LAWS OBSERVATORY
UNIVERSITY OF MISSOURI

BULLETIN NO. 11

THE VARIABLE RS CASSIOPEIAE (108.1904)[1]

BD.+61°2487, $9^{m}.3$, 1855.0 R.A. $23^{h}30^{m}29^{s}$ Dec.+61°37'.7
1900.0 32 33 52.6

The variability of this star was discovered by Madame Ceraski from plates made by Blakjo at Moscow, and was announced in A. N. No. 3953. The photographs indicated a variation from the ninth to the eleventh magnitude approximately. Observations by Miss Whitney at the Vassar College Observatory, A. N. No. 4050, confirmed the variation and gave a range in brightness of $9^{m}.7$ to $10^{m}.4$. The following provisional elements, based upon observations made here, were announced in Laws Observatory Bulletin No. 10.

$$\text{Min.} = \text{J.D.}2417412.50 + 6^{d}.298E, \qquad \text{G.M.T.}$$

The present paper contains a revision of these elements and a discussion of all the observations thus far obtained.

Measures were made upon 101 nights during the interval 1906, July 18, to 1907, March 5. In all, 262 observations were secured. Of these 68 are by Professor Seares, all made between 1906, July 18, and November 9. The remaining 194 observations are by me. My own observations antedating 1907, January 1 were made with the right eye. Since that time it has been necessary to use the left eye, a circumstance which may have introduced a slight systematic difference into the series.

The instrument used was the equalizing photometer with the Zeiss wedge, described in Bulletin No. 7, attached to the 7½-inch equatorial.

The comparison stars used were a = BD.+61°2486, $9^{m}.1$, and b = BD.+61°2481, $9^{m}.4$. As usual, the settings were so arranged as to give not only the differences $v-a$ and $v-b$, but also that of $b-a$, and, at the same time, to eliminate any uniform changes in atmospheric extinction and in the intensity of the comparison star.

[1] The observations and discussion contained in this Bulletin have been made, in part, with the assistance of a grant from the Gould Fund of the National Academy of Sciences.

TABLE I

OBSERVATIONS OF RS CASSIOPEIAE

Date	G. M. T.	Julian Day	Phase	Obs.	Star	Wedge	$b-a$	Δm	Mag.	O − C
1906, July 18	$19^h\ 37^m$	2417410.82	$4^d.51$	S	*a*	24.1 28.1	$+0^m.45$	$+0^m.43$	$9^m.52$	− 18
				S	*b*	28.3 29.0		+ 0.08	9.77	+ 7
20	17 42	7412.74	0.13	H	*a*	21.4 30.3	0.47	+ 0.96	10.05	+ 1
				H	*b*	25.8 30.4		+ 0.50	10.19	+ 15
	20 4	.84	0.23	S	*a*	19.0 27.9	0.61	+ 0.95	10.04	+ 2
				S	*b*	24.8 28.9		+ 0.45	10.14	+ 12
21	16 14	7413.68	1.07	S	*a*	26.0 29.6	0.67	+ 0.40	9.49	+ 2
				S	*b*	32.0 30.0		− 0.23	9.46	− 1
23	17 15	7415.72	3.11	H	*a*	25.6 27.8	0.49	+ 0.24	9.33	− 12
				H	*b*	30.1 28.4		− 0.19	9.50	+ 5
24	18 10	7416.76	4.15	S	*a*	24.6 28.6	0.45	+ 0.44	9.53	− 10
				S	*b*	28.7 28.4		− 0.04	9.65	+ 2
25	17 28	7417.73	5.12	H	*a*	27.6 34.3	0.52	+ 0.74	9.83	0
				H	*b*	32.3 34.4		+ 0.23	9.92	+ 9
26	16 2	7418.67	6.06	S	*a*	31.0 39.8	[0.57]	+ 0.96	10.05	+ 2
	6	.67	6.06	S	*b*	36.1 39.6		+ 0.37	10.06	+ 3
28	18 40	7420.78	1.88	H	*a*	23.4 25.4	0.75	+ 0.20	9.29	0
				H	*b*	30.4 25.1		− 0.58	9.11	− 18
29	17 52	7421.74	2.84	S	*a*	25.0 27.1	0.56	+ 0.23	9.32	− 9
				S	*b*	30.1 26.4		− 0.41	9.28	− 13
30	17 17	7422.72	3.82	H	*a*	27.6 31.5	0.49	+ 0.43	9.52	− 5
				H	*b*	32.0 31.7		− 0.04	9.65	+ 8
Aug. 1	17 57	7424.75	5.85	H	*a*	29.8 37.5	0.44	+ 0.85	9.94	− 6
				H	*b*	33.7 37.4		+ 0.40	10.09	+ 9
3	16 48	7426.70	1.51	S	*a*	27.9 31.5	0.65	+ 0.40	9.49	+ 19
				S	*b*	33.7 31.7		− 0.23	9.46	+ 16
8	15 43	7431.65	0.17	H	*a*	29.6 36.5	0.41	+ 0.77	9.86	− 18
				H	*b*	33.3 36.6		+ 0.37	10.06	+ 2
9	17 22	7432.72	1.24	S	*a*	27.6 29.9	0.43	+ 0.25	9.34	− 5
				S	*b*	31.5 28.5		− 0.33	9.36	− 3
11	18 6	7434.75	3.27	H	*a*	24.9 29.6	0.32	+ 0.52	9.61	+ 13
				H	*b*	27.8 29.9		+ 0.23	9.92	+ 44
13	17 55	7436.75	5.27	S	*a*	26.1 32.1	0.53	+ 0.67	9.76	− 11
				S	*b*	30.9 31.6		+ 0.08	9.77	− 10
14	16 37	7437.69	6.21	H	*a*	26.0 33.9	0.56	+ 0.88	9.97	− 8
				H	*b*	31.1 33.9		+ 0.32	10.01	− 4
15	17 16	7438.72	0.95	S	*a*	25.5 29.8	0.62	+ 0.47	9.56	+ 3
				S	*b*	31.2 29.5		− 0.18	9.51	− 2
16	16 40	7439.69	1.92	H	*a*	20.6 24.0	$+0.81$	+ 0.36	9.45	+ 16
				H	*b*	28.2 23.5		− 0.50	9.19	− 10

