,1	68 - 77
					78 - 102

$\vartheta = 2^{\circ}.0$

λ	β	λ	β
146 - 148	0	309 - 311	+ 0.6
149 - 151	+ 0.1	312 - 314	+ 0.5
152 - 154	+ 0.2	315 - 317	+ 0.4
155 - 156	+ 0.3	318 - 319	+ 0.3
157 - 159	+ 0.4	320 - 322	+ 0.2
160 - 162	+ 0.5	323 - 325	+ 0.1
163 - 165	+ 0.6	326 - 328	.0
166 - 168	+ 0.7	329 - 331	- 0.1
169 - 172	+ 0.8	332 - 334	- 0.2
173 - 175	+ 0.9	335 - 336	- 0.3
176 - 178	+ 1.0	337 - 339	- 0.4
179 - 182	+ 1.1	340 - 342	- 0.5
183 - 185	+ 1.2	343 - 345	- 0.6
186 - 189	+ 1.3	346 - 348	- 0.7
190 - 193	+ 1.4	349 - 352	- 0.8
194 - 197	+ 1.5	353 - 355	- 0.9
198 - 202	+ 1.6	356 - 358	- 1.0
203 - 208	+ 1.7	359 - 362	- 1.1
209 - 214	+ 1.8	3 - 5	- 1.2
215 - 224	+ 1.9	6 - 9	- 1.3
225 - 249	+ 2.0	10 - 13	- 1.4
		14 - 17	- 1.5
		18 - 22	- 1.6
		23 - 28	- 1.7
		29 - 34	- 1.8
		35 - 44	- 1.9
		45 - 69	- 2.0

Hypotheses 1°.7 gives mean Resid 1°.06
" 2°.0 " " " 1.07

" 2.0 gives parallax −0°.14 between obsns N & S of equator. This is probably due to absorption.

Observations on Zodiacal Light,

Arequipa – Peru.

General Notes.

The zodiacal light seems to be much more brilliant here than in Cambridge. Mass. About July 1st it appeared very bright as twilight ended & remained till about 10 P.M. In the east it began at 2 A.M. increasing in brilliancy till dawn

Monday, Aug 3. 1891

10.30 P.M.

From Notes

July 31. Prof. Pickering & AED. agreed that Zodiacal Light showed in E & W - at 11.00 P.M.

at 7.30 it had reached to zenith from the W by 1 AM. It showed brilliantly in E.

Aug 2. Showed in W at 7.30 to zenith - at 3. AM. it reached to within 10° of Jupiter.

Time of greatest brilliancy 10.45 P.M. 19.35 Sid Time.

Sunset a little before 6.

Z. L. showed most brilliantly at 7.45

Reaching just beyond zenith

Position of tip. Observations during the evening placed its terminus at ¼ distance between α Librae & Antares - from the former.

It is now faintly visible about α Librae

E Z L and shows faintly in the East, rising up towards Jupiter, which is 30 to 40° high

10.57 On looking for a continuous band across the sky from E to W - I should say that such a band is visible. The Milky Way

Z. B. about Scorpio, interferes with western obs. & Jupiter in the E makes it difficult to observe in a limited portion. A number of evenings in the past two weeks. I have noticed a portion of the sky between Jupiter & Scorpio more brilliant than portions N & S of it but had not associated it with the Z Band but it now seems to be a part of this band

Monday, Aug 3. 91

11.30 Z L shows distinctly in E to within 10° of Jupiter. α Librae is still above horizon but the Z L is confused with the natural horizon light.

E. Z.L. tip.

11.42 In regard to the horizon light - it is brighter & extends up higher at the point in the W where the Z L should be, than at any other point on the whole horizon.

Horizon light

#

The band across the sky is probably helped by (if it is not due to) some outlaying portions of the Milky Way.

outlaying portions of M.W.

11.50 The brightest point (from Klein's Star Atlas) is located in R.A. 20h 52m Dec -17

This may be Gegenschein.

From the Nautical Almanac I get the position of the sun, as R.A. 8h 55m & Dec +17 20

Then from the point abv probably is Gegenschein

Gegenschein position.

12.05 The axis of the Z B in the E has a ~~strong~~ N line, but curves & passes a few degrees S of Jupiter or on Jupiter & in general towards Scorpio - through Capricornus & so to W horizon

Z B axis.

C. E. D. Olsen,

Should say in addition that the above phenomenon had a dense center, surrounded by a disc or ring several times its diam. this seemed to shade off more gradually in line with the band.

Gegenschein shape.

Tuesday. Aug. 4. 1891

M.T.

7.55 16.45 S.T. Regulus has just set - Axis passed about at that point. It then runs up 1°S of ~~δ Leonis~~ η Virginis - 3° N of Spica, thence 1°S of α Librae, thence to some point between β & δ Scorpii - nearer β.

W Z L axis

8.10 The cone seems to stop - as a cone - about 0.4 from Spica to α Librae but the band continues till it gets near the bright stars of Scorpio & the M.W.

W Z L ip

Z.L. changes in appearance in this way:- Immediately after sunset - or rather twilight the cone is exceedingly brilliant up to 30° or 40° but no band shows - as the cone sinks in the west, the band can bee seen prolonging itself towards the E. At a point about 23° above the horizon the cone rapidly spreads out N & S joining with the natural horizon light. The cone, as it were, sinks into this. This is connected with what was observed last night, viz:- that after the cone had distinctly set - a glow still showed at the point of setting.

W Z L changes

8.20 Should say that the C. decreased more gradually on the N side (25°+ above hor.) than on S. This I observed earlier in the evening, but as the Prof. considered that the reverse was the case, this is very doubtful.

W Z L, dif. brt. sides

Tuesday, Aug 4, 1891

Photographs- At 7.20 P.M. started two plates for Z. L.
one S26 in my camera (Hawkeye) & one
A & R. in 4x5 cam: Wide angle lens.
Both will probably include an edge of horizon
& are pointed at brightest portion of Z. L.

9.15 Have noticed this evening, as last evening, a
general hazy appearance of sky, perhaps
slightly intensified at the Z. B. It now
seems to be clearing off. My impression
is that I have noticed this frequently
in past week or so. 2 months ago, by
9 P.M. the sky was perfectly black, showing
considerably darker than the sky in
Cambridge. If this phenomenon is con-
nected with Z. L. it means that the
luminous matter comprising the Z. L.
is an ellipse in shape & that the earth
is now at the aphelion point of it.

Haze in sky

9.25 N.B. I now notice Tr of clds over β Scorpii - however
Clouds the above haze is more conspicuous in E
in large area free from M.W.

Have thus far traced the band to Scorpio - will
now continue beyond M.W. towards E.

Tuesday, Aug 4, 1891

9.48 Observe Gegenschein more or less 7° in diam, and centering about on θ Capricorni R.A. 20h 59m + Dec. −18

Gegenschein Position Size

Band 20° wide in Aquarius + centers on λ
Centers also at 22.20 + −10
Centers also at 21.35 × −15

Z.B. width axis.

10.10 Z L or B still shows brilliantly in W, 25° wide
Haze Haze has cleared off and small stars are all out
10.15 Centers at 23.10 × −08 − just S of Jupiter,
" " 23.55 × −02, but that is still near the E horizon + is uncertain, The H light seems to to be rather high this evening all round, also,

Z.B. axis. Horiz. light

10.40 Prof Pickering agrees that the Z.L. is now faintly visible in the E. It is still fairly bright in the west. Also he independently selected θ Capricorni as the center of the brightest point of the Z.B. + gave this bright portion a diam of 3° or 4°

E+W. Z.L. Gegenschein Position

A E Douglass

Saturday, evening, Aug 8, 1891

Observation on Gegenschein.

11.00 Should say S. so called centred ~~on~~ 28 or 9 Capricorni - (Klein's atlas) and was some 4 to 6° in diam.

Gegenschein Position

Position of 28 (or 9) Cap. is R.A. 21h 09m Dec 15°.6

Position of sun is: RA. 9h 15m Dec 16.0

As this departs only 6m in R.A. (less than 1½°) + 22′ in Dec. from the theoritical position and has unmistakably moved from its position when first observed (Aug 3) there can hardly be any doubt about its genuineness.

A E Douglass

Friday, Eve Aug. 21. 1891

7.. ~~25~~ 20 Z.L. very brilliant - think it more so than any portion of M.W. Think it has slight resemblance to double cone or - that there is a cone more or less distinct and a sheath around it continuing into the Z.B.

W Z L intensity

2 cones

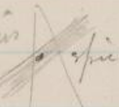
β Virginis is just setting - at height of γ " width of "cone" is:-

W Z L width

to N 0.4 from δ towards ε 12..52 x +07
to S to δ Corvi. 12..25 x -16

7..30 Extreme limits at same point are:-
to N - Arcturus or in line below it towards horiz.
to S - halfway between square in Corvus & South. Cross.

Sheath or Z B limits

7..35 Seems as if there were a dark band crossing Z.L. at Spica thus  Spica. (probably optical - D. Nov 21 93)

7..37 "Sheath" above mentioned - extends clear into Scorpio
Sheath to N is half way from α Librae to μ Serpentis
to S - is 11° S of α Librae but is slightly interfered with by M.W.

Sheath width.

7..45 Should say Z B showed in east from M.W. down towards Jupiter. Should call brightest point half way between ι + θ Aquarii or at e = 22..04 x -12
But light of moon behind Mtns is showing brilliantly & this obsn is of comparatively small value.

Gegenschein Position

Should say Z L had a tendency to shade off more suddenly to N than S. Moon rose at 8..19

Z.L. dif. bet. sides

Friday. Aug 28. 1891

7.30 Z.L. very brilliant. Cone extends 0.4 from Spica to α Librae, bright, & more faintly to α Librae itself. On N it extends plainly to Arcturus.

W. Z.L. tip Limit

Have noticed on few nights past the general illumination of sky above mentioned. Tonight there appears to be a cloud over lower valley i.e. over city.

Haze

11.00 Gegenschein very hard to see as it is so near Jupiter. — Good way of telling when Jupiter gets to opposition. Z.B. shows finely.

Gegenschein Hard to see

Note. Nov. 21. 1893. This haze noticed several times almost invariably is succeeded by clouds and may be considered as due to changing meteorological conditions. A.E.D.

160

Sunday Aug 30, 1891

ZB length brightness axis

14.20 Z.B. very bright.
Can be seen from 15° above W horizon
to 15° of eastern.
Centres on Jubiter in W & its brightest
point is as below

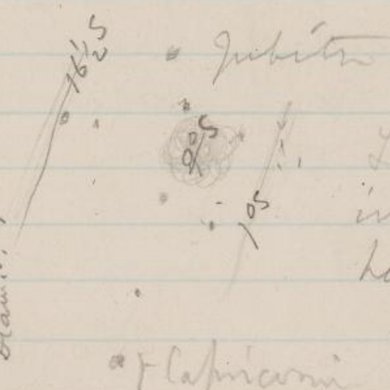
Gegenschein Position

ZB width 18°

Gegenschein, RA. 22h 30 to 32 Dec − 9° (deduced Sept 16)

Sun RA. 10h 35 Dec + 8° 57'

~~width~~ Diam. 3, 7°



Limits of ZB are put in. G is in centre but here owing to wrong position of stars, does not appear so

14.35 ZB becomes rather faint at point now on meridian or better half an hour W of meridian – going from a point half way from Pleides & Jubiter, to region of Jubiter itself, say as far E of Jub. as G is west.

