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COMMUNICATIONS FROM THE OBSERVATORY AT LEIDEN.

Photographic Photometry of SY Aurigae, by *E. Rybka*.

1. On plates taken by P. TH. OOSTERHOFF with the Leiden 33-cm. refractor for photographic photometry of SX Aurigae, the variable SY Aurigae is also present and, though the images are faint, most of the plates can be also used for the latter variable. The last 17 plates with double exposuretime (3 images of 6 min. each) and SY Aurigae in the middle of the plate were taken by the writer. The first plate used in the present note was taken 1928 Febr. 28 and the last one 1930 March 2, the total number of plates (Eastman 40) being 106 and of exposures 431.

All the plates have been taken with a coarse grating placed in front of the objective. The difference between the central image and the diffraction images of the first order was assumed to be $^{m}{\cdot}97$. Therefore, to obtain the scale of magnitudes, one comparison star only was needed. As such was used B.D. + 42°1205 ($9^{m}{\cdot}2$), the photographic brightness of which is nearly equal to the mean brightness of the variable. The distance between the variable and the comparison star is 5′ or 8 mm on the plate.

TABLE 1. Observations.

J. D. hel. M. Astron. T. Greenw.	Number of exposures	Exposure-time	Phase	mag.	No. in the Table 2	J. D. hel. M. Astron. T. Greenw.	Number of exposures	Exposure-time	Phase	mag.	No. in the Table 2
d		m	P	m		d		m	P	m	
2425305·330	5	4	·6574	10·32	15	2425645·469	4	4	·1891	9·68	3
25309·347	3	4	·0534	9·28	1	25646·421	3	4	·2819	9·87	6
25310·303	4	4	·1476	9·58	2	25646·446	3	4	·2854	9·82	6
25311·334	3	4	·2493	9·76	4	25646·473	3	4	·2880	9·86	6
25311·376	3	4	·2534	9·83	4	25647·413	5	4	·3807	10·03	8
25311·400	3	4	·2558	9·87	4	25647·459	5	4	·3852	10·02	8
25311·426	3	4	·2583	9·90	5	25647·496	4	4	·3889	10·07	9
25318·399	8	4	·9458	9·53	21	25654·402	4	4	·0796	9·28	1
25321·345	5	4	·2362	9·86	4	25655·389	4	4	·1670	9·56	3
25321·390	6	4	·2406	9·78	4	25655·418	3	4	·1699	9·61	3
25322·317	5	4	·3320	9·90	8	25656·484	3	4	·2749	9·81	6
25322·348	3	4	·3351	9·90	8	25662·453	3	4	·8634	9·56	20
25323·345	5	4	·4333	10·17	10	25663·345	3	4	·9513	9·42	22
25323·384	5	4	·4372	10·13	11	25663·378	3	4	·9546	9·36	22
25332·331	5	4	·3192	9·87	7	25663·411	3	4	.9578	9·38	22
25332·361	3	4	·3222	9·97	7	25670·377	5	4	·6445	10·29	14
25334·314	3	4	·5147	10·29	12	25670·431	6	4	·6499	10·27	15
25334·341	3	4	·5174	10·37	12	25671·428	5	4	·7482	10·08	16
25334·369	3	4	·5201	10·30	12	25672·426	6	4	·8465	9·53	19
25343·327	3	4	·4032	10·03	9	25673·421	8	4	·9446	9·40	21
25343·350	3	4	·4055	10·13	9	25675·352	6	4	·1350	9·40	2
25502·607	3	4	·1054	9·31	1	25687·419	2	4	·3246	9·93	7
25502·628	1	4	·1075	9·37	1	25688·391	4	4	·4204	10·03	10
25503·600	3	4	·2033	9·64	3	25707·368	2	4	·2912	9·78	6
25503·621	1	4	·2054	9·63	3	25717·334	3	4	·2737	9·76	5
25506·560	3	4	·4951	10·21	11	25718·339	3	4	·3728	9·95	8
25506·589	3	4	·4980	10·26	11	25721·338	3	4	·6684	10·30	16
25506·617	3	4	·5007	10·27	12	25865·596	7	3	·8897	9·56	20
25506·643	3	4	·5033	10·28	12	25866·621	8	3	·9907	9·47	22
25645·440	3	4	·1862	9·64	3	25921·558	8	3	·4065	10·12	9

