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

Hertzsprung, E.

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	s		d	s		d	s		d	s	
2423935·290	—·18	4	2423945·258	—·15	5	2423960·247	—·18	2	2423971·226	·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

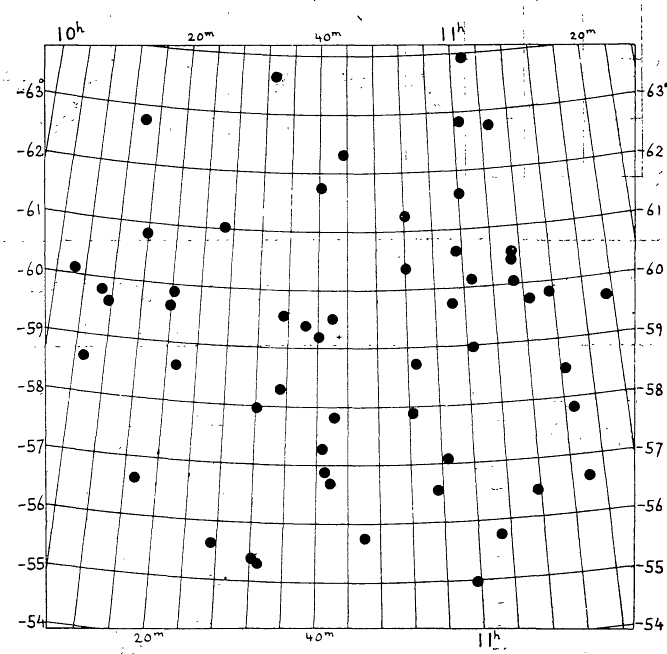
Provisional or revised ephemerides of 23 known variable stars of the eclipsing type within 6° of η Carinae, by *Ejnar Hertzsprung*.

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, determination of period with least square solution 1*h*, calculation of phases to thousandths of the period 2*h*, arranging according to phase, calculation of mean values etc. 3*h*, 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 primary 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° × 10°, 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 1 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 1.

Star	α(1875)	δ(1875)	C. P. D.		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	° ′		m	m	d	d	d⁻¹	s	s		P	
ST Cn	10 11 39·0	— 59 35·5	— 59°2007	9·2	9·3	2423901·675	·90165	1·109086	·63	·04	408	·293	·18
CO Cn	13 58·0	— 62 45·0	— 62°1513	9·7	10·5	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			13½	3898·707	2·3942	·41768	·70	·0	389	·412	·12
CU Cn	35 1·2	— 58 16·2			13½	3928·944	4·10112	·243836	·95	·0	368	·018	·05
BL Cn	40 2·9	— 59 11·1			14½	3900·874	3·35531	·298035	·69	·03	370	·597	·13
CV Cn	40 47·1	— 57 15·5	— 57°3774	9·6	10·3	3900·209	14·4157	·069369	1·64	·03	408	·5536	·10
SW Cn	41 7·4	— 56 53·4	— 56°3777	9·4	10·0	3941·923	8·16608	·122458	1·89	·0	408	·720	·09
CW Cn	41 42·4	— 56 40·6			13½	3940·986	1·97398	·506592	·73	·0	377	·472	·13
BP Cn	41 54·8	— 59 30·4			11½	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	11·0	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 Vl	59 35·5	— 54 58·8			11½	3901·375	2·51037	·398347	1·26	·0	402	·101	·11
DD Cn	11 0 49·5	— 62 49·5			13½	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			12½	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.

ST Car.

number of plates	fraction of period	brightness in steps
n	P	s
27	·018	—·009
30	·092	—·004
30	·154	—·001
11	·200	·017
6	·220	·095
7	·233	·166
5	·247	·344
6	·262	·432
6	·282	·585
6	·298	·613
7	·312	·546
6	·333	·383
5	·359	·208
6	·369	·102
10	·394	·017
30	·441	·002
30	·511	—·007
30	·574	—·006
30	·643	—·004
30	·709	—·000
30	·780	·031
30	·856	·010
30	·942	—·002

CO Car.

number of plates	fraction of period	brightness in steps
n	P	s
100	·120	·019
94	·384	·016
3	·518	·44*
3	·521	·52*
3	·524	·61*
2	·528	·86*
10	·552	1·30*
4	·563	1·04*
4	·572	·67*
5	·584	·34*
10	·592	·13*
80	·689	·027
89	·873	·006

YY Car.

number of plates	fraction of period	brightness in steps
n	P	s
40	·036	·145
40	·105	·135
40	·235	·127
40	·360	·128
19	·441	·102
4	·480	·27*
4	·496	·45*
4	·508	·71*
3	·522	·82*
3	·531	·87*
4	·543	·85*
4	·554	·64*
4	·564	·52*
4	·575	·31*
4	·584	·20*
20	·607	·133
40	·673	·099
40	·767	·104
40	·866	·086
40	·959	·144

