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Provisional or revised ephemerides of 23 known variable stars of the eclipsing type within 6° of η Carinae (Errata: 3 70)

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J. D. hel. M. T. Grw.	brightness in steps	number of plates	J. D. hel. M. T. Grw.	brightness in steps	number of plates	J. D. hel. M. T. Grw.	brightness in steps	number of plates	J. D. hel. M. T. Grw.	brightness in steps	number of plates
d 2423935 ²⁹⁰	s —18	4	d 2423945 ²⁵⁸	s —15	5	d 2423960 ²⁴⁷	s —18	2	d 2423971 ²²⁶	s 20	1
36 ²⁷¹	—18	4	46 ²⁵⁵	—23	4	62 ²⁴⁴	—10	2	74 ²⁰⁸	30	1
37 ²⁸⁰	—29	4	47 ²⁰⁸	—14	1	63 ²²²	—15	3	75 ²³¹	30	1
38 ²⁴⁰	—16	3	48 ²⁴⁷	—12	4	64 ²²⁸	—17	3	76 ²²⁸	10	1
39 ²⁵⁹	—23	5	49 ²⁰⁷	—02	1	65 ²⁴²	24	2	77 ²¹²	14	2
40 ²⁵⁸	—23	5	55 ¹⁹⁹	—22	1	66 ²³¹	05	3	85 ²⁰³	18	1
41 ²⁶⁷	—34	4	56 ²¹²	—28	2	67 ²⁴¹	20	2	86 ²⁰³	40	1
42 ²⁶³	—11	5	57 ²⁴²	—13	3	68 ²²⁷	37	2	87 ²⁰¹	35	1
43 ²⁵⁶	—21	5	58 ²²⁷	—10	3	69 ²³⁴	22	2	88 ¹⁹⁸	00	1
44 ²⁵⁴	—18	5	59 ²²⁷	—08	3	70 ²¹⁸	26	2	89 ¹⁹⁶	20	1

Provisional or revised ephemerides of 23 known eclipsing type within 6° of η Carinae, by *Ejnar Hertzsprung*.

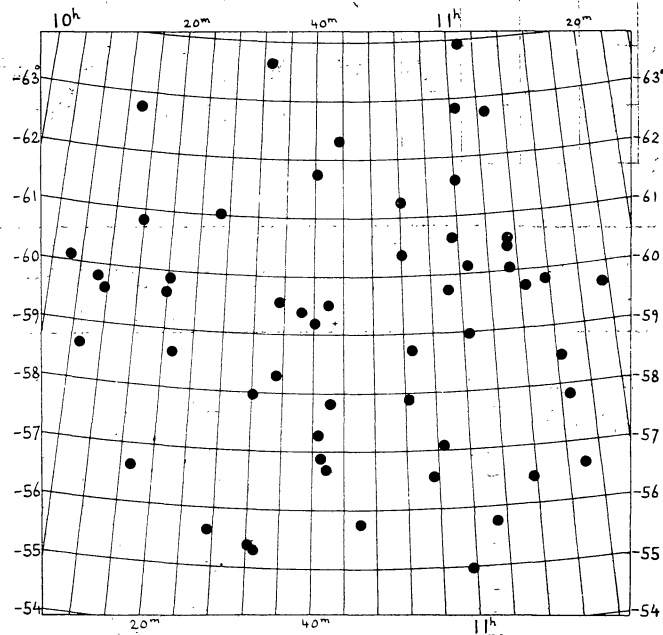
In continuation of the ephemeris given in *B. A. N.* 65 of 26 new eclipsing variable stars, I have further examined 15 variables of this type already announced in these columns together with 8 others previously known. The only revised ephemeris is that of ST Carinae, the 22 others being new. The general remarks made in *B. A. N.* 65 also hold for the present note. In all 408 plates taken on 117 nights between J. D. 2423786 and 2423993, were available. The majority of these were exposed for 30 min. (max. 37 min.), the total exposure time being 181 hours. The numbers of plates taken on the same night are as follows

number of plates	1	2	3	4	5	6	7	8	9	10	11	12	
nights		23	20	22	27	11	2	3	2	5	1	0	1