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J. D. hel. M. Astron. T. Greenw.	Number of exposures	Exposure-time	Phase	mag.	N°. in the Table 2	J. D. hel. M. Astron. T. Greenw.	Number of exposures	Exposure-time	Phase	mag.	N°. in the Table 2
d		m	P	m		d		m	P	m	
2425950·513	8	3	·2610	9·82	5	2426004·318	8	3	·5652	10·33	13
25950·572	6	3	·2668	9·84	5	26004·379	3	3	·5712	10·40	13
25964·324	4	3	·6225	10·36	13	26016·417	3	3	·7580	10·03	17
25964·350	4	3	·6251	10·35	13	26017·291	4	3	·8441	9·54	18
25964·379	4	3	·6279	10·42	14	26017·318	4	3	·8468	9·56	19
25964·406	4	3	·6306	10·32	14	26024·370	3	3	·5420	10·32	12
25964·609	4	3	·6506	10·27	15	26027·451	3	6	·8457	9·63	19
25964·645	4	3	·6542	10·30	15	26027·470	3	6	·8476	9·59	20
25965·590	4	3	·7473	10·05	16	26029·398	3	6	·0377	9·27	1
25965·615	4	3	·7498	9·98	16	26029·416	3	6	·0394	9·28	1
25965·643	4	3	·7525	9·93	17	26029·435	3	6	·0413	9·32	1
25966·321	8	3	·8194	9·76	17	26030·370	3	6	·1335	9·34	2
25966·370	4	3	·8242	9·76	18	26030·395	3	6	·1359	9·42	2
25966·505	6	3	·8375	9·71	18	26030·416	3	6	·1380	9·40	2
25966·543	6	3	·8413	9·60	18	26033·451	3	6	·4372	10·08	11
25966·589	6	3	·8458	9·59	19	26033·472	3	6	·4393	10·14	11
25971·386	8	3	·3187	9·97	6	26033·492	3	6	·4413	10·09	11
25971·439	8	3	·3239	9·98	7	26035·357	3	6	·6251	10·23	14
25972·376	8	3	·4163	10·16	10	26035·377	3	6	·6271	10·22	14
25972·426	4	3	·4212	10·23	10	26035·396	3	6	·6290	10·23	14
25986·393	5	3	·7981	9·82	17	26038·205	3	6	·9147	9·45	20
25995·398	2	3	·6859	10·28	16	26038·314	3	6	·9166	9·41	20
25995·443	4	3	·6903	10·21	16	26038·333	3	6	·9185	9·44	21

2. The plates were measured by the writer in the Schilt photometer. In all cases the central image and the diffraction images of the first order of both stars were measured. In no case the difference in magnitude between the two stars exceeded that between the central image and the diffraction images of the first order. The total number of settings was 3204.

On the first of the two plates taken on J. D. 2425995 3 exposures of the Pleiades were added, using the same exposuretime of 3 min. Adopting for the two stars in the Pleiades Gaultier 66 and 85 photographic magnitudes of $9^{m}.85$ and $8^{m}·75$ respectively in the system given in Table 14 of E. HERTZSPRUNG: *Effective Wavelengths of Stars in the Pleiades* (Mem. de l'Acad. Roy. de Danemark, Sec. des Sciences 8^{me} série, t. IV, No. 4; 1923), the photographic magnitude of B. D. + 42°1205 was found to be $9^{m}·82$. This value was used for the reduction of my measures of SY Aurigae. The mean photographic magnitude of SY Aur. is thus found to be $9^{m}·84$, while JORDAN has $9^{m}·54$ and ROBINSON $10^{m}·71$.

The phases of my observations were computed by the formula:

$$\text{phase} = {}^{d-1}·09858229\ (\text{J. D.} - 2400000)$$

and are given in the fourth column of Table 1. The corresponding period is $10^{d}.14381$.

The 106 plates were then arranged according to phase and divided into 22 groups, each containing about 20 exposures. Mean values of phase and magnitude for each of these groups are given in Table 2 and shown graphically in the last section of the diagram, the zero being here the magnitude of the comparison star.