UNIVERSITY OF MISSOURI
LAWS OBSERVATORY

COLUMBIA, MISSOURI,

May 13, 1907.

Prof. Isidor Loeb,
Chairman Grad. Com.

Dear Sir:— I beg leave to submit herewith a paper on "The Variable R Coronae" as a thesis in partial satisfaction of the requirements for the degree of Master of Arts.

Yours respectfully

E. S. Haynes.

Date	G. M. T.	Julian Day	Phase	Obs.	Star	Wedge		$b-a$	Δm	Mag.	O − C
1906, Aug. 17	17h 3m	2417440.71	2d.94	S	*a*	20.4	27.0	+ 0m.97	+ 0m.70	9m.79	+ 36
				S	*b*	29.5	26.8		− 0.29	9.40	− 3
18	15 54	7441.66	3.89	H	*a*	26.2	32.8	0.65	+ 0.74	9.83	+ 25
				H	*b*	32.0	32.7		+ 0.08	9.77	+ 19
22	16 46	7445.70	1.63	S	*a*	21.6	23.7	0.61	+ 0.22	9.31	+ 2
				S	*b*	27.4	24.9		− 0.27	9.42	+ 13
23	17 51	7446.74	2.67	H	*a*	17.0	20.1	0.60	+ 0.36	9.45	+ 6
				H	*b*	22.4	20.4		− 0.21	9.48	+ 9
24	17 56	7447.75	3.68	S	*a*	21.2	27.3	0.57	+ 0.65	9.74	+ 19
				S	*b*	26.5	27.8		+ 0.14	9.83	+ 28
27	16 0	7450.67	0.31	S	*a*	23.3	31.8	0.70	+ 0.93	10.02	+ 3
				S	*b*	29.8	32.3		+ 0.28	9.97	− 2
28	17 6	7451.71	1.35	H	*a*	20.6	24.1	0.76	+ 0.37	9.46	+ 11
				H	*b*	27.7	24.2		− 0.38	9.31	− 4
29	15 59	7452.67	2.31	S	*a*	24.0	26.9	0.69	+ 0.31	9.40	+ 6
				S	*b*	30.4	26.4		− 0.44	9.25	− 9
	16 8	.67	2.31	H	*a*	26.1	28.5	0.61	+ 0.27	9.36	+ 2
				H	*b*	31.6	28.7		− 0.32	9.37	+ 3
30	13 48	7453.58	3.22	S	*a*	30.0	33.9	0.62	+ 0.44	9.53	+ 6
				S	*b*	35.5	33.9		− 0.18	9.51	+ 4
	55	.58	3.22	H	*a*	28.6	33.2	0.63	+ 0.51	9.60	+ 13
				H	*b*	34.3	33.0		− 0.14	9.55	+ 8
Sept. 5	14 12	7459.59	2.94	S	*a*	27.2	31.4	0.82	+ 0.47	9.56	+ 13
				S	*b*	34.5	32.6		− 0.21	9.48	+ 5
	20	.60	2.95	H	*a*	25.6	29.3	0.75	+ 0.40	9.49	+ 6
				H	*b*	32.4	29.7		− 0.30	9.39	− 4
	16 59	.71	3.06	S	*a*	25.6	28.1	0.71	+ 0.27	9.36	− 9
				S	*b*	32.0	28.3		− 0.42	9.27	− 18
	17 7	.71	3.06	H	*a*	24.0	27.9	0.62	+ 0.42	9.51	+ 6
				H	*b*	29.7	27.8		− 0.21	9.48	+ 3
6	14 24	7460.60	3.95	H	*a*	27.8	33.1	0.65	+ 0.59	9.68	+ 9
				H	*b*	33.6	32.5		− 0.13	9.56	− 3
	16 54	.70	4.05	H	*a*	23.5	29.9	0.72	+ 0.69	9.78	+ 17
				H	*b*	30.2	30.2		0.00	9.69	+ 8
7	14 46	7461.62	4.97	H	*a*	26.7	33.0	0.54	+ 0.70	9.79	− 1
				H	*b*	31.6	33.3		+ 0.19	9.88	+ 8
	17 18	.72	5.07	S	*a*	26.2	31.3	0.68	+ 0.57	9.66	− 16
				S	*b*	32.3	32.1		− 0.02	9.67	− 15
8	15 32	7462.65	6.00	S	*a*	22.6	32.2	0.59	+ 1.04	10.13	+ 10
				S	*b*	28.2	32.2		+ 0.45	10.14	+ 11
9	14 16	7463.59	0.65	H	*a*	22.5	27.9	+ 0.49	+ 0.57	9.66	− 8
				H	*b*	27.2	28.7		+ 0.17	9.86	+ 12