ZB Intensity length

It brightens up slightly about G but only of a radius of half the width of itself.

Gegenschein ~~Shape~~ size

14.40 Z L shows in east, cone extending to ~~Hy~~ Aldebaran, or half way between Aldebaran & Pleides

EZL tip.

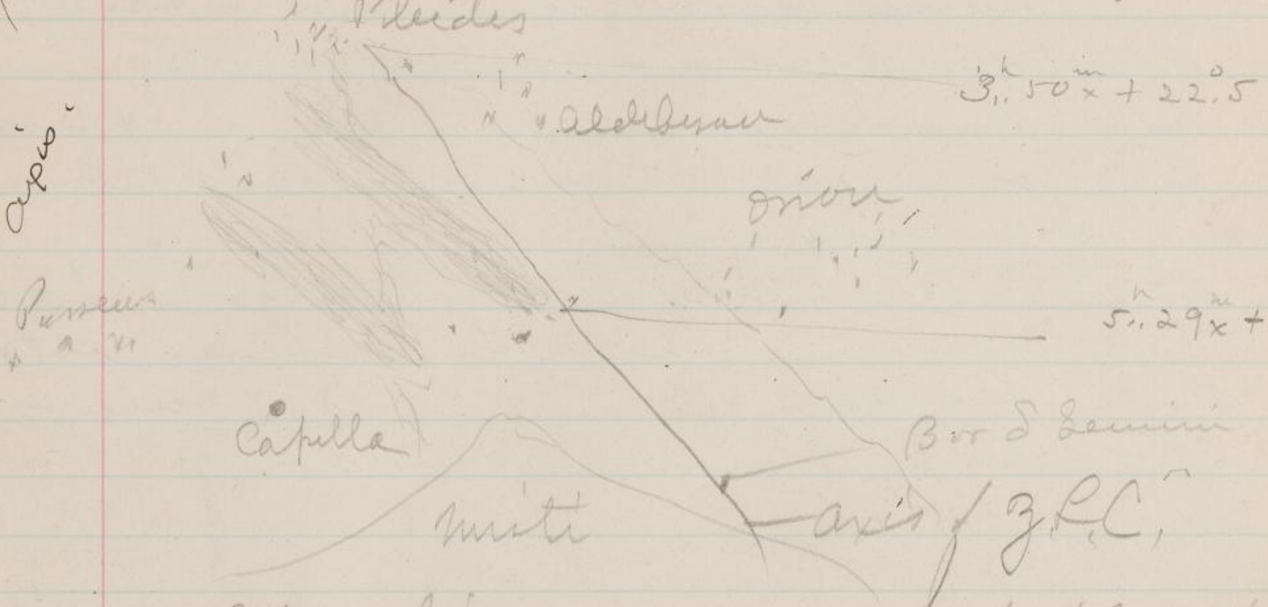
The E horizon seems to have a general illumination, in addition, probably from moon. Really from M.W.?

Sunday, Aug 30, 1891

15.00 There are some dark places in Z L cone

Milky Way

E Z L apex.



Above diagram shows dark places in general. General light in E has not increased as moonlight would, but only cone of Z.L. has brightened

E. Z. L. tip & its movement

As Z L rises its tip appears to extend farther towards W from Pleiades. Have noticed this before, and it seems as if I had seen slow changes in brilliancy in places, but it is hard to tell how much of this is due to change in eye

Horizon light

Since I have been watching N horizon about Cassiopeia has greatly brightened, but it may be due to M.W. which has set in mist

Sunday, Aug 30. 1891

)5h.12

Haze in air

For a few moments past have observed same general haziness mentioned before, except in S. but it disappears - it may be effect of light on eyes. This is especially noticeable in Z.B.

Method of observing.

N.B. These observations should be taken in perfect darkness with ~~an~~ recorder at hand - using a dark lantern.

Sunday, Sept. 6, 1891

14..25 W MW set. EMW just rising.
Air very clear
Stars out tonight with unusual brilliance even for anywhere. Seem to be able to see fainter stars with more distinctness. Have noticed that early this evening ZB shows with great ease. For example a light from bright dark lantern is shining on upper half of book. After writing these 3½ lines (to here) inside of 20 seconds keeping eyes open, have been able to trace course of ZB. Now again with eyes closed part of the interval = this time it was between 15 + 20ˢ However the eyes are blinded a good deal by this treatment.

ZB Brilliancy

ZB shows in west to Jupiter – in east reaches to tip of ZL cone at 5ʰ R.A. At end of tip of cone is a darkened space before ZB begins in earnest. This space (prob. due to M.W. – Nov 2 '93) is not entirely devoid of light. Above this at Pleiades ZB has almost exactly the width of distance in degrees between Aldebaran + the Pleiades.

Milky Way ZB length to E ZL tip?

width 15°

14..42 Can trace ZB to half way from Jupiter to W. horizon. What I have called tip of E cone is probably so, but is somewhat confused with EMW. Dark spaces noted, may be due to MW, But at Pleiades + above ZB is as bright as just off tip of cone in early evening, but diminishes regularly in brightness to Jupiter, with very slight decrease in width

ZB W limit

ZB intensity Milky Way

Sunday, Sept. 6, 1891

15 .. 00 Milky Way outlying parts

To test absolute intensity of Z.B., note the following. Take heaviest part of M.W., midway between Taurus & Gemini, R.A. about 6^h. I judge a branch at that point bends up towards Aldebaran - That branch appears to to continue nearly to Jupiter. That is the Z.B. At 6^h R.A. on the M.W. taken as a standard of intensity it diminishes with perfect regularity to within 5 & 8° of Jupiter. The dark spaces above referred to, have bridges which preserve the regularity.

Z.B. Brilliancy of M.W.

M.W. about 1^h above E horizon

Gegenschein near Jupiter

Gegenschein is so near Jupiter that no satisfactory observation on its position can be obtained.

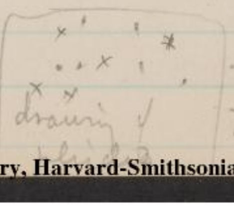
15 .. 15 Test of certainty of obs'ns

One thing is very certain & that is the reality of the Z.B. After being away from the lantern for a few minutes, looking about, I can at any moment & from any azimuth raise my eyes & see the Band, always in same position.

Possible observations

Think perhaps some observations on brightness could be made with polarizing photometer. Also Z.L. in general could probably give spectrum by exposing several evenings in succession on same region.

ZB intensity



Estimation of intensity of ZB at zenith - Somewhat less bright than general illumination between belt & shoulders of Orion

Sunday, Sept 6

Obs to be made on Gegenschein

N.B. Observations should be made on Gegenschein every hour or 2h in course of night to see if it is a long region of light extending from earth. In ~~that~~ case we would get it of less R.A. than theoretical position in early evening & greater in late night

ZB inclination Brilliancy

16.05 ZL in E is bright on horizon but fairly well inclined say 25° to 35° - Then comes MW of same brightness about 2h + up then broken dark spaces & ZB. Should say there was a little more dif. bet MW & ZB than remarks before indicate but it is nearly true that a regular decrease in intensity is observable.

Outlaying portions of MW compared to ZB

16.45 Can see outlaying portion of MW W side making a line (its limit to W) from Betelgeuse to Sirius - to Canopus - to big Mag. Cloud. Can see ZB from above Pleiades way past zenith of about same brilliancy as this region of MW.

Monday, Sept 7. 1891

11.30 P.M. Noticed outlying portions of M.W. which had first interfered with obs.ns on Gegenschein. This region covers whole of Capricornus & extends N & S nearly parallel with M.W. Can trace it to South with ease farther than to North.

Outlying por-
tions of M.W. com-
pared by J.C.B.

Thurs. Sept. 24. 1891

Alt. absorption

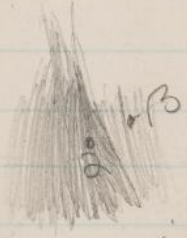
7h26 alt. heavy absorptn in west is 09°.0
Highest noticeable absorption 13.5

Tip position

M.W. diminishing rapidly,
I put tip .65 from α Libræ to ~~β~~ δ Scorpii
that is 15h.35 × − 19.2

Z.L. & sheath axis limits.

Alt. α Libræ 17°.5
Z.L. at that alt (seems to change but) was



sh. extends + 0.4 beyond β of dist α to β.
Axis 14h.45 × − 16.3

Seems to decrease more regularly on S side
but goes equally far on N

mist

7h40 slight mist all round horizon – in valley E.

Tip of cone Position

7h41 should still put tip Z.L. same point as before

Gap between Tip & sheath

Limits

Almost a gap at tip but sheath shows
beyond. axis at 16h.04 × − 23.8
Limit of sh. to N is 16h.27 × − 18.

Outlying portions of M.W.

Seems to be an outlying portion of M.W. across α δ β Scorpii
which must affect things somewhat.

Thursday Sept, 24, 1891

G. 7„55 G. hard to find

G. 8„10 approx pos. ~~0h 22m × −02.0~~ 0h 08m × +0°.3 ~~00.0~~ alt. 26°

position shape

Shape roundish, 09°.0 in diam.

alt of Absorption

Greatest alt. of noticeable absorp. 20°

Wrong
see next page

Absorption Angle fr. Sun 0h

1h

Gegen. Changes in intensity shape 2h

3h

4h

Probably outlying portions of M.W.

5

6h

7

8h

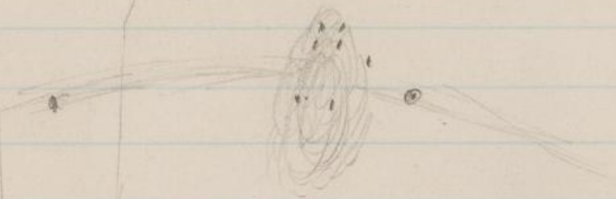
9

10h

changes 11

12h

At 10„05 G seemed to flash out extending East to about 1h 30m R.A. & West to 23„40 with possibly two wings extending S towards β Ceti & North towards γ Pegasi in a curve ~~thus~~



Previous to this time it had been hard to find, & after a moment it mostly disappeared.

13

14h

Mist on horizon and its effects 15

16h

17

18h

19

20h

Gegen. Halo around it. or Milky Way outlying parts. 21

22h

23

24h

10„15. Mist on horizon has been very bad this evening, even causing β Scorpii to disappear when above H. Sky also showed that general illumination, mentioned some ways back. But in the last few minutes it has cleared up greatly, especially to the E. and G. has come out much better.