AS Car.

number of plates	fraction of period	brightness in steps
n	P	s
40	·042	—·001
40	·134	·006
40	·221	·000
40	·338	·025
40	·465	—·000
40	·566	—·004
40	·662	—·006
48	·747	·002
5	·802	·22*
5	·810	·38*
4	·819	·51*
2	·828	·84*
4	·840	1·20*
4	·854	1·18*
5	·865	·63*
3	·871	·41*
5	·879	·24*
5	·887	·13*
37	·948	·015

CP Car.

number of plates	fraction of period	brightness in steps
n	P	s
40	·072	·152
40	·185	·147
40	·281	·176
9	·347	·13*
6	·362	·27*
6	·369	·38*
6	·377	·52*
4	·390	·67*
5	·404	·82*
6	·421	·80*
6	·434	·65*
7	·445	·53*
5	·456	·35*
9	·479	·12*
40	·563	·138
40	·698	·138
40	·791	·146
40	·884	·132
40	·988	·170

CU Car.

number of plates	fraction of period	brightness in steps
n	P	s
3	·985	·24*
5	·998	·36*
3	·008	·70*
5	·014	·96*
5	·021	1·05*
7	·031	·57*
2	·041	·24*
20	·088	·135
100	·259	·139
100	·551	·134
100	·806	·118
18	·952	·131

BL Car.

number of plates	fraction of period	brightness in steps
n	P	s
34	·006	·106
40	·096	·132
40	·218	·109
40	·348	·076
40	·468	·110
10	·539	·20*
8	·552	·24*
8	·564	·56*
4	·578	·72*
3	·603	·76*
4	·617	·66*
6	·624	·61*
4	·632	·48*
4	·640	·36*
5	·653	·25*
40	·710	·096
40	·809	·070
40	·909	·071

CV Car.

number of plates	fraction of period	brightness in steps
n	P	s
26	·042	·090
20	·114	·078
14	·185	·066
17	·256	·066
16	·334	·048
13	·411	·048
26	·472	·066
1	·508	·16*
1	·510	·31*
1	·512	·36*
1	·518	·54*
1	·519	·61*
1	·520	·71*
1	·522	·76*
1	·524	1·11*
1	·525	1·41*
1	·527	1.50*
7	·532	1·68*
7	·536	1·72*
7	·539	1·72*
7	·544	1·71*
7	·553	1·71*
7	·566	1·70*
7	·572	1·69*
7	·577	1·69*
3	·580	1·44*
1	·582	1·41*
1	·584	1·11*
1	·588	·59*
1	·590	·66*
1	·592	·44*
1	·594	·49*
3	·599	·14*
9	·604	·096*
29	·629	·080
40	·687	·065
30	·756	·048
30	·823	·057
30	·892	·041
30	·962	·048

SW Car.

number of plates	fraction of period	brightness in steps
n	P	s
70	·073	—·000
60	·216	·004
70	·400	·004
60	·581	·004
4	·678	·10*
3	·686	·31*
2	·690	·50*
3	·693	·76*
3	·697	·86*
3	·701	1·17*
3	·717	1·89*
1	·738	1·17*
2	·754	·27*
4	·762	·06*
60	·823	·002
60	·952	·002

CW Car.

number of plates	fraction of period	brightness in steps
n	P	s
70	·154	·062
60	·312	·084
14	·412	·118*
6	·434	·37*
6	·447	·62*
6	·462	·79*
6	·480	·71*
11	·507	·426*
60	·619	·063
70	·769	·072
68	·948	·088

BP Car.

number of plates	fraction of period	brightness in steps
n	P	s
40	·033	—·022
40	·123	—·027
30	·221	—·004
3	·265	·223*
3	·277	·823*
3	·287	·527*
3	·292	·297*
3	·297	·073*
40	·357	—·024
40	·416	—·022
38	·506	—·028
29	·610	—·021
40	·715	—·034
37	·822	—·030
52	·929	—·016

CD Car.

number of plates	fraction of period	brightness in steps
n	P	s
40	·074	·018
42	·177	·042
4	·250	·31*
4	·260	·58*
2	·267	·80*
2	·278	·84*
2	·286	·78*
3	·296	·53*
4	·303	·41*
5	·313	·19*
40	·382	·016
40	·468	·024
40	·574	—·013
40	·684	·025
40	·770	·023
40	·862	·022
38	·974	—·003

CX Car.