Date	G. M. T.	Julian Day	Phase	Obs.	Star	Wedge		$b-a$	Δm	Mag.	O − C
1906, Sept. 10	16h 48m	2417464.70	1d.76	H	*a*	23.5	26.8	+ 0m.36	+ 0m.35	9m.44	+ 15
				H	*b*	26.9	26.8		− 0.01	9.68	+ 39
	17 40	.74	1.80	S	*a*	26.1	28.5	0.56	+ 0.27	9.36	+ 7
				S	*b*	31.2	27.4		− 0.42	9.27	− 2
12	15 28	7466.64	3.70	H	*a*	19.4	21.4	0.47	+ 0.21	9.30	− 25
				H	*b*	23.8	21.6		− 0.23	9.46	− 9
	18 12	.76	3.82	S	*a*	27.3	31.6	0.58	+ 0.48	9.57	0
				S	*b*	32.5	30.5		− 0.23	9.46	− 11
14	16 11	7468.67	5.73	S	*a*	23.1	29.8	0.50	+ 0.72	9.81	− 16
				S	*b*	27.8	30.1		+ 0.25	9.94	− 3
15	15 28	7469.64	0.41	S	*a*	26.0	33.2	0.54	+ 0.80	9.89	− 3
				S	*b*	30.9	33.2		+ 0.26	9.95	+ 3
16	14 17	7470.60	1.37	H	*a*	27.5	30.3	0.58	+ 0.31	9.40	+ 5
				H	*b*	32.6	30.5		− 0.24	9.45	+ 10
17	15 35	7471.65	2.42	H	*a*	26.5	28.8	0.55	+ 0.25	9.34	− 1
				H	*b*	31.5	28.8		− 0.30	9.39	+ 4
18	15 34	7472.65	3.42	S	*a*	22.5	27.2	0.70	+ 0.50	9.59	+ 9
				S	*b*	29.0	28.0		− 0.11	9.58	+ 8
19	15 39	7473.65	4.42	H	*a*	21.6	25.8	0.45	+ 0.44	9.53	− 15
				H	*b*	25.9	25.4		− 0.06	9.63	− 5
20	14 40	7474.61	5.38	H	*a*	21.8	28.6	0.66	+ 0.73	9.82	− 7
				H	*b*	28 0	28.6		+ 0.07	9.76	− 13
	16 43	.70	5.47	S	*a*	26.3	32.3	0.46	+ 0.67	9.76	− 15
				S	*b*	30.5	31.5		+ 0.12	9.81	− 10
21	15 13	7475.63	0.10	S	*a*	25.6	33.1	0.66	+ 0.83	9.92	− 13
				S	*b*	31.6	34.2		+ 0.29	9.98	− 7
	20	.64	0.11	H	*a*	22.4	30.3	0.44	+ 0.85	9.94	− 11
				H	*b*	26.5	30.6		+ 0.45	10.14	+ 9
22	15 10	7476.63	1.10	H	*a*	21.4	24.6	0.56	+ 0.34	9.43	− 2
				H	*b*	26.6	24.7		− 0.21	9.48	+ 3
	20	.64	1.11	S	*a*	24.9	26.5	0.41	+ 0.18	9.27	− 18
				S	*b*	28.6	27.5		− 0.12	9.57	+ 12
23	15 28	7477.64	2.11	H	*a*	18.8	22.6	0.53	+ 0.41	9.50	+ 19
				H	*b*	23.8	23.1		− 0.07	9.62	+ 31
24	15 1	7478.63	3.10	H	*a*	25.0	27.1	0.49	+ 0.23	9.32	− 14
				H	*b*	29.5	27.5		− 0.22	9.47	+ 1
	8	.63	3.10	S	*a*	28.5	32.0	0.62	+ 0.39	9.48	+ 2
				S	*b*	34.1	32.0		− 0.23	9.46	0
25	15 26	7479.64	4.11	S	*a*	27.4	33.7	0.58	+ 0.71	9.80	+ 17
				S	*b*	32.5	33.6		+ 0.12	9.81	+ 18
	33	.65	4.12	H	*a*	26.0	31.0	+ 0.44	+ 0.55	9.64	+ 1
				H	*b*	30.0	30.8		+ 0.09	9.78	+ 15