10„15. Should say there was something like a halo round the G. Taking distance from γ Peg. to β Ceti, N limit is about γ Peg 0.1 towards β Ceti. S limit is β Ceti .15 to .20 tow. γ Peg. the E & W limits are not so well defined

18.7
14.3
4.4

Thursday Sept. 24, 1891

10h 20 Gegn Position — Should place G at 0 22 × ~~−02.2~~ −00.2

Correction to Position of Gegn
Think my first obsn is wrong from not identifying stars correctly. Correcting it would bring it nearer 0h 08 × −1°.7 See next page

Gegn 10h 40 Position — G. 0h 13m × ~~−1°.4~~ +0.6

Gegn 10h 47 Position — On facing W. should put G at same point as at 10h 20 0h 22m × −00°.2

Gegn 11h 01 Position — G. 0h 14m × ~~−1.0~~ +1.0

Milky Way? ~~Fig.~~ Gegn 11h 20 size & wings — G Seemed to be large & show N & S wings.

Moon 12h 40 ~~moonlight~~ — Moonlight shows in E.N.E. or North.

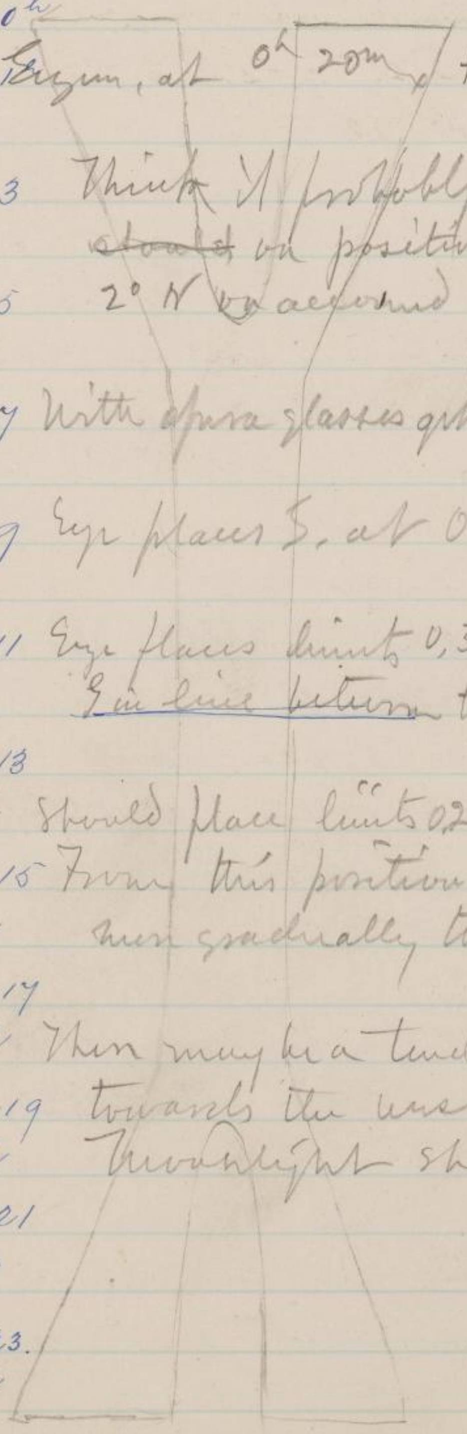
Gegn 12h 48 ~~shape~~ dif in E & W sides. Geg Position size — G has more of a tendency to extend towards W. while ~~⊕~~ earlier in ev. it faded more suddenly toward W. Can still see Z B & should place G more to W than before, say 0h 07m Dec ~~−2.0~~ 00.0 with diameter of 9°. Can't see the surrounding halos

Absorption. Value of these Obs'ns. Test of seeing — On the whole, absorption has been so great for long ~~tit~~ (probably influencing the 1st obsn) that these are not as good obsns as I hope to get. The air was improved somewhat with the lateness of the night but not much. The ease in seeing stars on the Hor. is a good test of value of a nights observations.

Friday, Sept. 25, 1891

Tests of clear air

Air much clearer than last night.
Can easily see stars at S Pole. Z B much more distinct than last night.



Angle fr. Sun 0h

Geg: Position 12,,26

Gegen, at 0h 20m × +0°,4

2h

N.B. Correction to yesterday's Obsns

3 Think it probably that all of last nights Obsns
4h ~~stand~~ on position of gegenschein should be put
5 2° N on account of poor identification of stars

6h

Geg: Position with opera glasses 12,,45

7 With opera glasses get G at 0h 25m × +0°,5, Diam 4°

8h

Geg Position 13,,30

9 Eye places G. at 0h 20m × ±0, Diam 8°

10h

Geg: 13,,35 limits their Position

11 Eye places limits 0,3 fr γ Peg & 2.2 from β Ceti.
12h G in line between the two ✶ (0h 21m):

13

Geg: Position 13,,40 limits Difn N & S sides

14h Should place limits 0.2 fr. γ Peg, & 0.3 fr β Ceti with G. 0,45 fr γ Peg,
15 From this position it has a tendency to shade off
16h more gradually towards S. (0 2/1 × 0.0

17

Geg: 13,,45 Extends W.

18h There may be a tendency of the G. to extend a little
19 towards the west.
20h Moonlight shows behind Mtns

21

22h

23.

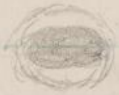
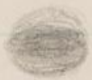
24h

Sunday, Sept. ~~26~~ 27, 1891

Clouds Haze 7.30 Few cirrus clouds at sunset.
Slight haze in valley.

Geg. Axis Position 7.42 G. rather hard to find, should make its long-axis extend
more or less from 0h 05m × −2.5 to 0h 55m × +1
Sid Time about 20h 10m   30 × −0.7

Geg. axis Position 9. ~~02~~ 05 ~~In~~ Pos Sag. axis ~~+ E & W limits~~ 0h 08 × −2.0 to 0.38 × +0.8
23m −0.6

Geg. shape N & S limits 9.08 Shape of Gegenschein  or 
Limits N & S. N. 0.15 from γ Peg
S. 0.2 from β Ceti

Geg. W end brighter & trends N. 9.15 Should ~~rather~~ say that W end of dense portion
might be the brighter. Possibly it has a tendency
to swing towards the N.

Milky Way Wisp near γ Peg + β Ceti Also notice that same wing appearance no-
ticed a few nights ago but it is in same
place i.e. more or less parallel to line
between β Ceti & γ Peg & 2° W with a width of 5°/10

Geg. Position ~~appear~~ Z.B. length centralized 10.08 Should place G at 0h 30m × +1°.3. More centralized than before
Can follow Z.B. easily as continuous from M.W. in Sag
to within 13° of E level horizon.

Geg. large shape 10.15 G. again appears spread out E & W but rather wider
than before say now ^th 0.7 & before 0.5 of length
Observed length about 14°

Sunday, Sept. 27, 1891

Geg. Position shape size

11..18 Should place G. at $0^h 29^m \times +0°.7$. Still elongated and more or less 8° in average diameter.

Note. On first looking out it ~~settee~~ ZB were ~~very~~ brilliant. A long band could

Angle fr. Sun 0^h

Milky Way Mag. Cld Branch

1^h be seen ~~separ~~ partially separated from

2^h ZB (i.e. making a fork with it) could be

3 seen stretching from about $1^h 40 \times +5°$

4 down to Hand of Orion. Suddenly

Changes (probably haze)

5 this disappeared, the ZB became hard

6 to find & the G hard to estimate ones.

7 This extra band has been noticed before

8 Think it may be a branch of the M.W.,

9 but dont know.

10

Geg 11..25 Should place G. at $0^h 20^m \times 0°$ ~~rather more~~

Position shape size

12 about circular & some 11° in diam.

13 The band above referred to separates from

14 ZB about $2^h \times +5°$ & curves down

Milky Way Mag. Cld Branch

15 to S & W of Orion, becomes parallel to

16 M.W. & points to Big Mag Cld but makes

17 a circuit out round it — this, I should

18 add is the course of the W edge.

19

Geg 12..22 20 Should place G. at $0^h 28^m \times -1°.2$. 11° in diam.

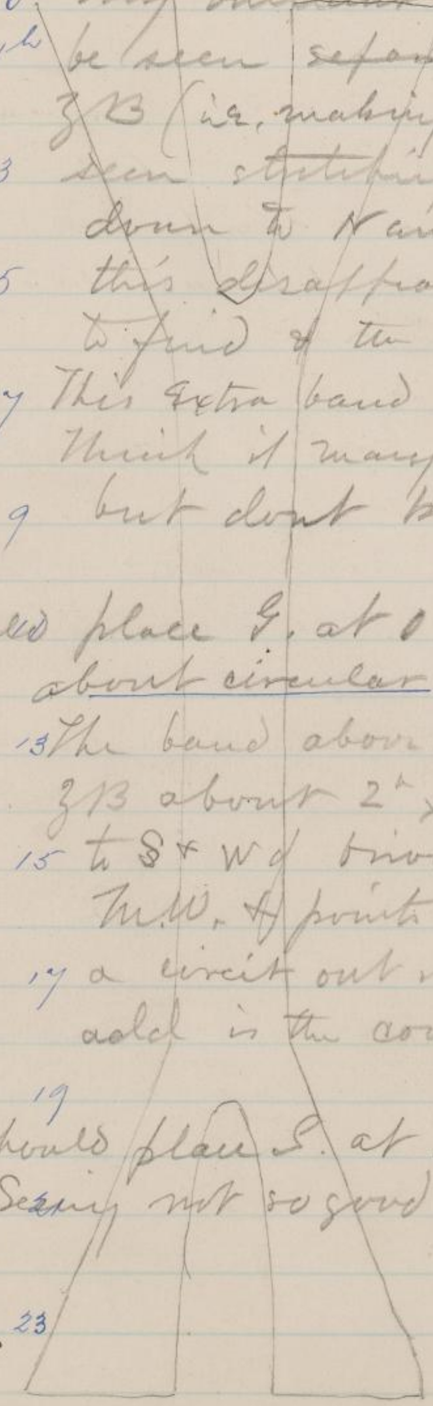
Position size

Seeing not so good now as at 11..18

22

23

24



Sunday, Sept. 27. 1891

Geg. Position shape size ~~11.05~~ 13..05(?) Should put G at 0h 24m × +2°.[illegible]
Shows condensed center 3° in diam but extends more faintly out to 10° in diam. Seems to be perfectly circular.

