TABLE 1 (*Continued.*)

J. D. hel. M. astr. T. Grw.	phase	estimate	measure	J. D. hel. M. astr. T. Grw.	phase	estimate	measure
	P	s	m		P	s	m
2424288·317	·027	·19	·19	2424291·421	·955	·00	·11
·388	·344	·00	·01	2·201	·454	—·04	·02
·412	·449	—·20	—·04	·225	·560	—·13	·02
9·214	·048	·22	·15	·295	·877	—·11	·04
·237	·154	·13	·12	3·387	·774	—·29	—·04
·308	·470	—·31	—·13	·410	·880	·12	·10
·331	·576	—·19	—·11	4·385	·255	·00	·11
·402	·893	—·06	·13	·408	·355	—·23	—·02
·425	·999	·02	·13	6·392	·261	—·06	·07
90·220	·566	—·09	—·10	7·348	·549	—·09	—·10
·244	·672	—·15	—·02	·370	·649	—·13	—·03
·360	·194	·00	·08	·392	·749	·02	·01
·389	·321	—·08	·05	4559·451	·687	—·24	—·14
1·204	·979	·14	·18	·475	·796	—·13	—·05
·227	·085	·04	·17	·499	·905	—·07	·03
·310	·458	—·13	—·00	·523	·010	—·08	·12
·333	·557	—·25	—·05	60·520	·483	—·28	—·05
·355	·656	—·05	—·04	6·504	·336	—·13	—·02
·377	·756	—·12	·01	86·514	·126	·18	·13
·399	·855	—·12	·02	·537	·232	—·06	·04

TABLE 2.

number of plates	phase	estimate	measure
	P	s	m
10	·035	+·025	+·165
11	·141	+·073	+·154
10	·215	—·068	+·091
10	·289	—·117	+·043
10	·362	—·196	—·043
10	·434	—·219	—·076
10	·464	—·209	—·048
10	·525	—·250	—·101
11	·561	—·222	—·095
11	·638	—·205	—·068
10	·728	—·177	—·044
10	·794	—·206	—·039
10	·857	—·075	+·047
10	·925	—·052	+·089
11	·977	+·016	+·137

On the character of the variation of S X Aurigae, by *Ejnar Hertzsprung.*

The variability of S X Aurigae was discovered by Miss LEAVITT (*H. C.* **130**). The star was first systematically observed by ENEBO from 1907 Sept. 8 to 1912 Febr. 1. The observations of ENEBO were published in three series, viz. in his "Beobachtungen veränderlicher Sterne" III, IV and VI. ENEBO derived a period of $1^d.532$, which was also used by MARTIN and PLUMMER in computing the phases for their photographic observations (*Month. Not.* **77**, 627; 1917). Neither ENEBO nor MARTIN and PLUMMER consider the period of 1·532 as final, but they do not succeed in finding a satisfactory solution of the problem.

In fact, we have here again a case of the well known kind, where observations have been taken merely at constant time-intervals (multiples of one day), as a consequence of which circumstance the number of periods in a day or the reciprocal period is uncertain by an integer. In Table 1 I have collected a number of examples of this kind including SX Aurigae. P′ is the spurious period and P the correct one.

TABLE 1.

	P′	P	$\frac{1}{P'}$	$\frac{1}{P}$	$\frac{1}{P}-\frac{1}{P'}$	$\frac{1}{P}+\frac{1}{P'}$
	d	d	d^{-1}	d^{-1}		
TY Tau	1·165	·549	·838	1·854	1	
SX Aur	1·532	½×1·210	·653	1·653	1	
VV Ori	3·05	1·485	·328	·673		1
YY Gem	½×4·	½× ·814	·5	2·46	2	3
RR Leo	4·75	·452	·211	2·210	2	
U Com	·226	·293	4·42	3·42	—1	
R Mus	·8825	7·51	1·133	·133	1	
Z CVe	1·89	·654	·529	1·529	1	
RZ Lib	1·479	·596	·676	1·677	1	
TV Lib	·369	·270	2·710	3·709	1	
H.R. 5752	1·0085	105·6	·9916	·0095		1
68 u Her	38·5	½×2·051	·026	·975		1