Date	G. M. T.	Julian Day	Phase	Obs.	Star	Wedge		$b-a$	Δm	Mag.	O − C
1906, Sept. 26	15h 16m	2417480.64	5d11	H	*a*	25.2	32.8	+ 0m62	+ 0m85	9m94	+ 11
				H	*b*	30.8	33.1		+ 0.26	9.95	+ 12
Oct. 1	15 30	7485.65	3.83	H	*a*	21.2	24.5	0.63	+ 0.35	9.44	− 13
				H	*b*	27.1	24.9		− 0.24	9.45	− 12
	40	.65	3.83	S	*a*	24.4	28.1	0.60	+ 0.40	9.49	− 8
				S	*b*	29.9	27.9		− 0.22	9.47	− 10
6	13 27	7490.56	2.45	H	*a*	19.9	22.9	0.46	+ 0.32	9.41	+ 5
				H	*b*	24.3	22.7		− 0.16	9.53	+ 17
	15 59	.67	2.56	H	*a*	29.0	31.1	0.58	+ 0.23	9.32	− 5
				H	*b*	34.2	31.3		− 0 32	9.37	0
	17 9	.71	2.60	H	*a*	23.2	26.4	0.61	+ 0.33	9.42	+ 4
				H	*b*	28.9	26.4		− 0.28	9.41	+ 3
	18 2	.75	2.64	S	*a*	25.7	29.7	0.42	+ 0.44	9.53	+ 14
				S	*b*	29.5	29.6		+ 0.01	9.70	+ 31
	10	.76	2.65	H	*a*	24.3	28.6	0.51	+ 0.47	9.56	+ 17
				H	*b*	29.0	28.3		− 0.08	9.61	+ 22
	19 3	.79	2.68	H	*a*	24.1	28.6	0.60	+ 0.49	9.58	+ 19
				H	*b*	29.6	28.7		− 0.10	9.59	+ 20
7	17 58	7491.75	3.64	H	*a*	27.6	32.0	0.47	+ 0.49	9.58	+ 4
				H	*b*	31.8	31.7		− 0.02	9.67	+ 13
9	17 52	7493.74	5.63	S	*a*	25.9	31.7	0.48	+ 0.64	9.73	− 23
				S	*b*	30.3	31.9		+ 0.19	9.88	− 8
10	20 18	7494.85	0.45	H	*a*	30.4	37.0	0.64	+ 0.74	9.83	− 6
				H	*b*	36.1	37.2		+ 0.12	9.81	− 8
11	16 2	7495.67	1.27	H	*a*	25.8	29.2	0.62	+ 0.37	9.46	+ 8
				H	*b*	31.4	29.0		− 0.27	9.42	+ 4
12	14 46	7496.62	2.22	H	*a*	27.8	30.0	0.51	+ 0.24	9.33	0
				H	*b*	32.4	30.1		− 0.26	9.43	+ 10
18	18 16	7502.76	2.07	H	*a*	28.9	31.4	0.52	+ 0.28	9.37	+ 6
				H	*b*	33.6	30.8		− 0.31	9.38	+ 7
19	18 0	7503.75	3.06	H	*a*	29.8	32.5	0.56	+ 0.30	9.39	− 6
				H	*b*	34.8	31.5		− 0.37	9.32	− 13
27	16 57	7511.71	4.72	H	*a*	28.9	33.1	0.60	+ 0.47	9.56	− 18
				H	*b*	34.3	33.0		− 0.14	9.55	− 19
29	13 42	7513.57	0.29	H	*a*	28.5	35.6	0.51	+ 0.79	9.88	− 11
				H	*b*	33.1	35.8		+ 0.30	9.99	0
30	18 28	7514.77	1.49	H	*a*	30.0	31.0	0.57	+ 0.11	9.20	− 10
				H	*b*	35.1	30.9		− 0.47	9.22	− 8
31	17 12	7515.72	2.44	H	*a*	25.8	28.1	0.56	+ 0.25	9.34	− 2
				H	*b*	30.9	28.1		− 0.31	9.38	+ 2
Nov. 1	17 10	7516.71	3.43	H	*a*	25.5	28.3	+ 0.54	+ 0.31	9.40	− 10
				H	*b*	30.4	28.4		− 0.22	9.47	− 3

Date	G. M. T.	Julian Day	Phase	Obs.	Star	Wedge		$b-a$	Δm	Mag.	O-C
1906, Nov. 8	$14^h\ 10^m$	2417523.59	$4^d.02$	H	*a*	29.4	36.1	$+0^m.72$	$+0^m.75$	$9^m.84$	+23
				H	*b*	35.8	36.1		+0.03	9.72	+11
9	15 51	7524.66	5.09	S	*a*	32.0	36.2	0.47	+0.46	9.55	−27
				S	*b*	36.3	37.4		+0.12	9.81	−1
12	18 0	7527.75	1.89	H	*a*	21.2	21.1	0.61	−0.01	9.08	−21
				H	*b*	26.9	21.1		−0.62	9.07	−22
21	16 59	7536.71	4.56	H	*a*	23.3	29.8	0.57	+0.70	9.79	+8
				H	*b*	28.6	29.7		+0.12	9.81	+10
26	16 21	7541.68	3.24	H	*a*	22.6	27.6	0.80	+0.53	9.62	+14
				H	*b*	30.1	28.1		−0.22	9.47	−1
27	15 18	7542 64	4.20	H	*a*	24.5	28.6	0.66	+0.45	9.54	−10
				H	*b*	30.5	28.6		−0.21	9.48	−16
Dec. 3	17 13	7548.72	3.98	H	*a*	32.2	35.2	0.65	+0.33	9.42	−18
				H	*b*	38.2	35.5		−0.29	9.40	−20
5	15 12	7550.63	5.89	H	*a*	29.4	37.5	0.63	+0.90	9.99	−2
				H	*b*	35.0	37.5		+0.27	9.96	−5
6	11 38	7551.48	0.45	H	*a*	29.6	38.3	0.59	+0.95	10.04	+14
				H	*b*	34.9	37.9		+0.32	10.01	+11
	21 16	.89	0.86	H	*a*	23.6	28.2	0.60	+0.49	9.58	−1
				H	*b*	29.2	28.1		−0.12	9.57	−2
7	13 45	7552.57	1.54	H	*a*	33.4	36.2	0.74	+0.31	9.40	+11
				H	*b*	40.3	36.0		−0.45	9.24	−5
	56	.58	1.55	H	*a*	36.0	38.1	0.81	+0.22	9.31	+2
				H	*b*	43.4	37.9		−0.61	9.08	−21
11	15 9	7556.63	5.60	H	*a*	33.6	44.0	[0.73]	+1.14	10.23	+28
	13	.63	5.60	H	*b*	40.5	45.8		+0.61	10.30	+35
12	14 46	7557.62	0.30	H	*a*	30.8	41.0	0.74	+1.11	10.20	+20
				H	*b*	37.5	40.8		+0.35	10.04	+4
17	16 17	7562.68	5.36	H	*a*	20.2	28.2	0.61	+0.85	9.94	+5
				H	*b*	26.0	28.6		+0.29	9.98	+9
18	13 39	7563.57	6.25	H	*a*	15.6	23.8	0.65	+0.94	10.03	−2
				H	*b*	21.1	24.2		+0.33	10.02	−3
1907, Jan. 4	15 49	7580.66	4.46	H	*a*	24.2	30.8	0.81	+0.72	9.81	+12
				H	*b*	31.6	30.4		−0.14	9.55	−14
20	15 36	7596.65	1.58	H	*a*	22.0	24.0	0.55	+0.21	9.30	+1
				H	*b*	27.2	23.8		−0.36	9.33	+4
21	16 57	7597.71	2.64	H	*a*	25.9	29.7	0.75	+0.42	9.51	+12
				H	*b*	32.6	29.8		−0.32	9.37	−2
23	15 54	7599.66	4.59	H	*a*	33.5	40.2	0.60	+0.72	9.81	+10
				H	*b*	39.1	39.4		+0.03	9.72	+1
25	15 0	7601.62	0.26	H	*a*	22.9	28.4	+0.62	+0.58	9.67	−34
				H	*b*	28.7	28.0		−0.08	9.61	−40