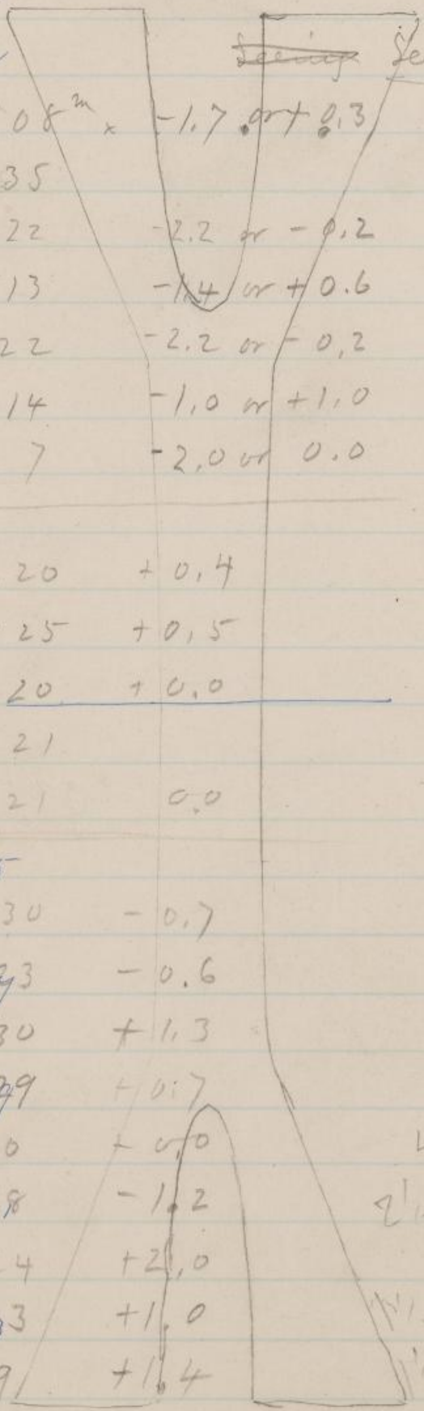
14
Geg. size shape Position 12h20 Diam G. 9° more or less circular, appears like a disc. Should place it at 0h 23m × +1°.0
Note - ~~Rather~~ Slightly hard to locate G. exactly as it seems to be affected by passing vapors or clouds.
Clouds &c S Horizon seems to be a trifle thicker and though there is no mist in valley, high stratus clouds show over the Misti + Bet. Char. + Pichu.

15
Geg. seeing Position 13h10 G hard to see on account of haze high up in atmosphere but should put it at 0.6 from β Ceti to γ Peg i.e. at 0h 19m × +1°.4
Clouds &c Seeing is not as good as earlier in eve, clouds between mountains still low but obscuration of stars is up to 30 or 40°
Moonlight beginning to show in E.N.E.

Sept 30, 91 Condensed on NW side Noted the 30th Observed at this same time that it was more condensed on N.W. side but forgot to put it down

Tuesday, Sept. 29. 1891

Summary of Wub's Observations
Gegenschein.



Angle fr. Sun			0h			Point off		Errors in.		
Sept. 24,	~~1h~~	1h			~~Seeing~~ Seeing	Sun.		R.A., + in		Dec
M.T. 8 ,, 10	2h		0h 08m ×	−1.7 or +0.3	1	0h 06m	+0°.6	2m	ε = 0°.5	0.3 S
10 ,, 05		3	0. 35		½	7	0.7	18m	ε = 4°.5	—
10 ,, 15 to 20	4h		0 ,, 22	−2.2 or −0.2		7	0.7	15m	ε = 3°.8	0.9 S
10 ,, 40		5	0 ,, 13	−1.4 or +0.6		7	0.7	6m	ε = 1°.5	0.1 S
.47	6		0 22	−2.2 or −0.2		7	0.7	15m	ε = 3°.8	0.9 S
11 ,, 00		7	0 14	−1.0 or +1.0		7	0.7	7m	ε = 1°.8 N	0.3 ~~N~~
12 ,, 48	8		0 7	−2.0 or 0.0		7	+0.7	0	ε = 0°	0.7 S
Sept 25		9				11				
M.S.T. 12 ,, 26	10		0 ,, 20	+0.4		~~10~~	+1.1	9m	ε = 2.3	0.7 S
12 ,, 45		11	0 25	+0.5		11	+1.1	14m	ε = 3.5	0.6 S
13 ,, 30	12		20	+0.0		11	+1.1	9m	ε = 2.3	1.1 S
35		13	0 21			11	+1.1	10m	ε = 2.5	—
40	14		0 21	0.0		11	+1.1	10m	ε = 2.5	1.1 S
Sept 27.		15								
M.S.T. 7 ,, 42	16		0 30	−0.7		17	1.8	13m	ε = 3.3	2.5 S
9 ,, 05		17	23	−0.6		17	1.9	16m	ε = 4.0	2.5 S
10 ,, 08	18		30	+1.3		17	1.9	13m	ε = 3.3	0.6 S
11 ,, 18		19	29	+0.7		18	1.9	11m	ε = 2.8	1.2 S
25	20		20	+0.0	4	18	1.9	2m	ε = 0.5	1.9 S
12 ,, 22		21	28	−1.2	2½	18	+1°.9	10m	ε = 2.5	0.7 S
13 ,, 05	22		24	+2.0		18	1.9	6m	ε = 1.5 N	0.1
14 ,, 20		23	23	+1.0	1½	18	1.9	5m	ε = 1.3	0.9 S
15 ,, 10	24.		19	+1.4	1½	18	1.9	1m	ε = 0.3	0.5 S

Tuesday, Sept. 29, 1891

Length in R.A.

9°.0
27.5
20 to 25

~~Same~~ 20 to 25° (?)

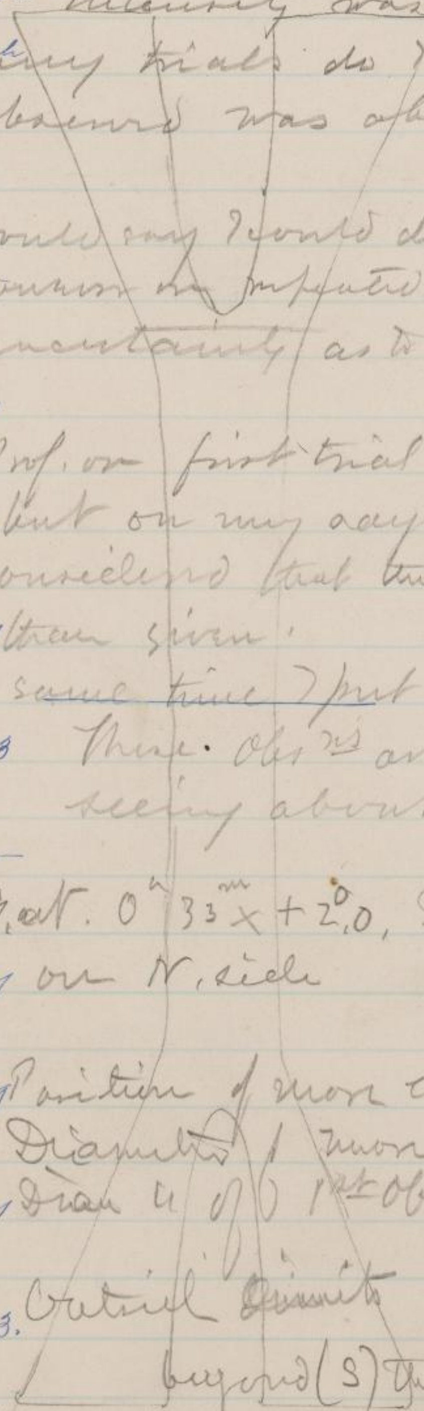
9

4° wide op. [illegible]
8°

17° ?

12½
7½
14 ~~Smaller~~
8
11
11
5° + 10
9

Tuesday Sept. 29. 1891



$8^h 00$ Polarization of Z.L. Have tried a Nicol's prism on Z L as a test for polarization, should say there was a little as if from reflected light but the change in

Angle fr. Sun 0^h intensity was so slight that only after many trials do I say this. The point

2^h observed was about α Librae

3

$8^h 12$ Z.L. Polarization 4^h Should say I could detect it W of β Scorpii also, However on repeated trials there seems to be great

6 uncertainty as to this.

7

$8^h 30$ Gegen. Position 8 The Prof. on first trial placed the G. at $0^h 25^m \times -3$

9 but on my saying it was too far south

10 considered that the center was farther north

11 than given.

Gegen. Position 12 At same time I put it about $0^h 15^m$ by +1

13 These Obs^{ns} are, however, worth very little

14 seeing about ½ to 1.

15

$12^h 10$ Gegen. Position ~~of whole~~ center (Condensing on N) 16 G. at. $0^h 33^m \times +2^\circ.0$, Seems to be more condensed

17 on N. side

18

$12^h 14$ Gegen Position of condensed part size 19 Position of more condensed point at $0^h 24^m \times +1^\circ.7$

20 Diameter of more condensed portion $5^\circ.4$

21 Diam. of G 1st Obs ($12^h 10$) is $14^\circ.4$

22 N. γ Peg.

$12^h 20$ 23. Outside limits S. 0.7 of dist from γ Peg to η Ceti

24 beyond (S) the latter

Inner limit 0.2 from γ Peg & 0.1 fr. η Ceti.

~~Thurs.~~ Tues. Sept. 29, 1891

Geg.
position
size

Geg. nearer N side
of Z.B.
Possible
correction of
previous obsns

12.25 Should place G as same position as at 12.14
Should call it circular + say 6° in diam
shading off still larger, Should say it
has a tendency to be located on northern
side of Z.B. This has been noticed
before but not allowed for in esti-
mating position, so possibly the southings
on ~~pages~~ 174 ~~&~~ may be partly explained
Should give it in general this appearance

~~Upper~~ Curve here is too sharp but
is not parallel to axis of Z.B.

(N ? Nov 22 93)
~~(this side North. H. Feb. 4. 99)~~
~~(Geg was some 20° N of zenith)~~
(evidently N - from text above)

Wednesday, Sept. 30, 1891

3 polarization 7 h 05 After repeated trials should say there might be polarization in the Z. L.

3 Z polarization 7 h 20 Think that the polarization about α Librae is a little stronger than 15m ago

Angle for Sun 0h

1h

Geg 10 h 30 Position shape size seeing 2 & 3 2h G. long. Axis in line from 29 Piscium to μ Piscium.

