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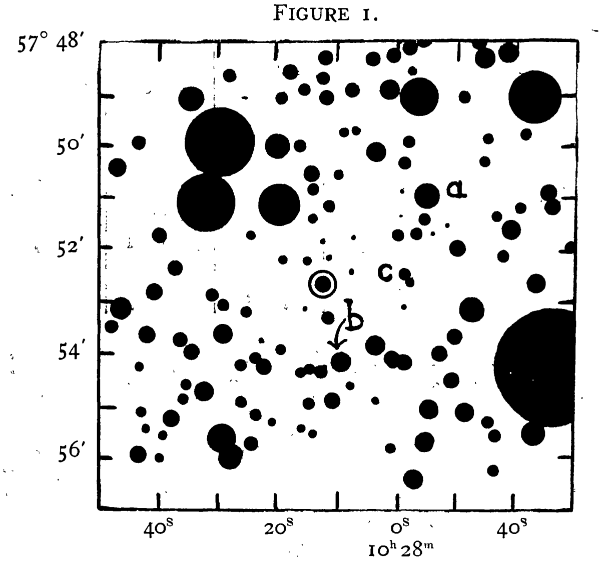
COMMUNICATION FROM THE OBSERVATORY AT LEIDEN.

Photographic observations of CR Carinae, by *A. J. Wesselink*.

This star, $\alpha = 10^h28^m13^s$, $\delta = -57°52'7$ (1875), $12^m\cdot4 - 12^m\cdot9$, belongs to the first variable stars of the δ Cephei type published as a result of the collaboration between Johannesburg and Leiden. The provisional lightcurve (*B. A. N.* 56, *c*) was based on 93 plates only, while at present about 8 times as many are available. The star was therefore taken up for further investigation in order to improve the elements.

The period is about 10 days and the lightcurve resembles a sinusoid.

FIGURE 1.



For my estimates I used the two comparison stars *a* and *b* indicated on the accompanying diagram Fig. 1. In my scale of steps *b* was in the mean found to be $^s\cdot158$ when *a* was taken as zeropoint. The variable was sometimes found fainter than both comparison stars. In that case the difference in steps from *b* only was used. The period was derived from the 22 epochs of minimum given in Table 1. The first of these minima appears on the Franklin-Adams chart N°. 18, made at Johannesburg 1910 May 7. A least square solution gave the period to be $9^d\cdot7617 \pm \cdot0008$ (m. e.) The phases were calculated from the formula:

$$\text{phase} = \overset{d^{-1}}{\cdot 10244}\ (\text{J. D. hel. M. astr. T. Grw.} - 2420000).$$

TABLE 1.

J. D. hel. M. astr. T. Grw. + 2400000	number of periods	O—C
d		d
18799·3	0	+ ·4
20605·3	185	+ ·5
20623·3	187	— 1·0
21035·3	229	+ 1·0
21287·3	255	— ·8
23787·0	511	— ·1
23816·4	514	·0
23884·3	521	— ·4
23903·8	523	— ·5
23942·3	527	— 1·0
23963·2	529	+ ·4
23972·2	530	— ·4
24168·9	550	+ 1·1
24177·1	551	— ·5
24197·4	553	+ ·3
24285·3	562	+ ·3
25320·3	668	+ ·6
25564·6	693	+ ·8
25641·5	701	— ·4
25652·1	702	+ ·5
25709·3	708	— ·9
25738·3	711	— 1·2
25760·2	713	+ 1·2

The 779 estimates [1]) were then arranged according to phase and divided into 39 nearly equal groups. The mean values thus obtained are given in Table 2 and represented graphically in Fig. 2.

These results suggested a close similarity with the lightcurve of YZ Sagittarii (period $9^d\cdot55$), as found by J. VOÛTE (*Ann. Bosscha Sterrenwacht*, Vol. 2 part 2) and also with that of S Normae (period $9^d\cdot760$) by S. TEN BRUGGENCATE (*l. c.* B 33).

I therefore decided to measure the plates for CR Carinae in the Schilt photometer in order to get a more accurate lightcurve than obtained from the estimates. The mean error of a single estimate is $\pm\ ^s\cdot048 = \pm\ ^m\cdot133$.