number of plates	fraction of period	brightness in steps
n	P	s
4	·065	·12*
3	·078	·21*
3	·085	·33*
3	·091	·48*
3	·096	·62*
4	·105	·86*
3	·114	1·13*
3	·122	1·26*
4	·132	1·20*
4	·140	1·04*
4	·148	·80*
3	·156	·60*
4	·162	·50*
3	·176	·25*
60	·256	·127
60	·393	·115
60	·536	·125
60	·670	·117
60	·814	·118
60	·958	·117

CZ Car.

number of plates	fraction of period	brightness in steps
n	P	s
40	·143	—·021
40	·245	—·040
40	·329	—·010
40	·413	—·021
40	·505	·003
40	·628	—·028
40	·721	—·013
40	·828	—·024
40	·913	—·005
9	·952	·03*
4	·963	·11*
4	·974	·27*
4	·992	·58*
3	·002	·71*
3	·015	·86*
3	·024	·77*
3	·034	·62*
3	·045	·38*
2	·056	·20*

XY Vel.

number of plates	fraction of period	brightness in steps
n	P	s
5	·063	·26*
7	·076	·49*
7	·091	1·02*
7	·104	1·22*
7	·112	·87*
7	·124	·58*
7	·133	·35*
8	·144	·14*
50	·212	—·012
50	·334	—·022
50	·476	—·016
50	·574	—·007
50	·712	—·016
50	·851	—·023
47	·991	—·012

DD Car.

number of plates	fraction of period	brightness in steps
n	P	s
45	·064	·020
5	·146	·28*
5	·173	·55*
5	·188	·66*
5	·201	·68*
6	·214	·58*
5	·226	·43*
4	·237	·27*
40	·288	·012
40	·368	·011
40	·486	—·011
40	·585	·002
40	·662	·025
50	·822	—·003
40	·947	—·009

DE Car.

number of plates	fraction of period	brightness in steps
n	P	s
3	·976	·37*
3	·985	·65*
4	·992	1·05*
4	·998	1·72*
2	·005	2·32*
3	·018	2·71*
5	·028	2·22*
5	·036	1·62*
4	·043	·98*
5	·049	·55*
5	·056	·28*
5	·063	·10*
90	·186	·015
90	·388	·020
90	·597	·023
90	·859	·010

TABLE 2.

number of plates	fraction of period	brightness in steps	number of plates	fraction of period	brightness in steps	number of plates	fraction of period	brightness in steps
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
			40	·011	·009			
			40	·093	·005	110	·030	·220
			40	·185	·018	110	·299	·214
			40	·273	·002	110	·591	·189
			40	·370	·001	7	·722	·311*
			40	·451	—·012	3	·731	·41*
			40	·551	·008	4	·735	·62*
			10	·616	·04*	1	·737	·80*
			7	·637	·11*	1	·745	·98*
80	·103	·039	2	·642	·40*	1	·749	1·28*
4	·262	·135*	7	·670	·89*	1	·751	1·51*
3	·273	·23*	8	·686	1·02*	1	·758	2·11*
3	·289	·41*	8	·703	·99*	1	·782	2·11*
5	·299	·45*	4	·723	·82*	1	·786	1·94*
6	·313	·385*	2	·726	·68*	1	·804	1·68*
9	·331	·23*	2	·729	·51*	1	·821	·91*
6	·344	·04*	2	·732	·29*	1	·823	·81*
80	·444	·041	40	·765	·010	1	·826	·72*
80	·706	·046	40	·835	·008	1	·831	·58*
89	·915	·035	40	·934	—·005	7	·847	·276*

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 ± ^{d}·003 (m. e.) respectively, give the period to be 9641^{d}·341/10693 = ^{d}·9016498 ± ^{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 ± ^{d}·01 and of period ± ^{d}·00003.

CP Car = **52** *b*. M. e. of epoch ± ^{d}·005 and of period ± ^{d}·0003.

CU Car = **52** *c*. M. e. of epoch ± ^{d}·004 and of period ± ^{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 ± ^{d}·01 and of period ± ^{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 ± ^{d}·002 and of period ± ^{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, 2^{s}·03, on an old plate from 2421010·272 J. D. hel. M. T. Grw.

CW Car = **54** *a*. M. e. of epoch ± ^{d}·006 and of period ± ^{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 ± ^{d}·007 and of period ± ^{d}·00004.

CX Car = **52** *e*. M. e. of epoch ± ^{d}·003 and of period ± ^{d}·00016.

CZ Car = 52*f*. M. e. of epoch ± ^{d}·008 and of period ± ^{d}·0003.

XY Vel = 54*b*.