The mean date of the 431 exposures is J. D. 2425750. The range of the lightvariation is $^{m}·96$ (from 9·36 to $10^{m}·32$).

TABLE 2. Normal points.

No.	Number of exposures	Number of plates	Phase	mag.	*O—C*	*O—C′*
			P	m	m	m
1	20	7	·0629	9·29	— ·07	— ·07
2	19	5	·1380	9·43	— ·01	— ·07
3	18	6	·1838	9·63	+ ·08	+ ·02
4	20	5	·2450	9·82	+ ·11	+ ·06
5	20	4	·2642	9·83	+ ·06	+ ·03
6	22	6	·2966	9·88	+ ·02	+ ·01
7	18	4	·3224	9·94	·00	+ ·01
8	21	5	·3625	9·97	— ·09	— ·05
9	18	4	·4019	10·10	— ·06	·00
10	21	4	·4221	10·15	— ·05	+ ·02
11	20	6	·4559	10·15	— ·11	— ·05
12	18	6	·5164	10·30	— ·01	+ ·02
13	19	4	·5908	10·35	+ ·05	+ ·03
14	22	6	·6318	10·29	+ ·04	— ·01
15	19	4	·6529	10·29	+ ·08	+ ·02
16	22	6	·7212	10·13	+ ·08	+ ·03
17	20	4	·7915	9·85	+ ·01	·00
18	20	4	·8373	9·65	— ·05	— ·03
19	19	4	·8462	9·57	— ·10	— ·07
20	19	5	·8871	9·52	— ·04	+ ·01
21	19	3	·9410	9·46	+ ·01	+ ·08
22	17	4	·9716	9·43	+ ·02	+ ·08

3. SY Aurigae has been observed previously mainly by L. V. ROBINSON (*H. B.* 871), SIGURD ENEBO

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(*Beobachtungen ver. Sterne III, V, VIII* and *X*), F. C. JORDAN (*Allegheny Publ.* Vol. 7, 118) and S. THORRUD (*Nordisk Astron. Tidsskrift* Bd. 9, 112).

The normal points given by ROBINSON (*l. c.*, page 6) and by F. C. JORDAN have been adopted as they stand. The observations of ENEBO and THORRUD were reduced anew and the brightnesses of the comparison stars, as deduced from the original estimates, are given in Table 3.

TABLE 3.

Comparison stars used by S. ENEBO and S. THORRUD.

B. D.	ENEBO'S design.	$St_{En.}$	THORRUD'S design.	$St_{Th.}$
°		s		s
+ 42 1190	g	0·0	c	0·0
+ 42 1192	f	2·2	b	3·3
+ 42 1206	a	7·9	—	—
+ 42 1205	b	8·3	d	8·9
+ 42 1203	c	9·2	—	—

The formulae used for the computation of the phases are in the cases of the different series as follows:

ROBINSON phase = ·5 + (J.D. — 2419172·082)/10^{d}·14489

ENEBO and THORRUD
phase = 0·^{d}098575 (J. D. — 2400000)

JORDAN phase = (J. D. — 2422012·419)/10^{d}·144012

The corresponding formula used for my own observations has been given above.

The normal points thus obtained are given for ROBINSON in Table 4, for ENEBO in Table 5, for JORDAN in Table 6 and for THORRUD in Table 7.

TABLE 4. Normal points (ROBINSON).

Number of plates	Phase	mag.	*O—C*
	p	m	m
10	·000	11·29	— ·12
10	·045	11·28	— ·09
10	·093	11·25	— ·01
10	·139	11·22	+ ·10
10	·214	11·12	+ ·30
10	·256	10·83	+ ·20
10	·276	10·34	— ·20
10	·328	10·31	— ·03
10	·367	10·18	— ·02
10	·418	10·14	+ ·06
10	·450	9·94	— ·09
10	·500	9·85	— ·16
10	·554	9·92	— ·16
10	·625	10·28	+ ·03
10	·674	10·53	+ ·09
10	·731	10·90	+ ·23
10	·787	11·09	+ ·17
10	·835	11·09	— ·02
10	·893	11·21	— ·08
10	·942	11·18	— ·20