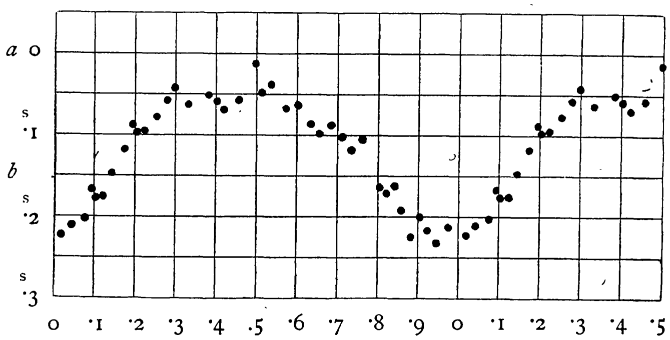
In order to include the whole variation of CR Carinae between the comparison stars, a third comparison

[1]) Four estimates made on plates showing very irregular fog were rejected.

TABLE 2.

Phase	Magnitude	Phase	Magnitude
P	s	P	s
·016	·224	·511	·050
·042	·211	·538	·040
·076	·203	·572	·068
·091	·168	·607	·064
·102	·176	·634	·086
·121	·176	·654	·098
·143	·147	·684	·088
·173	·118	·710	·103
·191	·088	·732	·120
·202	·098	·760	·106
·222	·095	·803	·165
·252	·079	·821	·172
·278	·059	·840	·162
·300	·042	·855	·194
·331	·064	·881	·225
·483	·051	·903	·201
·402	·060	·922	·218
·420	·070	·947	·232
·457	·058	·974	·214
·498	·014		

FIGURE 2.



star *c*, fainter than *b*, was added. The situation of *c* is indicated on Fig. 1.

Two diaphragms *d* 3 and *d* 5 were used in the Schilt photometer. Their diameters are 3·1 and 5·0 mm. respectively, of which about 25 times smaller images are formed on the plates. Naturally the fainter images were generally measured with the smallest diaphragm.

Three kinds of plates were used: Gevaert Sensima, Imperial SS and Ilford Zenith. The Imperial SS plates were less sensitive but showed a harder gradation. The 759 plates used were divided into three groups, viz:

Gevaert and Ilford	*d*3	381	plates
	*d*5	293	„
Imperial SS	*d*3	85	„

The reductions.

The galvanometer readings were converted into provisional magnitudes, m_{pr}, by the aid of a normal table, as described in *B. A. N.* 190.

The difference in magnitude on the normal scale between the two comparison stars *a* and *c* was taken as 1^m, which is not too far from the truth.

However, this uncertainty will only affect the range and not the form of the lightcurve of CR Carinae. Accordingly the magnitude of CR Carinae Δm was computed for each plate by the aid of the formula

$$\Delta m = \frac{m_{pr}\,(\mathrm{CR}) - \frac{1}{3}\,[m_{pr}\,(a) + m_{pr}\,(b) + m_{pr}\,(c)]}{m_{pr}\,(c) - m_{pr}\,(a)}.$$

The magnitudes thus obtained were treated separately for the three groups mentioned above in order to see if any systematic differences existed between them. In fact this proved to be the case as far as the zero point concerns.

The results derived from the 381 Gevaert and Ilford Zenith plates measured with the diaphragm *d*3 were taken as standard. The reductions of the two other groups to this system were found for the Gevaert and Ilford plates measured with the diaphragm *d*5 to be $-{}^{m}$·08 and for the Imperial SS plates $-{}^{m}$·07.

The mean error of one plate was computed from the differences between two observations following each other in phase and for each of the 3 groups found to be

Plates		Number of plates	m. e.	Adopted relative weights
			m	
Gevaert and Ilford	*d*3	386	± ·067	3
	*d*5	302	± ·081	2
Imperial SS	*d*3	88	± ·051	5
all plates		776	± ·073	

The total number of plates is here 776 — 759 = 17 greater than that used for the final lightcurve (see above). The reason for this is that finally 16 plates were rejected, on which the magnitude of the comparison star *b*, as derived from comparison with *a* and *c*, deviated more than 3 times the mean error from its mean value, which is ^{m}·485. One plate having the remark: "heavy fog and faint star images", was also rejected.

The remaining 759 magnitudes Δm, reduced to the same zeropoint as described above, are given in Table 3 for each plate. The observations were then arranged according to phase and divided into 38 about equal groups as indicated in Table 4, where weighted mean values of phase and Δm are given for each of these groups.