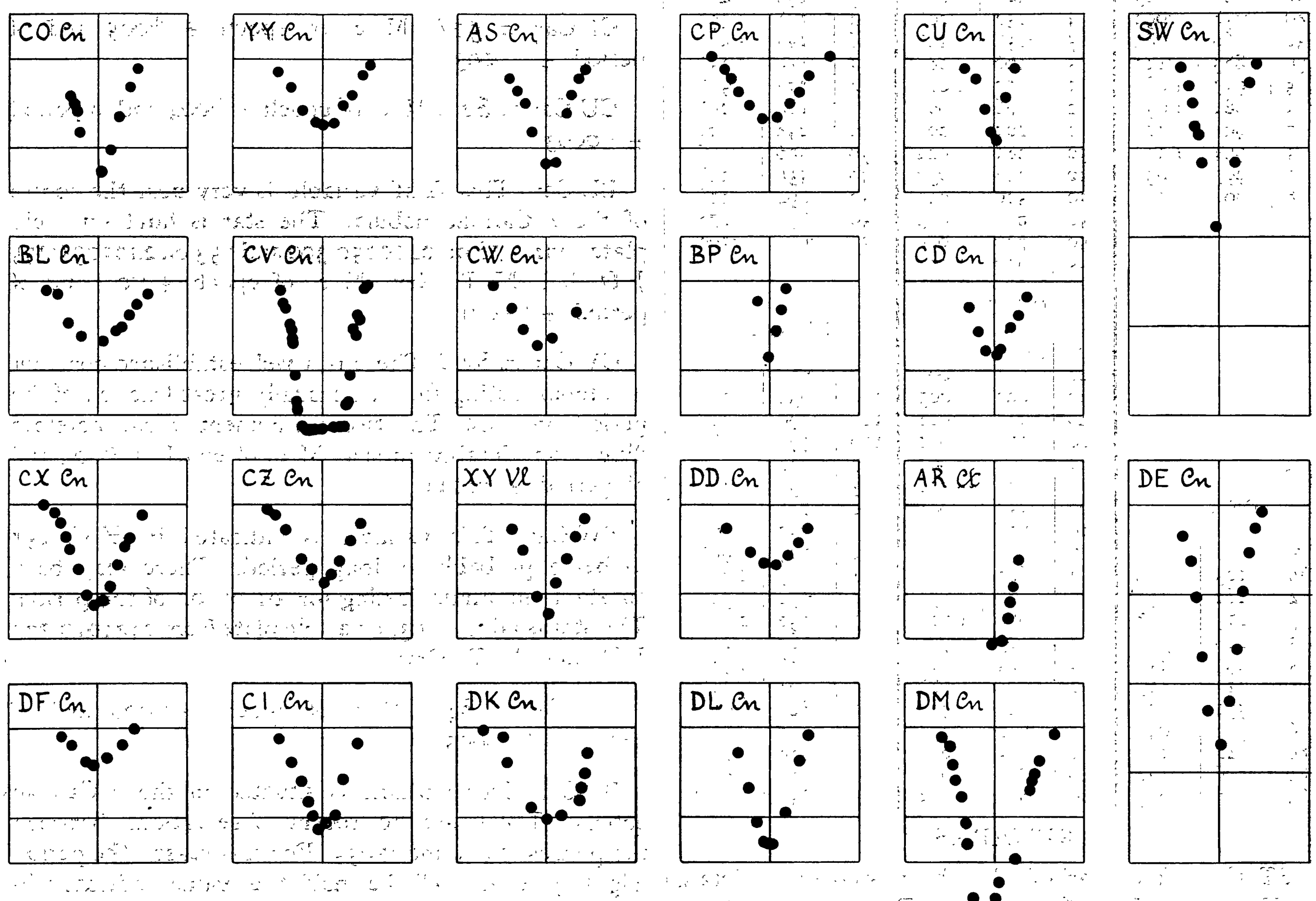
DD Car = 54*c*. M. e. of epoch ± ^{d}·004 and of period ± ^{d}·00013.

DE Car = 54*d*. 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 ·015 of the period. M. e. of epoch ± ^{d}·011 and of period ± ^{d}·0004.

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

DF Car = 54*f*. M. e. of epoch ± ^{d}·011 and of period ± ^{d}·0004.

FIGURE 2.



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

CI Car. The minimum is possibly constant for about ·02 of the period. M. e. of epoch ± ^{d}·008 and of period ± ^{d}·00003.

DK Car = 54*h*. 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 ·07 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 ·015 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 = 52*g*. M. e. of epoch ± ^{d}·01 and of period ± ^{d}·0006.

DM Car = 52*h* = 54*i*. The variable was found invisible on 8 other plates between the phases ·7615 and ·8085. The minimum is possibly constant for about ·04 of the period.