The following lines contain a few technical remarks regarding the treatment of the material. It was desirable to store the plates in such order, or rather disorder, that the observer would not know on which particular plates the consecutive estimates were made, and still so arranged that every plate of a certain number could be found without much trouble if wanted. This has been done by dividing the 408 plates in 10 groups according to the last figure of their number. The plates were kept in open boxes all lying the same way, film down with intermediate sheets of paper. I then usually started by estimating the variable on the plates having numbers ending on 0 and then took those ending on 3, 6, 9, 2, 5, 8, 1, 4 and 7. In this way nearly always several other plates will be estimated in between two plates taken during the same night. The time used for the different operations naturally varied from case to case, but the following nett times for the routine work may be taken as averages: estimates and reduction 4 hours, determina-

tion of period with least square solution 1h, calculation of phases to thousandths of the period 2h, arranging according to phase, calculation of mean values etc. 3h, total 10 hours. The average time for estimating one plate was about half a minute. The

FIGURE 1.



calculated phases were written on a special sheet of paper leaving room for adding the estimate of brightness. The sheet was then cut in slips, each containing one observation. During the cutting the slips were arranged in 100 groups according to the first 2 figures of the phase using a piece of cardboard divided into

100 sections. After this the final arrangement was easily made. All the operations mentioned above were made by the writer without assistance. The total number of observations used in the present note is 9087.

It will be noted that the range of the eclipsing variables given here is generally greater than for those contained in *B. A. N.* 65. The reason is that the latter are those found later, those with big range generally being discovered first.

A particularly interesting class of eclipsing variable stars is formed by those showing a constant minimum for a considerable fraction of the period. This class is represented in the present note by CV Car and DK Car. When, as is to be expected, the component of smaller surface brightness and greater size is the more yellowish in colour, the visual range of the pri-

mary minimum will be smaller than the photographic one. On the other hand there will be more prospect of detecting the secondary minimum by observations using light of longer wavelengths.

The accompanying diagrams are on the same scale as those given in *B. A. N.* 65.

Figure 1 shows the extent of the field (equinox 1875), $10^\circ \times 10^\circ$, covered by the plates and the distribution in this region of the 54 eclipsing variable stars so far mentioned in these columns. There is no striking deviation from accidental distribution.

A summary of the results is given in Table I and mean values of phase (using 2420000 J. D. hel. M. T. Grw. as zero point) and brightness for each variable in Table 2, followed by remarks on the separate stars.

The means represented in the diagrams are in Table 2 marked with an asterisk.

TABLE I.

Star	α (1875)	δ (1875)	<i>C. P. D.</i>	approximate phgr. mag. at maximum	epoch of min. J. D. hel. M. T. Grw.	period	reciprocal period	depth of minima	number of plates	phase of min. in fraction of period zeropoint J. D. 2420000	fraction of period occupied by minimum
	h m s	o ' "		m	d	d	d ⁻¹	s s		P	
ST Cn	10 11 39.0	-59 35.5	-59°2007	9.2	2423901.675	.90165	1.109086	.63 .04	408	.293	.18
CO Cn	13 58.0	-62 45.0	-62°1513	9.7	3877.983	8.3121	.120307	1.28 .0	407	.5485	.10
YY Cn	15 54.9	-60 48.8		10.0	3901.932	2.64264	.37841	.77 .02	397	.530	.12
AS Cn	19 59.3	-59 36.9		11	3921.655	2.76593	.361542	1.19 .02	407	.843	.13
CP Cn	21 17.6	-58 36.3		13 $\frac{1}{2}$	3898.707	2.3942	.41768	.70 .0	389	.412	.12
CU Cn	35 1.2	-58 16.2		13 $\frac{1}{2}$	3928.944	4.10112	.243836	.95 .0	368	.018	.05
BL Cn	40 2.9	-59 11.1		14 $\frac{1}{2}$	3900.874	3.35531	.298035	.69 .03	370	.597	.13
CV Cn	40 47.1	-57 15.5	-57°3774	9.6	3900.209	14.4157	.069369	1.64 .03	408	.5536	.10
SW Cn	41 7.4	-56 53.4	-56°3777	9.4	3941.923	8.16608	.122458	1.89 .0	408	.720	.09
CW Cn	41 42.4	-56 40.6		13 $\frac{1}{2}$	3940.986	1.97398	.506592	.73 .0	377	.472	.13
BP Cn	41 54.8	-59 30.4		11 $\frac{1}{2}$	3879.931	9.6449	.103682	.95 —	401	.279	.04
CD Cn	52 7.5	-60 21.1		12	3900.198	2.96756	.336977	.83 .0	386	.277	.08
CX Cn	52 26.9	-57 53.2	-57°4021	10.1	3909.914	3.34717	.29876	1.16 .0	408	.126	.12
CZ Cn	58 20.9	-59 43.9		13	3900.498	2.2850	.43764	.90 .02	398	.014	.13
XY VI	59 35.5	-54 58.8		11 $\frac{1}{2}$	3901.375	2.51037	.398347	1.26 .0	402	.101	.11
DD Cn	11 0 49.5	-62 49.5		13 $\frac{1}{2}$	3904.270	1.44272	.693137	.68 .01	370	.194	.14
DE Cn	1 3.2	-60 7.1		12	3891.343	3.71306	.26932	2.69 .0	408	.0165	.11
AR Ct	2 48.1	-55 44.9		12 $\frac{1}{2}$	3893.2	8.971	.11147	1.58 .0	400	.976	—
DF Cn	5 6.8	-62 44.3		13	3906.697	1.8663	.535824	.41 .0	376	.302	.10
CI Cn	8 43.5	-59 43.8		12	3901.246	2.81849	.3548	1.10 .0	393	.162	.11
DK Cn	11 32.1	-59 48.5		12	3918.458	11.335	.08822	.96 .01	452	.686	.10
DL Cn	12 33.9	-58 29.1		13	3901.355	4.8215	.2074	1.30 .0	391	.141	.09
DM Cn	13 10.9	-57 49.3		13	3911.648	5.3163	.1881	1.84 .0	363	.781	.14