The "constant interval" is ordinarily somewhere between a sidereal and a mean day. Wrong periods of the kind $1/P + 1/P' =$ integer wil more easily be suspected in cases, where an unsymmetrical lightcurve of definite character (quick rise and slow decrease of δ Cephei stars) is to be expected, as then the asymmetry will show the wrong way. In fact, of the 3 cases in Table 1, where $1/P + 1/P' =$ integer, 2 belong to eclipsing variables with symmetrical lightcurves and one is a spectroscopic binary. The latter case, *H.R.* 5752, has not yet been definitively settled, but the longer period satisfies the observations just as well as the shorter and gives a more plausible value for the mass-function. The short period is that of W. H. CHRISTIE (*Publ. of the Dominion Astrophys. Obs.* **3**, No. 14). In a few cases of eclipsing variables with not very different primary and secondary minimum (68 u Her and SX Aur) and of a spectroscopic binary with double lines of about equal intensity (YY Gem) the apparent period is half the period of rotation. It is uncertain whether the case of YY Gem is of the kind $1/P—1/P'$ or $1/P + 1/P'$.

From the observations of ENEBO and MARTIN and PLUMMER the J. D. of the 20 most pronounced minima were picked out. All the 17 minima of ENEBO and 2 out of the 3 of MARTIN and PLUMMER satisfied the period $2/(1+1/1{\cdot}53) = 1^{d}{\cdot}21$ leaving only one epoch (J. D. 2420840·45) as corresponding to the secondary minimum. The other 19 epochs of minimum (not reduced to the sun) are given in Table 3. A last square solution gave the period to be $1^{d}{\cdot}210080 \pm {}^{d}{\cdot}000006$ (m. e.).

The individual observations were then reduced to the sun and the phases calculated from the formula

$$\text{phase} = \overset{d-1}{\cdot 826392}\,(\text{J. D. hel. M. astr. T. Grw.} - 2400000)$$

In his third series ENEBO used other magnitudes for the comparisonstars than in his two first ones. The third series has therefore been treated separately. Within each of the 3 groups ENEBO III + IV, ENEBO VI and MARTIN and PLUMMER the observations were arranged according to phase and the mean values given in Table 4 and graphically represented in Figure 1 were formed.*)

According to these results SX Aurigae is evidently an eclipsing variable star, the two components of the system being nearly equal in size and surface brightness and near to each other. It is to be expected that both spectra will be visible and that the maximum separation of the lines will be near to 300 km/s.

The phase of minimum was derived in the following way. A smooth curve was drawn exactly through the observed points of the lightcurve. The magnitude of the variable was read off on this curve on 100 points equidistant in phase. The results thus obtained for the group ENEBO III + IV are given in the first part of Table 5. These 100 values of the magnitudes were then arranged in pairs symmetrical to an arbitrarily assumed approximate phase of minimum and the squares of the differences in magnitude within each pair formed. This procedure was repeated for other assumed phases of minimum. The assumed phase of minimum, which in this way gives the smallest sum of the squares of the differences is finally adopted as the true phase of minimum.

*) The observations indicated by ENEBO as uncertain have been omitted.

Though this method is rather simple, practice shows that an explanation in detail is desirable. In the last part of Table 5 are therefore given the calculations corresponding successively to the assumed phases of minimum ·845, ·855 and ·865. The sum of the squares of the differences between symmetrical magnitudes (taking for convenience 100 $(m-8)$) are in the 3 cases 1296, 720 and 1764 respectively. The phase of best symmetry, corresponding to the minimum value of this sum, hence is

$$\cdot 855 + \frac{1}{2} \times \frac{(1296-720)+(720-1764)}{(1296-720)-(720-1764)} \times \cdot 01 = \cdot 8536$$

supposing the sum of the squares to be a quadratic function of the assumed phase of minimum.

The primary and secondary minimum have been considered as being separated by exactly half the period.

FIGURE 1.