3 That makes it about 19° long.

4 Center between 51 Piscium & ζ Ceti, 0.3 fr former

5 That makes it $0^h 38^m$ * $+ 0^\circ.6$, Width 8°

6

Geg 10 h 45 Position shape size 2 to 3½ seeing 7 Should place G. in line between 51 Piscium and

8 ζ Ceti 0.35 from former. Diam 0.55 of distance

9 Pretty well rounded but showing the circular shape best on S. side

10

11 That puts it at $0^h 22^m$ * $+0.8$. Diam 9°

12

13

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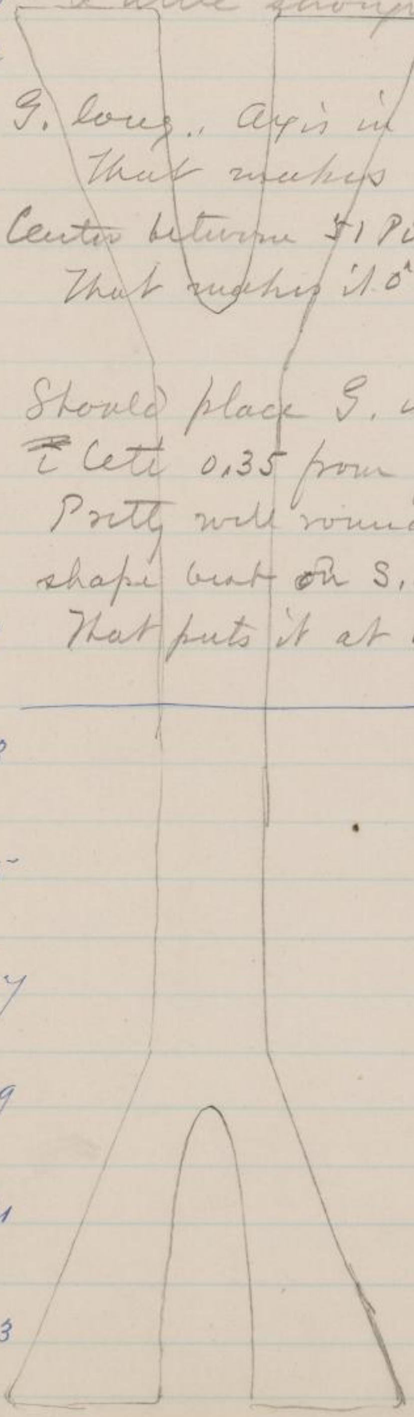


Sunday. Oct. 4. 1891

Z.L. Polarization.

7h 30 Should make polarization in Z.C. rather stronger than I have seen it before. Very slight at α Librae but much stronger about head of Scorpio – β, δ, &c.

Thursday. Dec. 17. 1891

8h 00 to 8h 10

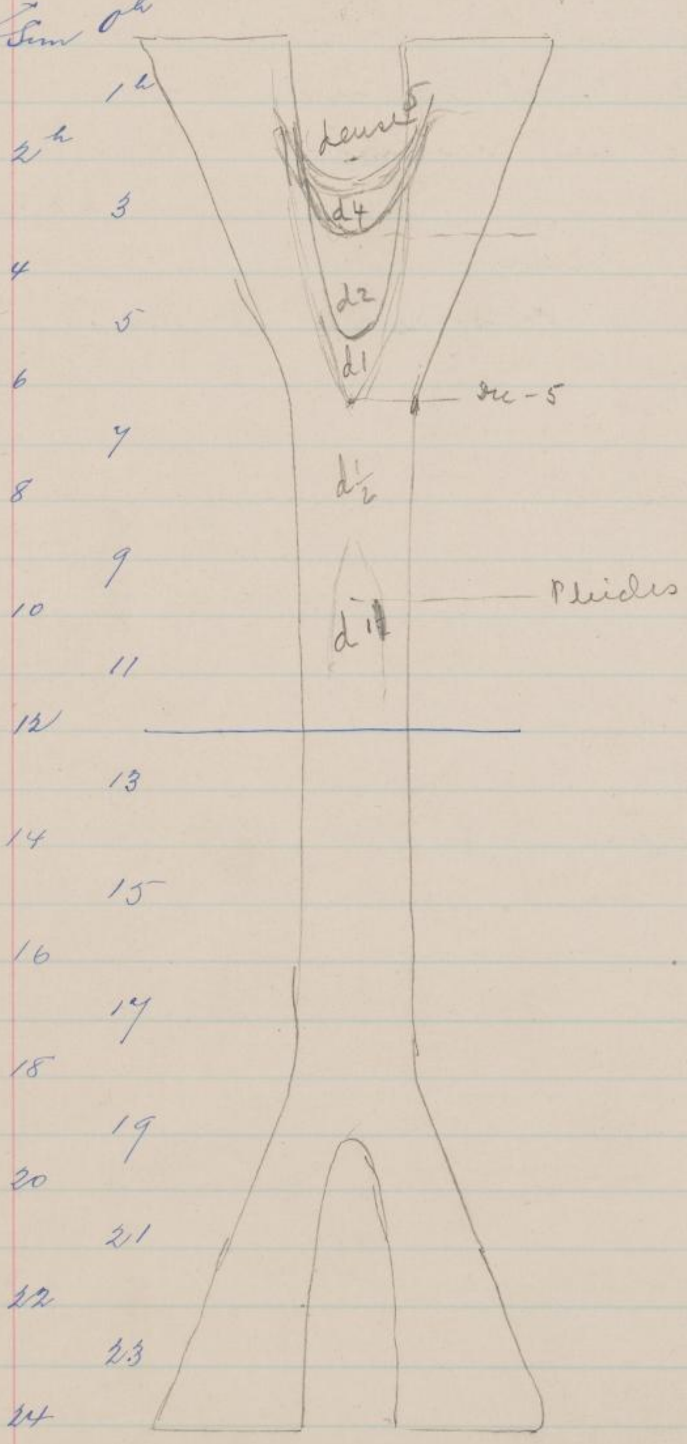
axis from 19h ~~35~~ 33 × ~~+17~~ -22 δ5

R.A. of sun ± 17h 40

Angle fr Sun

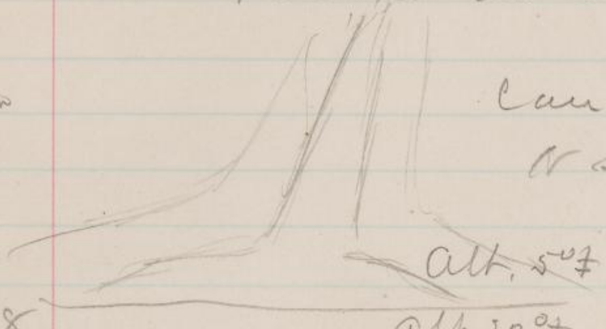
Z.L. Z.B. Beginning of Seg

Axis Intensity



Thursday, Dec. 17. 1891

Z L Changes in intensity Changes in shape 8..10 + Seems as if Z L had become much stronger in last few min. but I can't tell how much is due to eye getting used to it. Spreads out now much more along horizon & is more pointed ~~east~~ eastwards in center thus:-



absorption Can see effect of absorption on N side to 15° alt.

alt. 5° ±

alt 20° ±

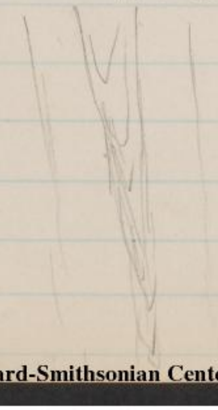
Z L + Z B Axis

8..18	Axis 20..22	x −19.0	d 4
8..21	21..35	x −15.7	d 3 to 4
..22	23..08	x − 6.5	d 2
24	23..50	x −1.0	d 1
30	0..43	x +2.0	d ½
	3..05	x +19.	

Milky Way Very difficult to separate it here from branches of Milky way.

Z B Width General width more dense streamer 4 or 5° of faint part 30°

Z L, Z B, shape More or less like this on towards S.

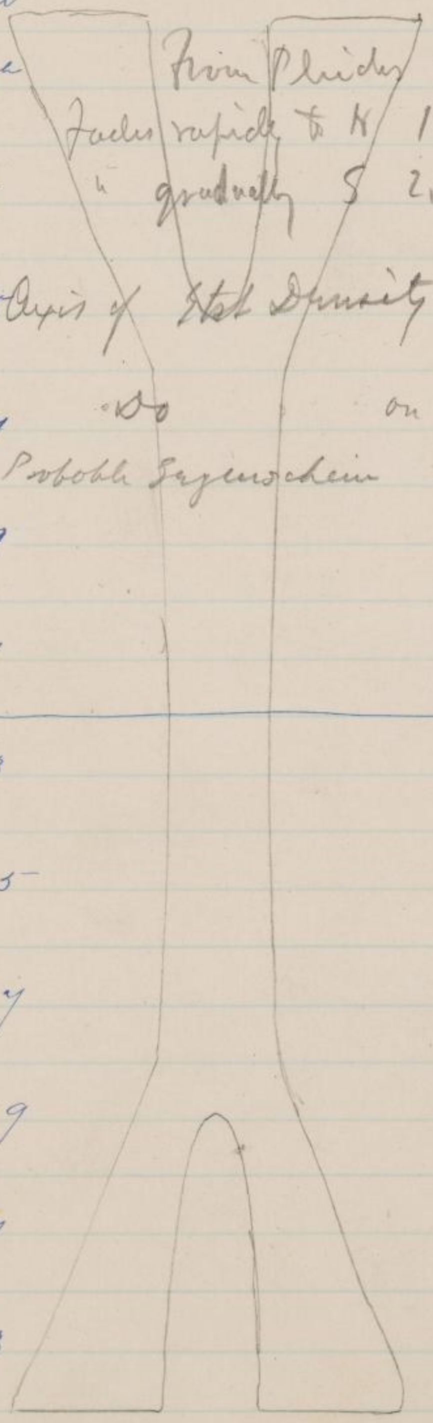


Sunday. Feb. 21, 92

z.L. axis 8h15 axis of greatest density z L through Venus—just set.

Do 2h07 x + 13.0

8h20 Do 3h58 x + 21.7



Angle fr Sun 0h

absorption

1h From Pleiades to Hor it shows absorp. on N side

8h25 2h Fades rapidly to N 1h56x+18

Dif. bet. sides + positions

3 " gradually S 2h30x+6

4

z.B. axis 8h35 5 Axis of Grst Density 8h33x+20.5

6

8h36 7 Do on Regulus 10h05x+12.6

Geg. Position 8 Probable Gegenschein near belt to N. 10h15x+15.7

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

Mon. Feb. 22. 92

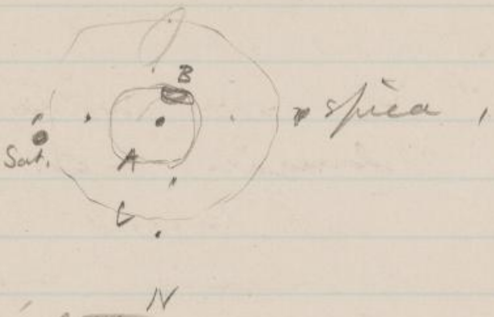
12h10 Midnight.

Obsd G. at 10h20 R.A. & +15°.3 . 10° in diam.