TABLE 2.

AR Cen.			CI Car.			DL Car.		
n	P	s	n	P	s	n	P	s
68	.100	.117	53	.051	.023	48	.063	.217
58	.213	.095	5	.115	.15*	4	.105	.49*
43	.323	.081	3	.129	.41*	4	.118	.88*
36	.436	.128	4	.139	.62*	4	.126	1.25*
50	.544	.103	3	.147	.86*	5	.133	1.47*
40	.658	.092	4	.152	1.00*	4	.138	1.49*
32	.769	.086	5	.158	1.16*	6	.144	1.50*
36	.883	.123	5	.166	1.08*	5	.158	1.15*
5	.973	1.68*	2	.177	1.01*	4	.174	.57*
5	.984	1.63*	2	.186	.60*	7	.184	.29*
7	.991	1.37*	2	.202	.20*	50	.258	.204
5	.994	1.20*	50	.281	.024	50	.396	.178
7	.997	1.03*	50	.384	.033	50	.556	.228
8	.004	.73*	50	.500	.027	50	.694	.218
			50	.636	.013	50	.831	.178
			50	.776	.016	50	.940	.190
			55	.912	.020			
DF Car.			DK Car.			DM Car.		
n	P	s	n	P	s	n	P	s
80	.103	.039	40	.011	.009	110	.030	.220
4	.262	.135*	40	.093	.005	110	.299	.214
3	.273	.23*	40	.185	.018	110	.591	.189
3	.289	.41*	40	.273	.002	7	.722	.311*
5	.299	.45*	40	.370	.001	3	.731	.41*
6	.313	.385*	40	.451	.012	4	.735	.62*
9	.331	.23*	40	.551	.008	1	.737	.80*
6	.344	.04*	10	.616	.04*	1	.745	.98*
80	.444	.041	7	.637	.11*	1	.749	1.28*
80	.706	.046	2	.642	.40*	1	.751	1.51*
89	.915	.035	7	.670	.89*	1	.758	2.11*
			8	.686	1.02*	1	.782	2.11*
			8	.703	.99*	1	.786	1.94*
			4	.723	.82*	1	.804	1.68*
			2	.726	.68*	1	.821	.91*
			2	.729	.51*	1	.823	.81*
			2	.732	.29*	1	.826	.72*
			40	.765	.010	1	.831	.58*
			40	.835	.008	1	.847	.276*
			40	.934	.005	7		

REMARKS.