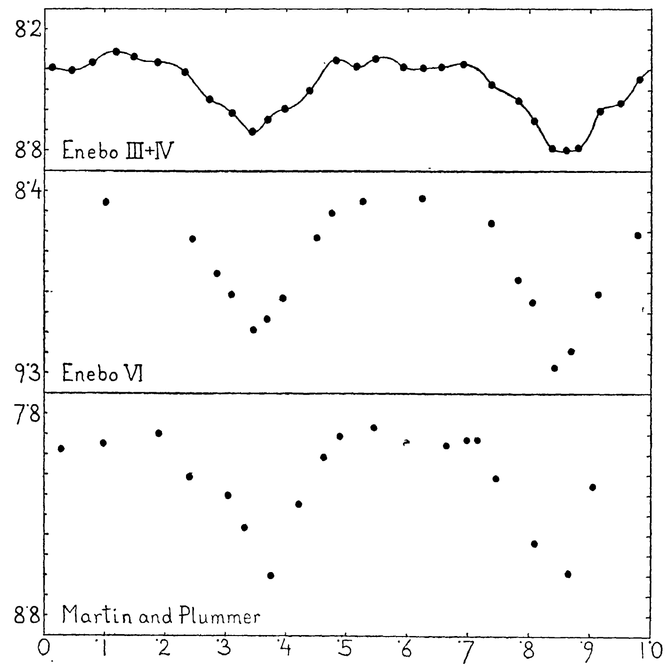

TABLE 2.

group of observations	first and last observation at J. D.	number of observations	m. e. of one observation	magnitude at max.	magnitude at min.	range	m. e. of one observation reduced to range m·8	total weight of observations (range m·8)	mean epoch of minimum J. D. hel. M. astr. T. Grw.	estimated m. e.
	d d		m	m	m	m	m	m−2	d	d
ENEBO III + IV	2417827 — 18746	291	± ·112	8·36	8·80	·44	± ·204	7000	2418218·779	± ·006
ENEBO VI	18894 — 19434	89	± ·101	8·44	9·36	·92	± ·089	11200	19219·515	± ·005
MARTIN and PLUMMER	20447 — 21300	94	± ·130	7·92	8·70	·78	± ·134	5250	20692·173	± ·007

In the same way the phase of minimum was derived for the group ENEBO VI to be ·8533 and for MARTIN and PLUMMER ·8466.

The mean error of a single observation was derived for each of the 3 groups separately from the differences between two observations following each other in phase. The values thus obtained are included in Table 2 together with other results of the present note.

TABLE 3.

J. D.	*E*	*O—C*	J. D.	*E*	*O—C*
d		d	d		d
2417853·34	0	+ ·01	2418360·33	419	— ·03
17945·31	76	+ 1	18377·31	433	+ 1
17991·28	114	0	18746·34	738	— 3
18014·30	133	+ 3	19039·23	980	+ 2
18043·35	157	+ 3	19103·35	1033	0
18159·48	253	0	19282·41	1181	— 3
18250·23	328	— 1	19362·30	1247	0
18279·28	352	0	20463·48	2157	+ 1
18337·34	400	— 2	20929·37	2542	+ 1
18348·25	409	— 1			

TABLE 4.

ENEBO III + IV			ENEBO VI			MARTIN and PLUMMER		
n	P	m	n	P	m	n	P	m
10	·013	8·39	6	·102	8·46	6	·028	7·98
10	·046	8·40	6	·246	8·64	6	·098	7·95
10	·079	8·36	5	·285	8·80	5	·189	7·90
10	·119	8·31	4	·310	8·91	5	·240	8·11
10	·148	8·34	5	·345	9·08	5	·303	8·20
10	·188	8·36	5	·368	9·03	5	·333	8·36
10	·233	8·41	5	·395	8·93	4	·375	8·60
10	·273	8·54	4	·450	8·63	4	·422	8·25
10	·310	8·61	5	·475	8·51	4	·461	8·02
10	·344	8·70	5	·527	8·45	5	·488	7·91
10	·369	8·65	5	·626	8·43	5	·544	7·87
10	·398	8·60	4	·738	8·56	5	·599	7·94
10	·438	8·50	4	·782	8·83	5	·664	7·95
10	·482	8·35	5	·806	8·94	5	·698	7·93
10	·515	8·38	5	·842	9·27	5	·716	7·92
10	·546	8·34	5	·869	9·18	5	·745	8·11
10	·593	8·39	5	·913	8·90	5	·809	8·46
10	·626	8·39	6	·977	8·62	5	·864	8·59
10	·655	8·39				5	·905	8·16
10	·693	8·37						
10	·739	8·47						
10	·782	8·55						
10	·808	8·65						
10	·837	8·79						
10	·860	8·80						
10	·880	8·78						
10	·915	8·60						
10	·950	8·56						
11	·980	8·44						

TABLE 5.