Date	G. M. T.	Julian Day	Phase	Obs.	Star	Wedge		$b-a$	Δm	Mag.	O − C
1907, Jan. 27	14h 40m	2417603.61	2d25	H	*a*	26.4	29.4	+ 0m67	+ 0m33	9m42	+ 9
				H	*b*	32.4	29.4		− 0.34	9.35	+ 2
Feb. 7	15 18	7614.64	0.69	H	*a*	27.9	33.0	0.69	+ 0.57	9.66	− 5
				H	*b*	34.1	33.0		− 0.12	9.57	− 14
8	13 35	7615.57	1.62	H	*a*	21.4	21.8	0.65	+ 0.05	9.14	− 15
				H	*b*	27.5	22.3		− 0.55	9.14	− 15
9	15 1	7616 63	2.68	H	*a*	25.5	25.5	0.50	0.00	9.09	− 30
				H	*b*	30.0	25.5		− 0.50	9.19	− 20
10	13 16	7617.55	3.60	H	*a*	22.3	23.9	0.67	+ 0.17	9.26	− 27
				H	*b*	28.5	23.9		− 0.50	9.19	− 34
11	12 54	7618.54	4.59	H	*a*	24.2	27.3	0.67	+ 0.33	9.42	− 29
				H	*b*	30.4	27.0		− 0.37	9 32	− 39
12	0 1	7619.00	5.05	H	*a*	28.0	35.5	0.69	+ 0.84	9 93	+ 11
				H	*b*	34.2	35.9		+ 0.19	9.88	+ 6
	13 17	.55	5.60	H	*a*	26.1	33.6	0.68	+ 0.84	9.93	− 2
				H	*b*	32.2	33.5		+ 0.15	9.84	− 11
13	12 45	7620.53	0.29	H	*a*	24.1	33.6	0.60	+ 1.05	10.14	+ 14
				H	*b*	29.6	33.4		+ 0.42	10.11	+ 11
14	12 50	7621.53	1.29	H	*a*	27.4	30.2	0.78	+ 0.31	9.40	+ 3
				H	*b*	34.4	30.5		− 0.44	9.25	− 12
	56	.54	1.30	H	*a*	27.4	29.6	0.60	+ 0.25	9.34	− 3
				H	*b*	32.7	29.7		− 0.34	9.35	− 2
	23 24	.97	1.73	H	*a*	26.3	29.1	0.69	+ 0.31	9.40	+ 11
				H	*b*	32.5	29.4		− 0.35	9.34	+ 5
	33	.98	1.74	H	*a*	28.0	28.9	0.56	+ 0.10	9.19	− 10
				H	*b*	33.0	29.1		− 0.44	9.25	− 4
15	13 12	7622.55	2.31	H	*a*	31.5	32.8	0.65	+ 0.15	9 24	− 9
				H	*b*	37.4	33.1		− 0.47	9.22	− 11
	22	.56	2.32	H	*a*	32.6	33.1	0.51	+ 0.05	9.14	− 20
				H	*b*	37.3	32.0		− 0.58	9.11	− 23
	30	.56	2.32	H	*a*	31.6	32.6	0.53	+ 0.12	9.21	− 13
				H	*b*	36.4	32.4		− 0.44	9.25	− 9
16	12 56	7623.54	3.30	H	*a*	28.5	30.3	0.64	+ 0.20	9.29	− 19
				H	*b*	34.2	30.2		− 0.45	9.24	− 24
	13 5	.55	3.31	H	*a*	28.6	31.3	0.68	+ 0.30	9.39	− 9
				H	*b*	34.7	31.5		− 0.36	9.33	− 15
17	14 1	7624.58	4.34	H	*a*	25.4	31.2	0.63	+ 0.64	9.73	+ 6
				H	*b*	31.1	31.2		+ 0.01	9.70	+ 3
18	13 42	7625.57	5.33	H	*a*	28.7	36.0	0.58	+ 0.81	9.90	+ 2
				H	*b*	33.9	36.2		+ 0.25	9.94	+ 6
	54	.58	5.34	H	*a*	31.6	39.0	+ 0.60	+ 0.80	9.89	+ 1
				H	*b*	37.0	39.4		+ 0.24	9.93	+ 5