ST Car. This variable has been studied in detail at Harvard (*H. A.* 60, No. 5). The period derived there is $^d.901652$, while from the Johannesburg observations alone I found $^d.90164$. The two median minima of Harvard and Johannesburg, J. D. hel. M. T. Grw. 2414260 $^d.334$ and 2423901 $^d.675 \pm ^d.003$ (m. e.) respectively, give the period to be $9641^d.341/10693 = ^d.9016498 \pm ^d.0000004$ (m. e.) The existence of a secondary minimum of about $^m.06$ (SHAPLEY, *A. N.* 4589) is confirmed by the present observations. The range is $^m.87$ (Harvard) or $^s.63$ in my scale of estimates giving the value of one step to be $1^m.38$ in this case. *Spektr. H. D.* 89234: A0.

CO Car. = 52 a. The minimum is possibly constant for .02 or .03 of the period.

YY Car. The variable is faint ($^s.78$) on one old plate from 2420963.321 J. D. hel. M. T. Grw.

AS Car. There seems to be a constant minimum lasting for about .025 of the period. As the order, in which the 3 exposures (each of 30 min.) on the Sydney plate mentioned in *U. C.* 48,51 were taken, could not be ascertained, the middle exposure 2418411.945 J. D. hel. M. T. Grw. was adopted for the epoch of minimum. M. e. of epoch $\pm ^d.01$ and of period $\pm ^d.00003$.

CP Car = 52 b. M. e. of epoch $\pm ^d.005$ and of period $\pm ^d.0003$.

CU Car = 52 c. M. e. of epoch $\pm ^d.004$ and of period $\pm ^d.0003$.

BL Car. This faint variable is very near the centre of the η Carinae nebula. The star is faint on 2 old plates, viz. $^s.78$ on 2420250.300 and $^s.53$ on 2421035.255 J. D. hel. M. T. Grw. M. e. of epoch $\pm ^d.01$ and of period $\pm ^d.0001$.

CV Car = 52 d. There is a well established constant minimum lasting for an unusually great fraction of the period, viz. .05. The two components must therefore differ considerably in size. M. e. of epoch $\pm ^d.002$ and of period $\pm ^d.0011$.

SW Car. This variable is indicated in *H. C.* 151 as being probably of long period. There may be a constant minimum lasting for .01 or .02 of the period. The star is faint, $^s.03$, on an old plate from 2421010.272 J. D. hel. M. T. Grw.

CW Car = 54 a. M. e. of epoch $\pm ^d.006$ and of period $\pm ^d.00003$.

BP Car. This variable is situated in the η Carinae nebula. There are no recent observations between the phases .7485 and .7955. For this reason the period might just as well be half the value indicated in Table 1. But the star was found faint, $^s.9$, on a plate from 2421401.243 J. D. hel. M. T. Grw, while it was bright, $^s.0$, on 2420991.275, the two plates being $409.968/9.6449 = 42.506$ periods apart. I do not however consider this evidence against a period of $4^d.82$ as quite conclusive. The star was found faint (*U. O. C.* 46, 17) on a copy of a plate taken at the Cape Observatory on 2412161.399 J. D. hel. M. T. Grw.

CD Car. The star is faint, $^s.58$, on an old plate from 2420327.248 J. D. hel. M. T. Grw. M. e. of epoch $\pm ^d.007$ and of period $\pm ^d.00004$.

CX Car = 52 e. M. e. of epoch $\pm ^d.003$ and of period $\pm ^d.00016$.

CZ Car = 52f. M. e. of epoch ± 0.008 and of period ± 0.0003 .

XY Vel = 54b.

DD Car = 54c. M. e. of epoch ± 0.004 and of period ± 0.00013 .