ENEBO (III + IV).

P	100 (m — 8)	P	100 (m — 8)	P ·845		Δ	P ·855		Δ	P ·865		Δ
·00	40	·50	36	80	79	1	80	80	0	80	80	0
·01	39	·51	38	80	75	5	80	79	1	78	80	2
·02	40	·52	38	80	71	9	78	75	3	75	79	4
·03	40	·53	37	78	66	12	75	71	4	70	75	5
·04	40	·54	35	75	61	14	70	66	4	63	71	8
·05	40	·55	34	70	58	12	63	61	2	59	66	7
·06	39	·56	34	63	55	8	59	58	1	58	61	3
·07	38	·57	34	59	53	6	58	55	3	58	58	0
·08	36	·58	36	58	51	7	58	53	5	56	55	1
·09	34	·59	38	58	49	9	56	51	5	53	53	0
·10	32	·60	39	56	47	9	53	49	4	49	51	2
·11	31	·61	40	53	44	9	49	47	2	45	49	4
·12	31	·62	39	49	41	8	45	44	1	41	47	6
·13	31	·63	39	45	39	6	41	41	0	40	44	4
·14	32	·64	39	41	38	3	40	39	1	39	41	2
·15	34	·65	39	40	37	3	39	38	1	40	39	1
·16	35	·66	38	39	37	2	40	37	3	40	38	2
·17	36	·67	38	40	38	2	40	37	3	40	37	3
·18	36	·68	37	40	38	2	40	38	2	40	37	3
·19	36	·69	37	40	39	1	40	38	2	39	38	1
·20	36	·70	38	40	39	1	39	39	0	38	38	0
·21	37	·71	39	39	39	0	38	39	1	36	39	3
·22	39	·72	41	38	39	1	36	39	3	34	39	5
·23	41	·73	44	36	40	4	34	39	5	32	39	7
·24	44	·74	47	34	39	5	32	40	8	31	39	8
·25	48	·75	49	32	38	6	31	39	8	31	40	9
·26	51	·76	51	31	36	5	31	38	7	31	39	8
·27	54	·77	53	31	34	3	31	36	5	32	38	6
·28	55	·78	55	31	34	3	32	34	2	34	36	2
·29	57	·79	58	32	34	2	34	34	0	35	34	1
·30	59	·80	61	34	35	1	35	34	1	36	34	2
·31	61	·81	66	35	37	2	36	35	1	36	34	2
·32	65	·82	71	36	38	2	36	37	1	36	35	1
·33	68	·83	75	36	38	2	36	38	2	36	37	1
·34	70	·84	79	36	36	0	36	38	2	37	38	1
·35	70	·85	80	36	35	1	37	36	1	39	38	1
·36	68	·86	80	37	35	2	39	35	4	41	36	5
·37	64	·87	80	39	37	2	41	35	6	44	35	9
·38	62	·88	78	41	41	0	44	37	7	48	35	13
·39	60	·89	75	44	45	1	48	41	7	51	37	14
·40	59	·90	70	48	50	2	51	45	6	54	41	13
·41	58	·91	63	51	53	2	54	50	4	55	45	10
·42	57	·92	59	54	57	3	55	53	2	57	50	7
·43	53	·93	58	55	58	3	57	57	0	59	53	6
·44	50	·94	58	57	59	2	59	58	1	61	57	4
·45	45	·95	56	59	60	1	61	59	2	65	58	7
·46	41	·96	53	61	62	1	65	60	5	68	59	9
·47	37	·97	49	65	64	1	68	62	6	70	60	10
·48	35	·98	45	68	68	0	70	64	6	70	62	8
·49	35	·99	41	70	70	0	70	68	2	68	64	4

$\Sigma \Delta^2 = 1296$ 720 1764