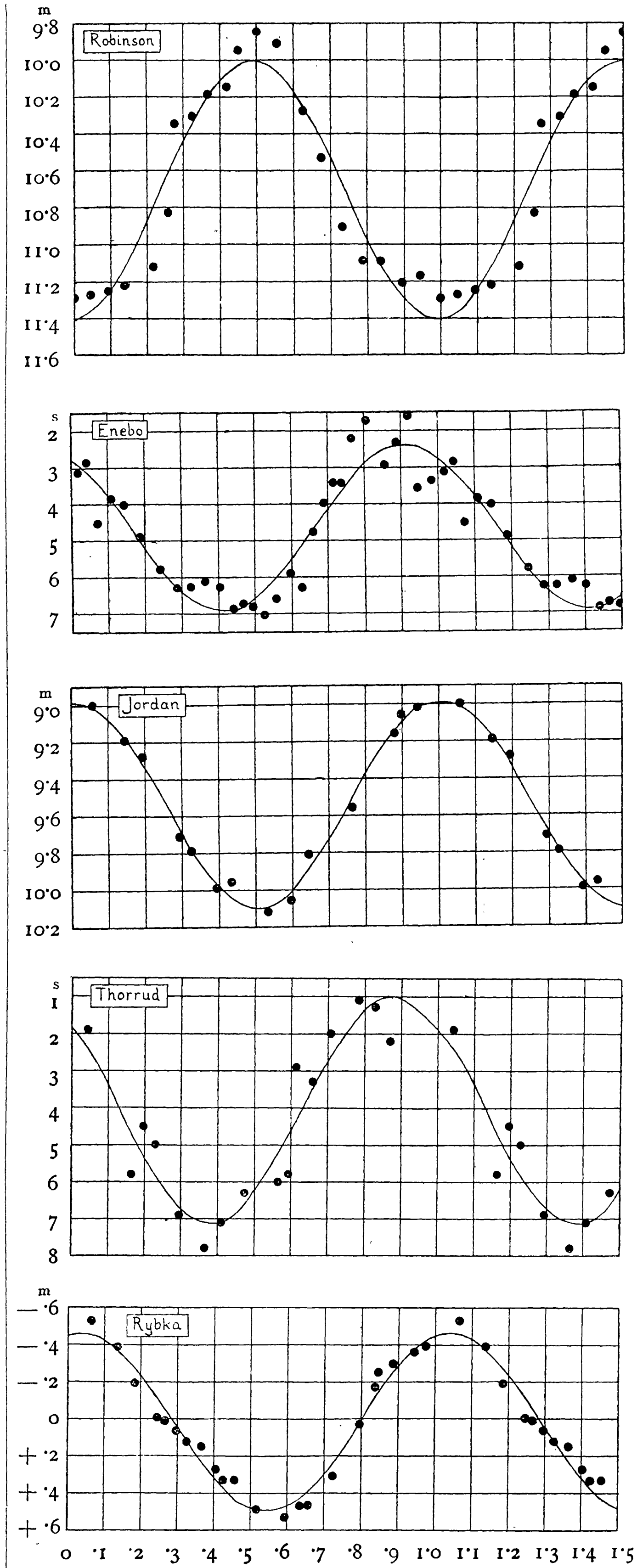

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TABLE 5. Normal points (ENEBO).

Number of estimates	Phase	steps	$O-C$
	P	s	s
10	·016	3·1	+ ·2
10	·041	2·8	— ·3
10	·070	4·5	+ 1·1
10	·107	3·9	·0
10	·144	4·0	— ·4
10	·186	4·9	— ·1
10	·243	5·8	·0
10	·287	6·3	·0
10	·322	6·3	— ·3
11	·363	6·1	— ·7
10	·401	6·3	— ·6
10	·439	6·9	·0
11	·466	6·7	— ·1
10	·493	6·8	+ ·2
10	·524	7·0	+ ·7
10	·556	6·6	+ ·6
10	·597	5·9	+ ·4
10	·626	6·3	+ 1·2
12	·657	4·8	— ·1
10	·689	4·0	— ·2
9	·713	3·4	— ·5
10	·736	3·4	— ·2
10	·763	2·2	— 1·1
10	·808	1·7	— 1·1
10	·854	2·9	+ ·4
10	·887	2·3	— ·1
10	·917	1·6	— ·8
10	·943	3·6	+ 1·2
10	·981	3·4	+ ·8

TABLE 6. Normal points (JORDAN).