Date	G. M. T.	Julian Day	Phase	Obs.	Star	Wedge		$b-a$	Δm	Mag.	O-C
1907, Feb. 21	13 21	2417628.56	2d03	H	*a*	29.3	29.7	+ 0m61	+ 0m05	9m14	— 16
				H	*b*	34.7	29.4		— 0.60	9.09	— 21
25	13 23	7632.56	6.03	H	*a*	26.7	34.7	0.64	+ 0.89	9.98	— 5
				H	*b*	32.5	34.8		+ 0.26	9.95	— 8
26	23 30	7633.98	1.16	H	*a*	33.5	36.8	0.58	+ 0.36	9.45	+ 3
				H	*b*	39.0	36.3		— 0.28	9.41	— 1
Mar. 1	13 27	7636.56	3.74	H	*a*	26.8	31.2	0.59	+ 0.48	9.57	+ 1
				H	*b*	32.1	31.2		— 0.11	9.58	+ 2
	16 22	.68	3.86	H	*a*	33.3	36.9	0.53	+ 0.40	9.49	— 9
				H	*b*	38.2	36.8		— 0.14	9.55	— 3
5	14 32	7640.61	1.50	H	*a*	30.0	31.7	+ 0.63	+ 0.19	9.28	— 2
				H	*b*	35.6	32.1		— 0.39	9.30	0

REMARKS

1906
July 20—Sky white, occasional clouds during second observation.
" 23—Haze, images diffuse and ragged.
" 24—Air transparent but unsteady.
" 26—Occasional haze, constant flashing of distant lightning.
" 30, Aug. 1—Sky white, occasional clouds, moon.
Aug. 3—Sky white and hazy, full moon.
" 8, 9—Haze.
" 16, 17, 22—Occasional clouds.
Sept. 7—Images somewhat diffuse.
" 10, 14—Sky thick.
" 26—Sky white, images diffuse.

1906
Oct. 7—Sky white.
" 9—Sky clear but images bad.
" 27, 29, 30, 31, Nov. 1—Sky white, moon.
Dec. 5—Haze.
" 7—Sky thick, some clouds.
" 11—Sky very thick.
" 17—Occasional clouds.
1907
Jan. 21, 23, 25, 27—Sky white, moon.
Feb. 7, 8, 9, 10, 17, 18—Haze.
" 26—Sky white, full moon.
Mar. 5—Sky thick.

The observations are printed in detail in Table I. The first three columns contain the date; the fifth and sixth, the initial of the observer and the comparison stars used. The wedge readings in column seven are in each case the means of four settings, the first number referring to the comparison star, and the second to the variable. The values of $b-a$ and Δm in columns eight and nine, respectively, were obtained by means of Table V, Bulletin No. 7. The occurrence of bracketed numbers in column eight indicates that, owing to haze, the observations referred to *a* and *b* were made independently, and not in a single series as is usually done. These values were given zero weight in forming the mean of the differences $b-a$. Of the remaining 129 values of this difference, 33 are by Seares and 96 by Haynes. The means and probable errors are

Seares $+0^{m}.591 \pm 0^{m}.014$,
Haynes $+0.599 \pm 0.007$,
All $+0.596 \pm 0.006$.

The constancy of the comparison star difference is indicated by the numbers in the second and fourth columns of Table II. These are the means of the differences $b-a$ in groups of ten, excepting in the case of the last, which is based upon only nine determinations. The Julian Dates in the first and third columns show the interval covered by each group.

TABLE II

MEAN VALUES OF COMPARISON STAR DIFFERENCE

Interval	$b-a$	Interval	$b-a$
J. D. 2417410–422	$+0^{m}.55$	J.D.2417491–514	$+0^{m}.55$
424–440	0.57	515–550	0.62
441–453	0.64	551–597	0.68
459–463	0.66	599–619	0.64
464–473	0.53	620–623	0.62
474–479	0.54	624–640	+0.60
479–490	+0.55	Mean	+0.596

In order to facilitate the reduction of the observations, the preliminary elements were used for the derivation of an approximate mean light-curve. This was drawn on tracing paper and superposed on the plotted observations for the determination of the epochs of minima. The twenty-one minima thus obtained are given in the first three columns of Table III. The corresponding weights are in column four. A least square solution based upon this data gave for the revised elements:

$$\text{Min.} = \text{J. D. } 2417412.607 + 6^{d}.2919\,E, \qquad \text{G. M. T.}$$

Column six of Table III gives the minima computed with the revised elements, and column seven, the residuals O – C.

In order to derive the final mean light-curve, the observations referred to star b were reduced to a by means of the difference $b-a = +0^{m}.60$. They were then combined into eighteen normal places in accordance with the phase values given in column four of Table I, which are counted from minima and derived by means of the revised elements. In forming the normals, all observations were given equal weight excepting those of 1906, Dec. 11, and 1907, Jan. 25. These were rejected on account of their very considerable deviation from the approximate mean light-curve mentioned above. The mean phase and the mean Δm are in columns two and three, and eight and nine of Table IV. The number of observations in each normal and the number

of nights involved may be found in columns four and five, and ten and eleven, respectively, while the deviations of the normals from the finally accepted light-curve are in columns six and twelve. The ordinates of the mean light-curve are given in columns two and five of Table V. The corresponding magnitudes for the variable, based on the magnitude of *a* derived below, are in columns three and six of Table V. The curve itself is shown in Fig. I.