Geg. Position size

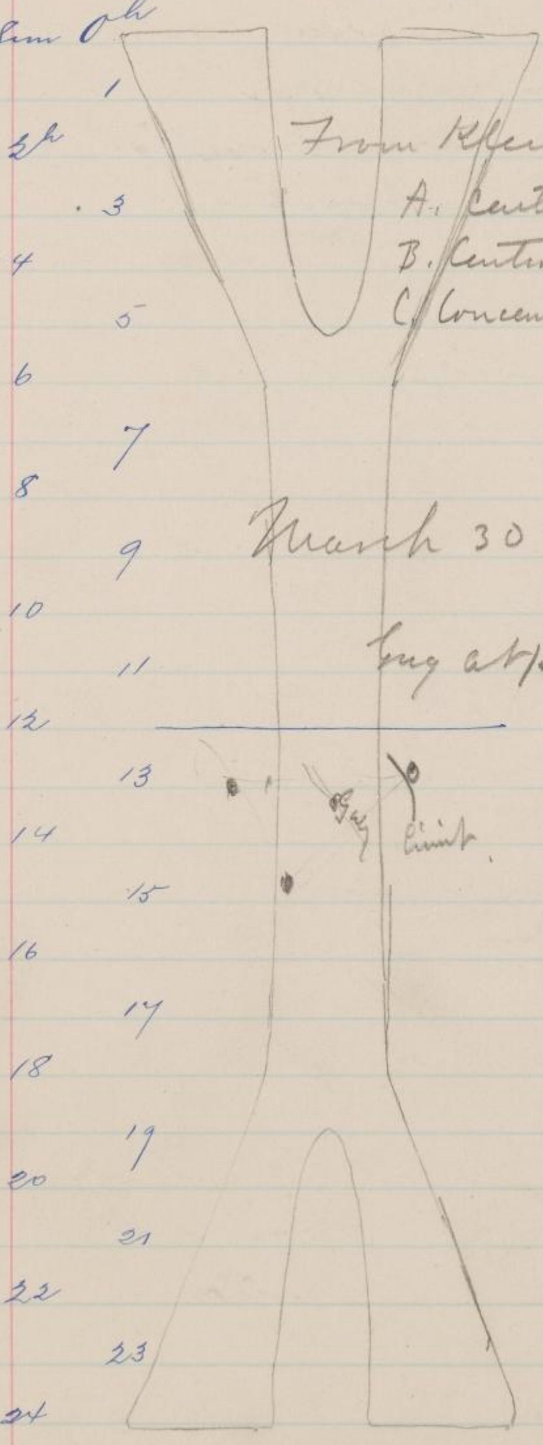
Tuesday, March 29. 92

12,,30 to 35.



Geg. Position Angle fr. Sun

Reduction from Klein



From Klein's Atlas.

A. Center 12,,35 × + 0.3 Radius 5°
B. Center 12,,42 × − 4.2 Diam. 3°
C. Concentric with A. Radius 13°

March 30 (from Bache Book No 64 pg 42)

Geg at 15,,50 S.T.

• Spica.

Geg. position

Position = 192°.6 × + 1,4

♄ Saturn

All positions in red ink which are in this book are from Heis' Atlas of the Zodiac.

Monday. April 18, 92

M.S.

8.25 At 7.45 noticed Geg in east as much elongated - at first called it eastern Zod. Light. ZL in west went up to zenith - then was fainter till pretty well east & then from 30° above hor, Geg showed brilliantly.

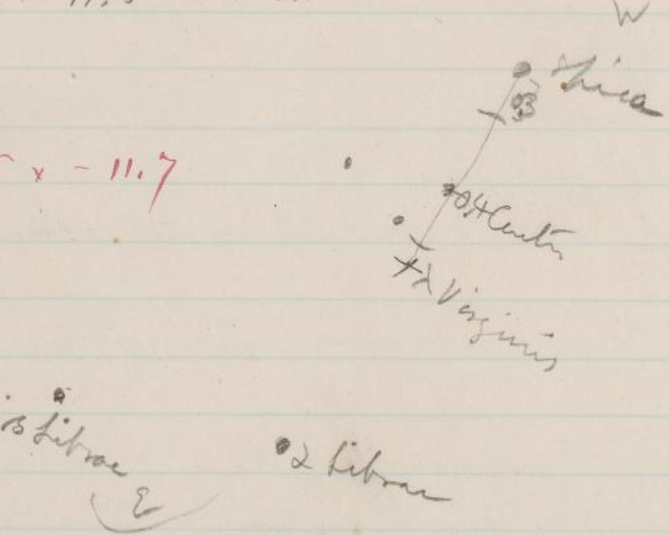
Geg. shape intensity

W.Z.L. tip.

8.33 Geg. 13.52 x - 11.5 = 208.0

Geg. Position shape size E & W

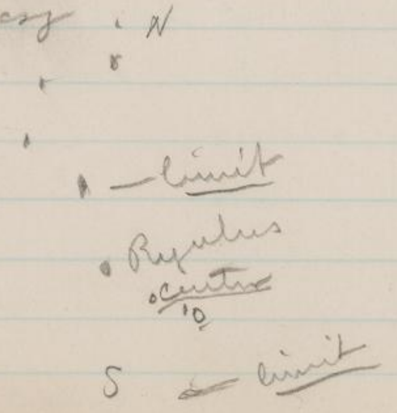
From Hris
207.5 x - 11.7



Seems to be cut off towards E but extends nearly to β Virginis on W.

Z.L. apex width

Z.L. at β Virginis - centre on β & has radius = distance to η Virg.



0.6 from Procyon to Castor
thus width of 0.6 that
distance

9.00 P.M.

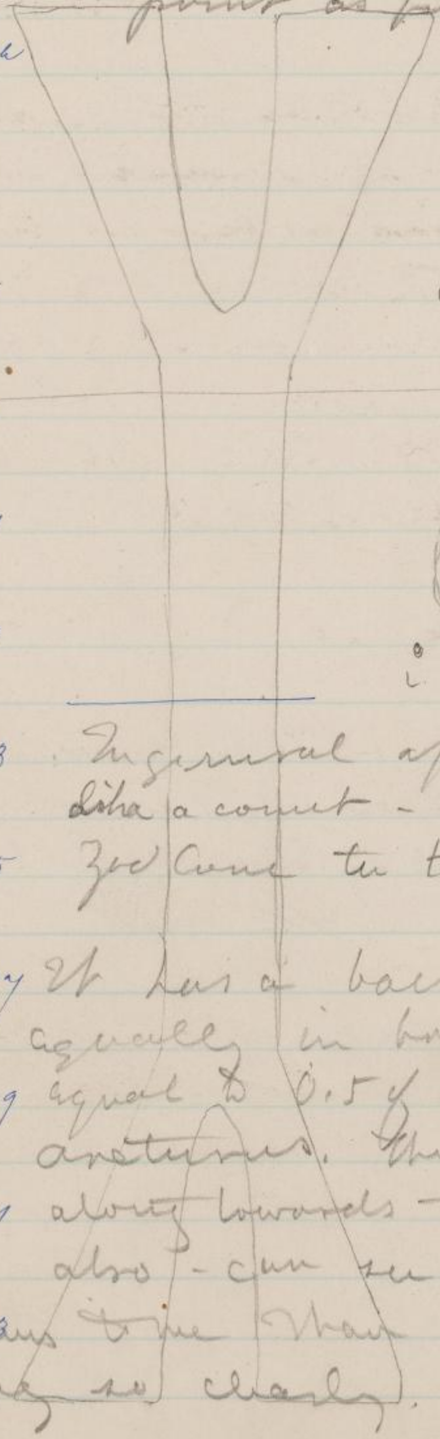
Tuesday April 19, 1892

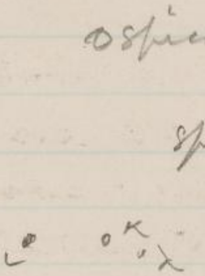
Geg. 8h 44 — method of Observing

Find a good way of Obs'g the Geg to be:- to swing my eyes round & round it, getting it by indirect vision. locate densest point as follows

Angle fr. Sun — Geg Position

0h
1h
2h
3
4
5
6
7
8
9
10
11
12



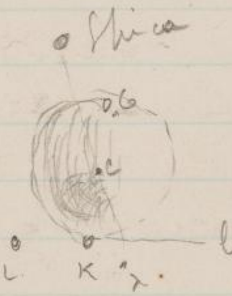


o Spica

Spica 0.8 towards κ

α 13h ~~50~~ 57 from Kleins. x − 10

8h 47 — Geg Position



o Spica

Sp. 0.6 to λ center

limit at κ.

Geg + Z L appearance

13 In general appearance it impresses me
14 like a comet - Geg is the head and W
15 Zod Cone the tail - Muss!

16

8h 55 — Z L limits

17 It has a background extending
18 equally in both directions a distance
19 equal to 0.5 of dist from its center to
20 arcturus. This seems to be continuous
21 along towards the W Z.L. & probably to E
22 also? - can see begin. of E Z L faintly.

Intensity

23 Seems to me I have almost never seen the
24 Geg so clearly.

Tuesday April 19.92

8h58 There seems to be a band about 3° in width going from Leo past β Virg. about half way between β & γ Leonis position 11h35 + 1°.5 This is densest of band

ZB axis width.

9h06 Seems as if whole band were now spread out with less condensation as above indicated - going as far as Arcturus with a central concentration about 15h50 + 3.5 and some 12° wide.
With this apt. widening I notice the same haziness within 30° of Zodiac as mentioned last Aug or Sept

ZB spread out

ZB condensed part

Haze

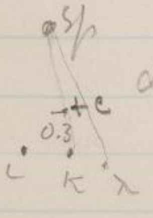
ZB 9h11 Densest region of ZL at 10h00 + 15 - 12° wide

axis width

9h14 Densest reg. Pollux 0.35 to Procyon decreasing more suddenly on N - owing to Almos atmosp. width 0.3 of the whole dist.

ZB axis Dif bet. sides width

9h18



densest part -

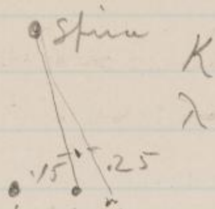
Next less dense part same center & limit κ

Geg Position Concentric contours

Wed. April 20, 1892

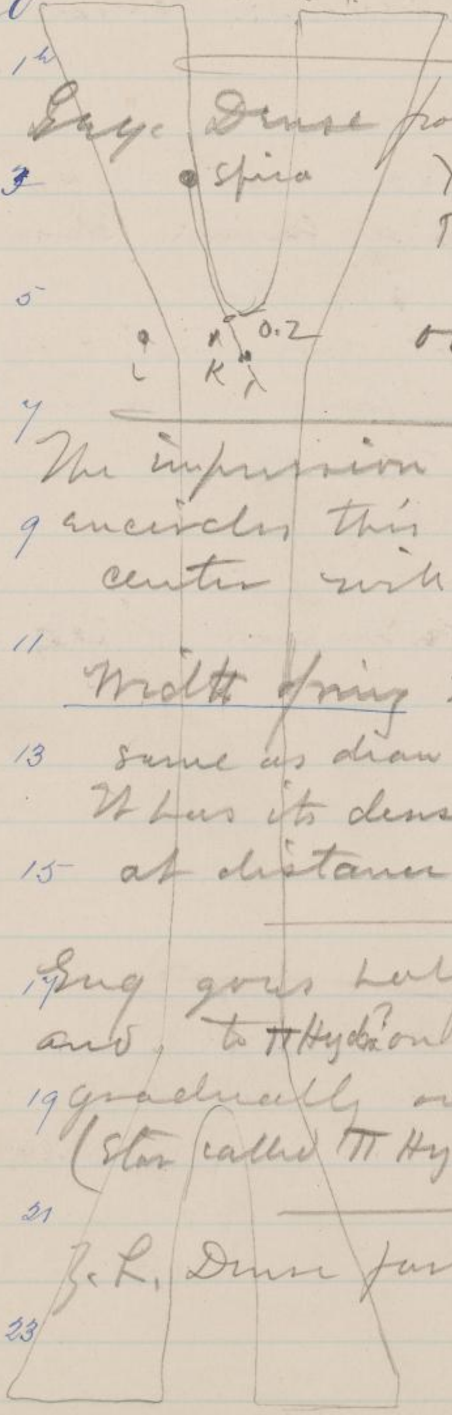
R.M.
8,,50 Geg. Position

Geg.