The mean error of one plate of average relative weight 2·84 is, in the same way as described above, found to be $\pm {}^{m}$·069, or of one of the 38 mean values $\pm {}^{m}$·015. The total weight of all the plates is $759/(\pm {}^{m}{\cdot}069)^2 = 159000^{m^{-2}}$.

TABLE 3.

J. D. hel. M. astr. T. Grw. + 2420000	phase	Δ *m*	J. D. hel. M. astr. T. Grw. + 2420000	phase	Δ *m*	J. D. hel. M. astr. T. Grw. + 2420000	phase	Δ *m*	J. D. hel. M. astr. T. Grw. + 2420000	phase	Δ *m*
	P	m		P	m		P	m		P	m
3786·501	·889	+ ·25	3831·519	·501	— ·29	3879·232	·388	— ·27	3903·413	·866	— ·04
·534	·893	+ ·17	·544	·503	— ·31	·257	·391	·00	04·242	·951	+ ·16
·555	·895	+ ·28	·570	·506	— ·22	·282	·394	— ·16	·268	·953	+ ·10
88·476	·092	+ ·32	33·579	·712	— ·05	·307	·396	— ·20	·296	·956	+ ·12
·497	·094	+ ·09	·604	·714	— ·25	·332	·399	— ·27	·322	·959	+ ·02
·511	·095	+ ·07	40·307	·401	— ·25	·357	·401	— ·24	·358	·962	+ ·11
·530	·097	+ ·04	·334	·507	— ·36	·382	·404	— ·17	·384	·965	+ ·07
89·518	·198	— ·14	·335	·508	— ·27	·434	·409	— ·26	·410	·968	+ ·14
·533	·200	— ·15	42·286	·604	— ·22	·486	·414	— ·38	07·297	·264	— ·28
90·474	·296	— ·21	·303	·606	— ·21	80·238	·492	— ·35	·324	·266	— ·15
·545	·303	— ·28	·342	·610	— ·07	·264	·494	— ·30	·378	·272	— ·21
·565	·305	— ·33	·368	·612	— ·13	·293	·497	— ·42	08·248	·361	— ·28
91·501	·401	— ·21	44·293	·800	— ·07	·323	·500	— ·43	·077	·364	— ·25
·520	·403	— ·25	·321	·803	+ ·10	·352	·503	— ·41	·352	·372	— ·32
99·488	·220	— ·06	·340	·805	— ·04	·378	·506	— ·34	10·232	·564	— ·33
·509	·222	— ·16	45·282	·902	+ ·24	·434	·512	— ·35	·259	·567	— ·30
·558	·227	— ·09	·309	·904	+ ·11	·489	·517	— ·41	·286	·568	— ·28
3813·374	·642	— ·11	57·269	·138	+ ·12	81·313	·602	— ·19	·313	·572	— ·31
·402	·645	— ·15	·295	·141	— ·06	·343	·605	— ·34	11·264	·670	— ·13
·436	·648	— ·19	·321	·144	— ·02	·371	·608	— ·24	·293	·673	— ·18
·449	·650	— ·23	·348	·147	— ·03	·431	·614	— ·24	·320	676	— ·26
·462	·651	— ·19	58·253	·239	— ·35	·488	·620	— ·24	·347	·678	— ·18
·474	·652	— ·13	·488	·263	— ·27	82·271	·700	— ·13	13·255	·874	— ·02
·486	·654	— ·23	·513	·266	— ·26	83·464	·822	·00	·284	·877	+ ·06
·499	·655	— ·18	68·244	·263	— ·21	·492	·825	— ·08	·311	·880	+ ·02
·511	·656	— ·30	71·236	·569	— ·31	84·241	·901	+ ·01	·341	·883	+ ·00
·524	·657	— ·07	·262	·572	— ·22	·299	·908	+ ·23	15·268	·080	+ ·08
·536	·659	— ·26	·287	·575	— ·31	·326	·910	+ ·06	·297	·083	+ ·08
14·383	·745	— ·05	·339	·580	— ·33	·382	·916	+ ·16	·325	·086	+ ·06
·413	·748	+ ·10	·363	·582	— ·26	·410	·919	+ ·12	·352	·089	— ·02