TABLE III

MINIMA FOR RS CASSIOPEIAE

Date	G. M. T.	Julian Date	Wt.	E	Comp. Min.	O - C
1906, July 20	$14^h\ 24^m$	2417412.6	2	0	2417412.61	— 0d01
26	21 36	7418.9	3	1	7418.90	0.00
Aug. 2	4 48	7425.2	3	2	7425.19	+ 0.01
8	12 0	7431.5	1	3	7431.48	+ 0.02
14	16 48	7437.7	2	4	7437.77	— 0.07
20	21 36	7443.9	1	5	7444.07	— 0.17
27	4 48	7450.2	2	6	7450.36	— 0.16
Sept. 9	0 0	7463.0	3	8	7462.94	+ 0.06
15	9 36	7469 4	3	9	7469.23	+ 0.17
21	14 24	7475.6	3	10	7475.53	+ 0.07
27	19 12	7481.8	1	11	7481.82	— 0.02
Oct. 10	7 12	7494.3	3	13	7494.40	— 0.10
29	7 12	7513.3	2	16	7513.28	+ 0.02
Nov. 10	21 36	7525.9	1	18	7525.86	+ 0.04
Dec. 6	2 24	7551.1	3	22	7551.03	+ 0.07
12	7 12	7557.3	1	23	7557.32	— 0.02
18	14 24	7563.6	1	24	7563.61	— 0.01
1907, Jan. 25	2 24	7601.1	2	30	7601.36	— 0.26
Feb. 13	7 12	7620.3	3	33	7620.24	+ 0.06
19	14 24	7626.6	2	34	7626.53	+ 0.07
25	19 12	7632.8	1	35	7632.82	— 0.02

The magnitude of comparison star *a* was determined by a reference to seven P.DM. stars, all of which are of nearly the same declination as the variable. One of the reference stars is quite near *a*. The remaining six were chosen in pairs, at approximately equal distances in right ascension on opposite sides of *a*. As a consequence, the effect of extinction has been eliminated from the mean magnitude of *a*, although no corrections were applied to the individual observations. The results of the comparison are given in Table VI. The means of the observed differences between *a* and the reference stars are in column five, and the resulting magnitudes for *a*, in column six. These values show a considerable deviation from the mean, due, partly, to the brightness of the reference stars and the extent of the interval measured. All

of the measures were made with the aperture reduced to four inches, but, even then, the settings were difficult and uncertain on account of the difference in appearance of real and artificial stars. The effect of atmospheric absorption is also such as to increase the deviation from the mean, although, as mentioned above, this has been eliminated from the final result. The mean magni-

TABLE IV

NORMAL PLACES FOR RS CASSIOPEIAE

No.	Phase	Δm	Obs.	Nts.	O - C	No.	Phase	Δm	Obs.	Nts.	O - C
1	$0^d.04$	$+0^m.94$	10	4	$-0^m.02$	10	$3^d.02$	$+0^m.34$	20	7	$-0^m.01$
2	0.26	0.95	12	6	+0.03	11	3.30	0.42	16	6	+0.02
3	0.53	0.74	10	5	0.00	12	3.75	0.42	20	9	−0.05
4	1.02	0.40	10	4	0.00	13	4.05	0.57	18	8	+0.05
5	1.28	0.30	14	6	+0.02	14	4.51	0.59	14	7	−0.02
6	1.55	0.20	16	7	0.00	15	5.07	0.73	12	6	0.00
7	1.82	0.20	14	5	0.00	16	5.36	0.77	12	4	−0.03
8	2.22	0.22	20	7	−0.02	17	5.64	0.87	8	4	0.00
9	2.58	+0.35	22	7	+0.06	18	5.97	+0.94	10	5	+0.01

TABLE V

MEAN LIGHT-CURVE FOR RS CASSIOPEIAE

PHASE FROM MINIMUM

Phase	Δm	Mag.	Phase	Δm	Mag.
$0^d.00$	$+0^m.96$	$10^m.05$	$2^d.50$	$+0^m.27$	$9^m.36$
0.25	0.93	10.02	3.00	0.35	9.44
0.50	0.78	9.87	3.50	0.42	9.51
0.75	0.58	9.67	4.00	0.51	9.60
1.00	0.41	9.50	4.50	0.61	9.70
1.25	0.30	9.39	5.00	0.71	9.80
1.50	0.21	9.30	5.50	0.83	9.92
1.75	0.19	9 28	6.00	0.93	10 02
2.00	+0.21	9.30	6.50	+0.94	10.03

tude of a from all the stars is 9.09. This combined with the difference $b-a=+0^m.60$, derived above, gives $b=9^m.69$. The magnitudes of the variable in column ten of Table I were derived by adding the adopted magnitudes of a and b to the quantities in column nine of the same table. The deviation of the individual observations from the mean light-curve is shown in the last column of Table I.