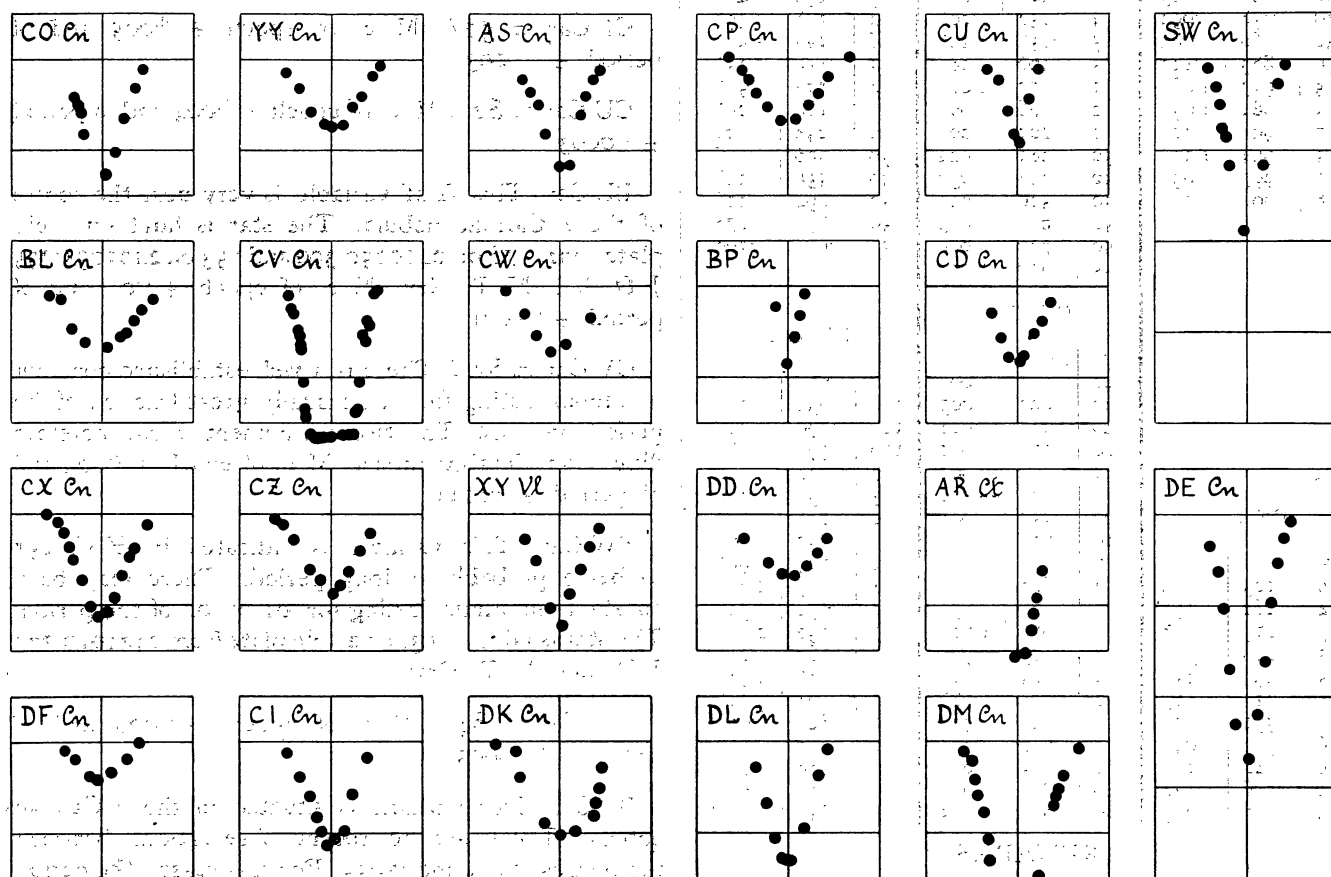
DE Car = 54d. Though the magnitude equivalent of the range 2^s.69 cannot be accurately indicated,

it is certainly one of the greatest known. The minimum is possibly constant for about 0.15 of the period. M. e. of epoch ± 0.011 and of period ± 0.0004 .

AR Cen = 54e. As there are no observations on the descending branch of the lightcurve, the epoch of minimum cannot be accurately indicated.

DF Car = 54f. M. e. of epoch ± 0.011 and of period ± 0.0004 .

FIGURE 2.



One square represents one tenth of the period in the abscissae, and one "step" in the ordinates.

CI Car. The minimum is possibly constant for about 0.2 of the period. M. e. of epoch ± 0.008 and of period ± 0.00003 .

DK Car = 54h. Of the plates, on which this variable has been estimated, 50 are taken with the centre at 11^h.9, -62°. The minimum appears to be constant for about 0.7 of the period. This would be the greatest fraction of the period known for a constant minimum. The rise from minimum to maximum only occupies 0.15 of the period. The difference in size between

the two components must therefore be very considerable, the proportion between the two diameters probably being about 4.

DL Car = 52g. M. e. of epoch ± 0.01 and of period ± 0.0006 .

DM Car = 52h = 54i. The variable was found invisible on 8 other plates between the phases 0.7615 and 0.8085. The minimum is possibly constant for about 0.4 of the period.