K 0.15 to Spica } central Bet,
λ 0.25 " " }
or 13,,54 x − 11°.3
Dense portion

Angle fr. Sun 0h



1h

9,,13 2h Gege Dense portion.

Geg. Position 3 λ 0.2 to Spica

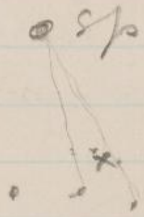
4 Rad = 0.1 of ~~[illegible]~~ λ to Sp. or ~~[illegible]~~ 1°.3

5

6 or 13,,57 x − 12,1

7

9,,17 8 The impression I get is that a ring 9 encircles this dense part whose 10 center will be



13,,57 x − 12

11

12 Width of ring 2°.6 or 13 same as diam of ~~nuc~~ nucleus (!) 14 It has its densest portion 15 at distance of 1 or is 8°.0 in radius,

Geg Ring Encircled by Ring 2°.6 wide 8° Radius Position dense

16

9,,24 17 Geg goes half way to Arcturus on N 18 and to π Hydrae on South – decreasing more 19 gradually on S (20 (Star called π Hydra has position 14h00 x − 26) (π Hydrae is right)

Geg limits pos. dif. tot. sides

21

9,,29 22 β L. Dense part central β 0.2 to star NNW 23 or 11,,43x + 3°.7 24 width 10°.

β L. Apex width 1

Wednesday April 20 . 92

Z.L. apex limits — 9h33 Z.L. Dense portion 20.4° E of Leonis. limit γ or 10h01 α + 14.5. Width. 14°.0

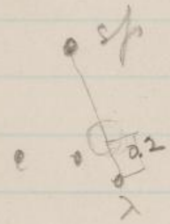
Geg. Position — 9h44 Prof puts Geg at 13h59 α − 10.2 or Spica 1/8 to κ

Z.L. axis width — At about 9h38 I made Center of Z.L. Castor ½ to Procyon and width 0.6 of that dist.

E Z.L. approaching M.W. — 9h48 E Z L goes about towards β Scorpii but is difficult to follow on account of being faint - approaching M.W.

extra wide Z.B. — Should say that a band of width as given of faintest limits of Geg. followed the Zodiac more or less continuously

Geg: Position size — 9h52 Geg.



size as before.

Geg: shape of outer portions — 9h55 Geg. Can't get any definite circular outline outside the nucleus - it spreads equally in both directions - κ is N limit. It may be a little elongated - if so it extends more towards W (& zenith) than E.

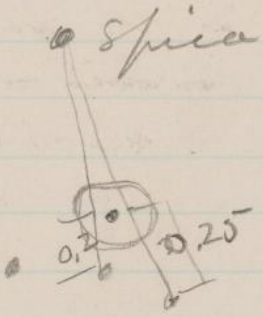
Wednesday April 20. 92

Geg: fainter spread out

11h45 Gg much fainter than earlier in eve. It is almost imperceptible. So far as I can tell Gg as same position as earlier in eve and is spread out - faint with c Virg. as limit.

Geg: Position size: Hard to locate

11h56 Should put nucleus thus

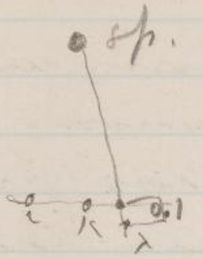


~~G~~G. is very hard to locate,
/ &

Thursday April 21, 92

Geg position

9.06 Geg.



Dense portion λ 0.1 to α & in line with ι & κ. Extends a little over 0.5 to λ (i.e. from its center to λ) or 14.05 × −12.5. Diam 2°.0

Geg & Z.L. brightness at 8.30

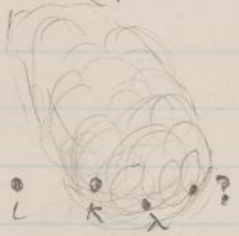
On looking for Geg. & Z.L. at 8.30 ~~it~~ and earlier it seemed much fainter than last evening & evening before. It would be well to see if it doesn't brighten on approach of moon — for if it is an electrically illuminated tail it ~~so~~ would very likely be affected by approach of moon.

suggestion

Geg & outer portions

9.12. Outer portions

α = ⊙ Spica



Surrounds κ λ & ? & goes λ 0.8 to α.

Geg & W Z B extension apparent change in intensity

9.17 On looking at it just now I got the impression of much greater general illumination throughout Geg & W Z B. — In region of ♍ it ~~extended~~ equally fair plainly to S half way to Arcturus. The W Z B was equally wide But whole seemed to go back to former faintness in 10 or 20 sec.

Thursday. April 21, 92

9.2[illegible] Think the above was due to catching it by indirect vision: for by fixing eyes on a point & revolving head the whole arch comes out in startling plainness - that indirectly is the way to look for it.

change just noted due to indirect vision method of obs'ing

9.26 Should put brilliancy of middle region ~~area~~ of Seg - (given above 2nd) as just equal to region ½ between Southern Cross & 3d mag stars a few degrees to N of it.

Seg. Brilliancy ✗

9.30 Should describe Z.L. in full as last night except between Castor & Procyon it appears say Castor 0.4 or 0.45 to Procyon.

Z.L. axis

Tuesday. April 26.92

R.M.
10..00 Geg ~~at~~ λ Virg 0.3 to β Librae. - dense portion perhaps 2°.5 in diam. Outer portions extend mostly to N.

Geg Position size dif. bet. sides

15..30 Geg. ~~at~~ λ 0.2 to β Lib. diam = 0.2 of dist λ-β outer portions extend mostly to N
L as a limit - Symmetrical E+W

Geg Position size

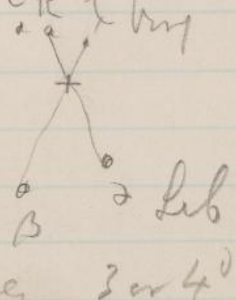
15..35 Geg λ 0.2 to β or in line between λ 0.3 to α Lib & λ 0.4 to μ Virg.
Z L shows brilliantly in East from 10° above hor to M.W. Shows more faintly in ~~so~~ west from 20° above Hor to M.W. W Hor is perhaps 8 or 10° lower than E horizon.

Z.L. & Z B full extent / Geg Position

15..50 by swinging ones head the W Z arch comes out in great distinctness.

W Z B aid by swinging head

15 55



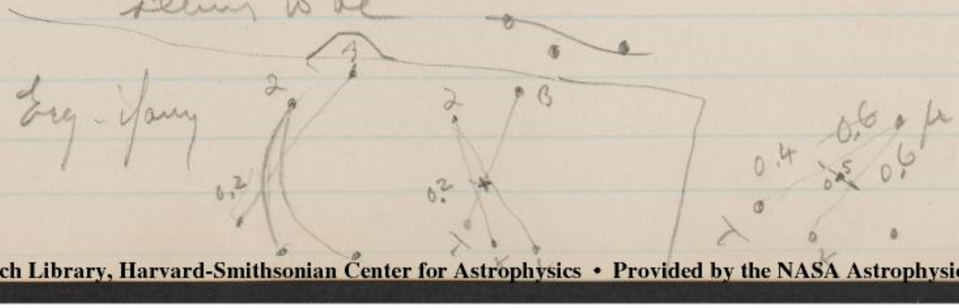
Geg. Dense part.

Geg Position

16..03 Geg 3 or 4° in diam & hard to see
seems to be

Geg Position size

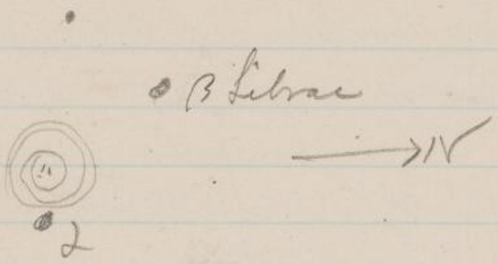
16..23 Geg - if any



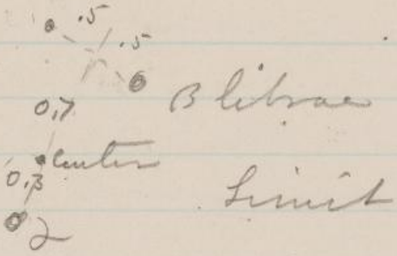
Geg Position

Wed. May 4. 92

May 2. 92 Geg. Position — Night before last I made an Obsn on Geg.



14.25 Geg Position size — Put Geg

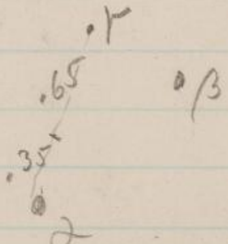


Limit 2.

14.40 Geg. Position size shape — I make Geg considerably elongated extending from κ Virginis to γ Librae and 10° wide. Should put the most condensed spot at γ Librae

14.50 Z.L. axis & 2 limits — Z. L. in East.
Center of density δ + γ Capricorni - 0.25 to β Aquarii
limit of dense portion δ+γ Cap 0.5 to β Aquarii
outside northern limit δ+γ Cap to β Aq + Same/2

14.56 Geg. Position size shape — Geg. dense portion :-



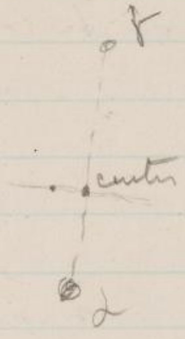
2 0.35 to γ Librae
~~Limit~~ to 0.05 γ of 2.

Dense portion symmetrical - Elongation above noted, shows well. Noticed before that its faint portions extended farther and more

Wed. May 4. 92

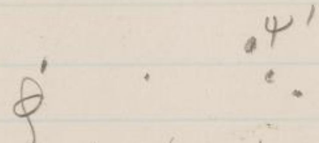
gradually to the N than south,

15.40 Geg. Geg position size



α is W. limit.