Table VII gives information as to the precision and consistency of the observations. In order to secure the data contained in this table the observations were divided into four groups. Group I comprises all the observations by Seares, excepting those made on 1906, Nov. 9, which are separated from the rest by a considerable interval of time; group II includes the observations made by Haynes during the same interval as that covered by group I; group III, the remaining observations by Haynes made with the right eye; and group IV, the observations with the left eye. Column two of Table VII shows the last three figures of the Julian Dates which limit the various groups. Column three contains the initial of the observer, while columns four and five give the number of observations on variable and comparison stars, respectively. The next three columns contain the average residual for the variable referred to *a*, for the variable referred to *b*, and for all the observations on the variable, respectively. These were obtained by averaging the residu-

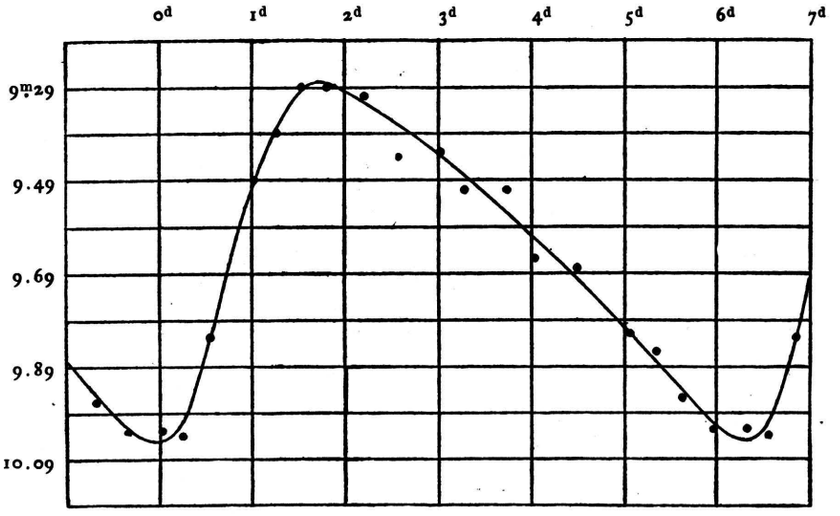

Fig. 1—Light-curve of RS Cassiopeiae

als in the last column of Table I, the algebraic sign being disregarded. The ninth column contains a similar result for the comparison star differences, the residuals being referred to the mean of the series, $b - a = +0^m.60$. The last four columns are similar in arrangement to those just considered. They contain the mean deviations, obtained from the various groups of residuals by regarding the algebraic sign, and exhibit the internal consistency of the observations.

The average residuals for the variable are sensibly the same throughout the entire series. On the other hand, the precision of the measures for $b - a$ is apparently greater for the end of the series than for the beginning. The reason for this is not clear. It is possible that the settings on the comparison stars during the latter part of the series were influenced by a knowledge on the part of the observer of what the difference in brightness should be. The mean deviations in columns ten to twelve suggest irregularities in the light change of the variable. This possibility is

further emphasized by the occurrence of series of uniformly discordant observations such as that extending from 1907, Feb. 7 to Feb. 11. During this interval the residuals for the variable are consistently negative and average $-0^m.23$. At the same time, the differences $b-a$ determined during this interval exhibit no abnormal errors of observation. It is not likely that these systematic deviations of the variable are due to any error in the assumed epochs of minima, for the irregularities are mostly confined to the descending branch of the curve. This is shown by the fact that the average residual for all observations taken during increasing light is $\pm 0^m.082$, while

TABLE VI

MAGNITUDE OF COMPARISON STAR *a*. OBSERVER, HAYNES

Star	BD. No.	P. DM. No.	P. DM. Mag.	Mean Δm	Mag. a	No. Obs.	No. Nights
m	+ 61°2444	IV 2073	5.03	+ 3.97	9.00	7	7
n	2533	2117	5.57	3.33	8.90	7	7
p	2433	2068	7.98	1.30	9.28	6	6
q	2551	2122	7.38	1.74	9.12	5	5
r	2427	2066	6.44	2.80	9.24	5	5
s	2562	2126	7.28	1.68	8.96	5	5
t	2490	2098	6.64	+ 2.48	9.12	7	4
					Mean 9.09		

TABLE VII

MEAN RESIDUALS AND MEAN DEVIATIONS

Group	Interval	Obs.	No. Obs.		Mean Residuals				Mean Deviations			
			v	$b-a$	v_a	v_b	v	$b-a$	v_a	v_b	v	$b-a$
I	410–493	S	66	32	0.105	0.091	0.098	0.088	— 0.001	+ 0.014	+ 0.007	— 0.005
II	410–493	H	80	40	0.094	0.111	0.102	0.096	+ 0.018	+ 0.070	+ 0.044	— 0.043
III	493–576	H	50	24	0.102	0.100	0.101	0.065	+ 0.009	— 0.017	— 0.004	+ 0.025
IV	576–640	H	64	32	0.110	0.115	0.113	0.060	— 0.050	— 0.087	— 0.068	+ 0.031

the corresponding mean residual for decreasing light is $\pm 0^m.112$. These irregularities doubtless account for the greater average residual shown by the observations on the variable, as compared with those resulting from measures of the comparison star difference.

Under the circumstances, one can not properly speak of a probable error, so far as observations on the variable are concerned. A notion of the accidental errors is best obtained from the comparison star differences, although, even here, it is clear that small systematic irregularities are present. From the entire series we find a probable error of $\pm 0^m.067$ for a single difference based upon eight settings of the wedge, four being made upon each star.

The data for the determination of the systematic difference of the observers is scanty and consequently unreliable. From the first two groups of Table VII we obtain

	Variable	$b - a$
S - C	+ 0m007	− 0m005,
H - C	+ 0.044	− 0.043,
S - H	− 0.037	+ 0.038.

The systematic difference resulting from the observations on the variable is in agreement with all such differences previously obtained. In this connection, see Laws Observatory Bulletins, No. 7, p. 99; No. 8, pp. 112, 113, 123, 124; No. 9, p. 140. The value S - H = + 0m038 obtained from the measures of $b - a$ is in striking contrast with these results. Whether this disagreement is accidental or the result of a definite cause can not now be determined.

Columbia, Missouri, 1907, April 27. *E. S. Haynes.*