Number of exposures	Number of plates	Phase	mag.	$O-C$
		P	m	m
12	4	·059	9·00	— ·01
8	4	·144	9·19	+ ·02
5	2	·191	9·28	— ·04
14	5	·293	9·71	+ ·04
8	4	·327	9·79	+ ·01
12	4	·392	9·99	+ ·03
20	8	·432	9·96	— ·08
8	4	·531	10·12	+ ·03
8	4	·596	10·06	+ ·04
9	4	·646	9·81	— ·08
8	4	·761	9·56	+ ·05
8	4	·879	9·16	+ ·02
12	4	·897	9·06	— ·04
8	4	·941	9·02	·00

TABLE 7. Normal points (THORRUD).

Number of estimates	Phase	steps	$O-C$
	P	s	s
5	·041	1·9	— ·5
5	·164	5·8	+ 1·1
5	·198	4·5	+ ·9
5	·229	5·0	— ·8
5	·296	6·9	+ ·2
5	·363	7·8	+ ·7
5	·408	7·1	·0
5	·475	6·3	— ·3
5	·561	6·0	+ ·7
5	·591	5·8	+ 1·0
5	·613	2·9	— 1·5
5	·658	3·3	— ·2
5	·709	2·0	— ·6
5	·785	1·1	— ·4
5	·828	1·3	+ ·2
5	·870	2·2	+ 1·2

To represent each of the 5 series, including my own, a sinusoid $A + B \sin 2\pi P + C \cos 2\pi P$ was determined according to least squares. The constants found are given in Table 8 together with the derived mean epoch of the maximum of the sinusoid.

In the Tables 2, 4—7 of the normal points the deviations from the sinusoid have been indicated sub $O-C$. In the case of my own observations a second term of the Fourier series was introduced adding $+ D \sin 4\pi P + E \cos 4\pi P$, and leaving the residuals given sub $O-C'$.

As the lightcurve is not exactly a sinusoid, the mean error of a single normal brightness was for each series derived from the differences between two consecutive values of $O-C$. The mean errors thus found are given in the tenth column of Table 8.

From the mean dates of maximum given in Table 8 the period was derived according to least squares, using the relative weights as indicated. The final elements thus found are:

Max. of sinusoid J. D. hel. M. Astr. T. Grw.

$$2423260^{d}\cdot140 + 10^{d}\cdot14397\ (E-403)$$
$$\pm\cdot029 \pm \quad \cdot00011 \text{ (m. e.)}$$

TABLE 8.

observer	number of: exposures or estimates	plates	normal points	brightness $= A + B \sin 2\pi P + C \cos 2\pi P$: A	B	C	m. e. of B or C	$\sqrt{B^2+C^2}$	m. e. of one normal brightness	phase of maximum	mean date of maximum of the sinusoid: J. D.	m. e.	relative weight	$O-C$	epoch E
				m	m	m	m	m	m	P	d	d		d	
Robinson	200	200	20	10·71	— ·506	+ ·698	± ·0335	± ·700	± ·106	·4885	2419171·965	± ·077	4	— ·154	0
				s	s	s	s	s	s						
Enebo	293	—	29	4·65	+ 1·21	— 1·89	± ·136	± 2·25	± ·52	·9092	19243·268	± ·096	3	+ ·140	7
				m	m	m	m	m	m						
Jordan	140	59	14	9·54	— ·017	— ·563	± ·0200	± ·563	± ·053	·0049	22266·075	± ·058	7	+ ·044	305
				s	s	s	s	s	s						
Thorrud	80	—	16	4·05	+ 2·12	— 2·21	± ·294	± 3·06	± ·83	·8782	24071·805	± ·154	1	+ ·146	483
				m	m	m	m	m	m						
Rybka	431	106	22	9·84	— ·120	— ·468	± ·0124	± ·483	± ·041	·0400	25735·252	± ·041	14	— ·019	647

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