15.45 Z L in E. EZL axis width



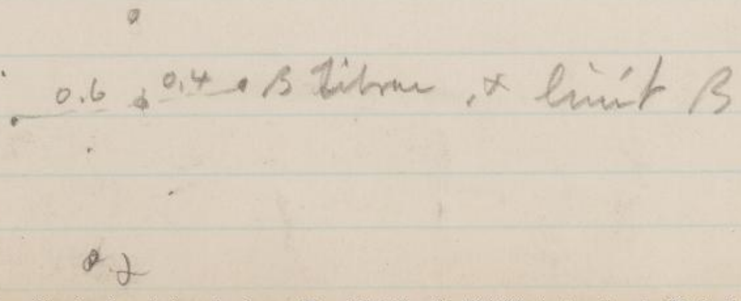
Center of densest part · ψ 0.6 to φ & has a semiwidth of ψ to φ Aquarii

50 Should put densest center exactly on φ EZL axis limits
limits S φ to ψ + $\frac{1}{2}$(φ to ψ) S
N. φ to ψ north of φ

53 Outer limits S. ζ² Aqu. EZL outer limits
N. γ Piscis

16.02 Extreme limits S - Fomalhaut EZL extreme limits
N - α Pegasi,

16.09 Geg. Geg Position size



Wed. May 4. 92

16h15 Z.L. spreads out and increases in brilliancy on meeting horizon light. Dense center at $\frac{1}{3}$(33–29 Piscium) north of 29 Piscium S. limit – dense part goes about equally far S of south side of that little Quadrilateral. This widening out ~~on~~ approaching horizon may be a cause of appearance of separate cones. as it is then seems to be a tip to an inner & brighter about half way between δ Aquarii & δ Capricorni

Z.L. shape at horizon
axis
limits
Double cone to
explain widening
at base :

Friday. Aug 19. 92

Geg. Position size limits 9.10 Gegen. ι Aquarii 0.3 to δ Capric. 21.55 × -15.0
densest portion 3° in diam
E limit 42 Aquarii (= 4°.5 from center.
W " γ Capric. (= 6°.0 " "

Geg Position size 12.05 Gegen. on ε Aquarii (22.04 × -12.3)
more or less circular -
diam. of dense part 3°
" " less " " 7°

Geg Position size elongation 14.10 Gegen. 22.10 × -11.8, θ 0.5 to 42 Aquarii, 8° in diam and pretty faint, may be elongated considerably to the E & possibly some to the west, but mass interferes in that direction.

Geg Position size Def. bdt. sides 15.22 Gegen. in same position as last Obsn, more spread out say 10° in diam. The ZB here grades off more sharply to N.

Sat. Aug 20. 1892.

P.M.

8h03 Gegen. (22.08 × −12.0) e 0.2 to 58 Aquarii. Seems to show absorption & ~~East~~ but extend a good way to west. rather hard to see.

Geg. Position shape absorption

12h03 Gegen. on e Aquarii (22.05 × −12.0)

Geg. Position

14h54 Gegen. 42 −0.3 to θ Aquarii (22.11 × −12.0)
Center 3° in diam.
outer part 10° in diam.

Geg. Position & size

Sunday. Aug 21. 92

10h 19 Gegen on 50 Aquarii 22h 18m δ −14
Dense part 5° in diam
Outer part large & round; 16° in diam

Geg & Position size

11h 57 Gegen. (e) E 0.3 & 58 Aquarii 4° in diam
outer part as before. In general
it fades more suddenly to N.

Geg & Position size

14h 24 Gegen. on (e) E Aquarii i.e. densest part, diam = 3½°
has a tail extending E to x Aquarii
average width 8°. Mass may
interfere in other direction.

Geg Position size Tail

For 58 Aquarii See next page, σ Aquarii is meant.

Mon. Aug 29. 92

14h 12 Gegen ½ way betw 58 & λ Aquarii (N.B. this star 58 is designated as the letter for the brighter star near it is indistinguishable) : is equal to ½(58 to λ) in diam of denser part and reaches to ι in fainter part but not faintest. It is pretty circular & decreases more or less regularly in all directions. (Geg. = ~~20~~.36 × −9°.5
22h 35.5 −9.7)

Geg. Position size limits

Thurs. Dec 22. 92

3L brightness

8.30. At 7.50 with the moon still 20° to 25° high the zod. light ~~lt~~ showed ~~bright~~ without trouble or the necessity of hiding the moon behind something.

do at this time of year

shape at this part of year

For some time it has been very bright showing clear down to the horizon at 8h00 P.M. It has been very long and narrow stretching to the zenith (at 8h) & 15 to 20° wide. However at its set at 11 to 12 P.M. it has spread out to double this width and the general horizon-light became more marked.

Theory

It seems as if this ring had some definite shape as now the W Z L appears as long & slender which at other seasons it appears short and broad.

Epoch 1855

1897	Mexican M.T.	R.A.	Dec.		λ	β	λ		
Jan. 26	13 00	~~130.4~~	~~+16.2~~	20° {near M.W.}	128.6	−1.9	129.2	127.6	+1.6

Epoch 1855.

1897. Mexican M.T.	h m	R.A.	Dec.		1855 λ	β	1897 λ	λ App. Sun.	Δλ
Jan. 26	13.00ᵐ	130.4	+16.2	20° {near M.W.}	128.6	−1.9	129.2	127.6	+1.6
″ 27	11.35	130.6	+16.2	13 ″	128.7	−1.9	129.3	128.6	+0.7
Feb. 7	9 50	143.1	+15.0	7	140.6	+0.4	141.2	139.7	+1.5
1897 Flagstaff M.M.T.									
Nov. 22	10 26	46.8	+17.4	6°	49.2	−0.1	49.8	61.2	−11.4
Dec. 24	12 00	95	+22	— {Near M.W.}	94.6	−1.3	95.2	93.8	+1.4
1898 Flagstaff M.M.T.									
Jan. 13	11 38	112.3	+21.0	9	110.7	−0.8	111.3	114.1	−2.8
″ 14	10 13	116.0	+21.0	7	114.2	−0.3	114.8	115.1	−0.3
″ ″	10 20	117.0	+22.0	7	115.0	+0.8	115.6	115.1	+0.5
″ ″	12 10	116.0	+21.0		114.2	−0.3	114.8	115.2	−0.4
″ 16	9 15	119.0	+21.6	8	116.8	+0.8	117.4	117.1	+0.3
″ 17	12 43	121.5	+20.5	7	119.3	+0.2	119.9	118.2	+1.7
″ 18	9 40	121.2	+20.6	10	119.3	+0.3	119.9	119.2	+0.7
″ 19	8 55	122.6	+20.6	8 ring	120.3	+0.6	120.9	120.2	+0.7
″ 20	11 40	{122.2 {123.5	+20.5 +20.2	5 11	{119.9 {121.2	+0.4 +0.4	120.5 121.8	121.3	{−0.8 {+0.5
″ 22	12 48	125.5	+20.0	5	123.1	+0.6	123.7	123.5	+0.2
″ 23	14 50	126.4	+19.9	7	123.9	+0.6	124.5	124.5	0
″ 24	12 33	127.1	+18.0	7	125.0	−1.0	125.6	125.4	+0.2
″ 25	13 39	128.8	+18.0	8	126.6	−0.6	127.2	126.5	+0.7
″ 29	13 15	132.8	+18.5	5 Moon 6° Alt. W	130.1	+0.6	130.7	130.5	+0.2
″ 30	13 20	134.6	+17.6	Moon 1st qu. 8 Moon 20° Alt. W.	132.0	+0.4	132.6	131.5	+1.1
Feb. 9	9 40	142.4	+15.1	6 Moon 1° high E.	139.9	+0.3	140.5	141.5	−1.0
	9 33	141.8	+15.2	24 + 12 — ☽ ?	139.3	+0.2			−2.6
″ 10	9 43	143.4	+15.0	5	140.8	+0.4	141.4	142.5	−1.1
″ 12	11 40	143.7	+13.5	5	141.6	−0.9	142.2	144.6	−2.4
	11 45	145.6	+13.3	4 (or same as last. D. 12°)	143.5	−0.4 ?	144.1	144.6	−0.5
″ 13	11 35-40	146.5	+13.0	3½	144.4	−0.4	145.0	145.6	−0.6
	″	144.6	+13.8	6	142.4	−0.3	143.0	″	−2.6
	″	146.5	+13.0	3½ (?)	144.4	−0.4	145.0	″	−0.6
″ 14	12 00	147.9	+12.9	6	145.6	−0.1	146.2	146.7	−0.5

Feb.	15	12	22	148.2	+13.3	5	145.8	+0.4	146.4	147.7	-1.3
"	18	11	28	154.5	+12.1	6	152.0	+1.5	152.6	150.7	+1.9

1897. Elsinore (S.T.)	P.S.T.	R.A.	Dec.	Diam.	1855 λ	β	1897.8 λ	λ opp. sun.	Δλ
Oct. 30	9. 50	31.6	+15.5	—	34.8	+2.5	35.4	38.1	-2.7
1898. Elsinore									
Feb. 11	9 34	143.0	+12.5	3	141.3	-2.0	141.9	143.6	-1.7
" 12	9 30	145.5	+13.4	3	143.3	-0.4	143.9	144.6	-0.7
" 13	9 05	147.8	+12.4	2	145.8	-0.6	146.4	145.6	+0.8
" 14	9 00	149.3	+14.5	2	146.4	+1.8	147.0	146.6	+0.4
" 15	9 04	151.0	+13.0	2	148.5	+1.1	149.1	147.6	+1.5
" 20	9 09	153.5	+11.8	4	151.2	+0.8	151.8	152.6	-0.8
" 23	9 40	156.2	+10.6	3	154.1	+0.7	154.7	155.7	-1.0

3f Polarization

7.45

Oct 4 Found Z l very slightly polarized being brightest when long diag of Nicol was vertical. Found it most marked just below δ Sext than around α Leonis though it was much brighter near latter.

8.05 Repeated near δ Scorpii with same result. Sky at equal alt. on either side & milky way showed no such effect.

W.H.P.

HARVARD COLLEGE OBSERVATORY,

CAMBRIDGE, MASS.

Recd at Flagstaff, Nov. 2 96

Oct. 29, 1896.

Dear Mr. Douglass,

Herewith I enclose a copy of your Gegenschein observations of 1893 (including those given in your letter) as they stand in the book here. I have added in red ink the values just received from you. The differences may be due to errors of reduction but more probably to different estimates of α and δ on the charts. In some cases you gave two positions (see Oct. 12 and 14, 1893) for the same time, because two maxima were observed, or because the maximum of light was not at the centre of the space enclosed in the contour line.

In my reduction, I took account of the change in longitude due to precession since the epoch of the chart, and probably you did also. In some cases, I had the α and δ direct from you, in others I had only the original drawings.

My article containing the results of your observations and those of other observers, which has been ready for publication for about two years, has now been sent to the printer. Early proof will be sent to you, so that if you wish to have any of your results changed, it can be done. Professor Pickering is desirous of having the published article in conformity, as regards the figures, with any other publication which you may make, and of course you are the best judge what the figures should be in any particular case. Perhaps the article can be printed early enough to be of service in your present work.

I am glad to hear that you have been pursuing your observations. I do not hear of any other observer of Gegenschein at the present time.

Very truly yours

Arthur Searle.

A. E. Douglass, Esq.
Lowell Observatory, Flagstaff, Arizona.

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