·440	·751	+ ·11	72·243	·673	— ·16	85·279	·008	+ ·09	16·318	·188	— ·17
·467	·754	— ·05	·263	·675	— ·28	·306	·011	+ ·11	·366	·193	— ·08
·514	·759	— ·12	·313	·680	— ·17	·331	·013	+ ·12	·390	·195	— ·30
·526	·760	— ·18	·339	·682	— ·22	·360	·016	+ ·11	18·279	·338	— ·23
·538	·761	— ·13	·365	·685	— ·11	·386	·019	+ ·26	·304	·494	— ·24
·551	·763	— ·03	·414	·690	— ·18	·412	·022	+ ·12	19·315	·495	— ·39
15·434	·853	+ ·01	74·252	·678	+ ·11	·441	·025	+ ·08	·326	·496	— ·46
·462	·856	+ ·16	·272	·880	+ ·07	·469	·027	+ ·13	·338	·497	— ·21
·481	·858	+ ·26	·311	·884	+ ·24	86·316	·114	+ ·13	26·214	·201	— ·19
16·362	·948	+ ·11	·333	·887	+ ·07	·343	·117	— ·05	27·219	·304	— ·33
·382	·950	— ·01	76·252	·083	+ ·09	·369	·120	— ·10	·243	·307	— ·29
·401	·952	+ ·19	·278	·085	+ ·14	·447	·128	+ ·04	28·219	·407	— ·34
·461	·958	+ ·20	·302	·088	+ ·09	87·256	·210	— ·20	·245	·409	— ·24
·487	·961	+ ·17	·327	·090	+ ·19	·375	·223	— ·16	·272	·412	— ·25
17·404	·055	+ ·17	·352	·094	+ ·19	·401	·225	— ·18	·296	·414	— ·31
·433	·058	+ ·20	·377	·096	+ ·13	·428	·228	— ·20	29·225	·509	— ·42
·462	·061	+ ·13	·402	·099	+ ·05	·455	·231	— ·14	·251	·512	— ·35
·488	·063	+ ·09	·427	·101	+ ·06	89·469	·437	— ·37	·277	·515	— ·29
·512	·866	+ ·05	·452	·104	+ ·09	97·236	·233	— ·32	·304	·518	— ·39
18·533	·171	— ·14	77·242	·184	— ·16	99·286	·433	— ·35	30·246	·614	— ·18
·559	·173	— ·07	·266	·187	— ·06	·301	·444	— ·24	·272	·617	— ·15
·584	·176	— ·01	·291	·189	— ·07	3900·223	·539	— ·36	·299	·620	— ·20
21·377	·462	— ·34	·316	·192	— ·25	·251	·542	— ·32	31·249	·717	— ·13
28·334	·175	— ·14	·341	·195	— ·11	·278	·545	— ·30	·276	·720	— ·08
·362	·177	— ·03	·397	·199	— ·12	·306	·548	— ·32	·304	·723	— ·14
·413	·183	— ·02	·449	·206	— ·11	·334	·551	— ·27	·332	·726	— ·04
·439	·185	— ·11	·475	·209	— ·20	01·238	·643	— ·17	32·235	·818	— ·09
·466	·188	— ·13	·500	·211	— ·13	02·335	·745	— ·07	·261	·821	+ ·02
·491	·191	— ·16	78·239	·287	— ·26	·364	·758	— ·09	·287	·823	— ·01
·542	·195	— ·15	·269	·290	— ·39	·390	·761	— ·10	·313	·826	·00
·565	·195	— ·25	·293	·292	— ·24	·416	·764	— ·09	33·244	·921	+ ·10
29·459	·290	— ·24	·318	·295	— ·24	03·235	·847	+ ·02	·325	·930	+ ·07
·490	·293	— ·24	·343	·297	— ·20	·261	·850	— ·02	34·243	·024	+ ·16
30·479	·394	— ·22	·399	·303	— ·43	·288	·853	+ ·02	·275	·027	+ ·10
·505	·396	— ·14	·453	·309	— ·23	·315	·856	+ ·10	·304	·030	+ ·05
·530	·399	— ·25	·477	·311	— ·34	·341	·858	+ ·01	·332	·033	+ ·17
·555	·402	— ·18	·504	·314	— ·31	·386	·863	+ ·02	35·244	·126	— ·06

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TABLE 3 (*continued*).

J. D. hel. M. astr. T. Grw. + 2420000	phase	Δ *m*	J. D. hel. M. astr. T. Grw. + 2420000	phase	Δ *m*	J. D. hel. M. astr. T. Grw. + 2420000	phase	Δ *m*	J. D. hel. M. astr. T. Grw. + 2420000	phase	Δ *m*
	P	m		P	m		P	m		P	m
3935·284	·131	+ ·06	3959·201	·581	— ·29	4169·509	·125	+ ·09	4204·479	·707	— ·11
·301	·132	— ·03	·228	·583	— ·20	·523	·126	— ·01	·503	·709	+ ·02
·328	·135	— ·05	·253	·586	— ·19	·536	·127	+ ·10	·526	·712	— ·07
36·223	·227	— ·17	60·234	·686	— ·12	·549	·129	— ·04	·550	·714	— ·05
·260	·231	— ·25	·260	·689	— ·14	·434	·321	— ·26	·574	·717	— ·08
·287	·233	— ·18	62·220	·889	+ ·05	·457	·324	— ·19	·597	·719	— ·18
·314	·236	— ·13	·268	·895	+ ·27	·481	·326	— ·18	05·335	·795	+ ·02
37·237	·331	— ·26	63·198	·990	+ ·10	72·422	·422	— ·23	·359	·797	— ·05
·266	·334	— ·22	·223	·992	+ ·15	·441	·423	— ·18	·382	·799	+ ·04
·293	·336	— ·12	·246	·995	+ ·10	·464	·427	— ·27	·406	·802	+ ·05
·325	·340	— ·28	64·203	·093	+ ·08	·488	·430	— ·22	·430	·804	+ ·08
38·211	·430	— ·33	·228	·095	— ·01	·511	·432	— ·27	·453	·807	+ ·11
·240	·433	— ·27	·253	·098	+ ·04	73·417	·525	— ·28	·477	·809	+ ·07
·268	·436	— ·24	65·207	·195	— ·04	76·409	·831	+ ·05	·497	·811	— ·05
39·204	·532	— ·30	·230	·198	— ·10	·433	·834	+ ·10	·518	·813	·00
·231	·535	— ·33	·254	·201	— ·12	·456	·836	+ ·05	·542	·816	·00
·258	·538	— ·30	66·205	·298	— ·22	·480	·839	+ ·09	·565	·818	+ ·01
·287	·541	— ·32	·232	·301	— ·18	·503	·841	+ ·11	·589	·821	+ ·08
·314	·543	— ·35	·257	·303	— ·44	·527	·843	— ·14	06·310	·894	+ ·02
40·206	·635	— ·17	67·204	·401	— ·28	·550	·846	+ ·09	·333	·897	+ ·02
·233	·637	— ·22	·229	·403	— ·30	·574	·848	+ ·13	·357	·899	+ ·06
·258	·640	— ·10	·257	·405	— ·28	·598	·427	— ·20	·380	·902	+ ·10
·283	·643	— ·25	68·215	·504	— ·37	77·406	·933	+ ·11	·404	·904	+ ·17
·310	·645	— ·04	·239	·506	— ·31	·430	·936	+ ·08	·428	·906	+ ·03
41·221	·739	— ·09	69·221	·507	— ·23	·454	·938	+ ·27	·451	·909	+ ·07
·253	·742	— ·04	·247	·610	— ·26	·477	·941	+ ·21	·475	·911	+ ·11
·282	·745	— ·05	70·205	·708	— ·15	·501	·943	+ ·21	07·418	·008	+ ·17
·311	·748	— ·10	·231	·710	— ·05	·524	·946	+ ·16	·434	·010	+ ·22
42·209	·840	— ·04	71·200	·810	+ ·05	·548	·948	+ ·31	26·281	·940	+ ·14
·235	·843	— ·07	·226	·812	— ·03	·571	·950	+ ·24	28·287	·146	— ·04
·262	·845	+ ·10	72·208	·913	+ ·15	·595	·953	+ ·15	38·285	·170	— ·10
·288	·848	+ ·05	·233	·916	+ ·21	87·573	·975	+ ·29	·308	·172	— ·17
·321	·851	+ ·09	73·224	·017	+ ·24	90·408	·265	— ·19	40·420	·389	— ·26
43·205	·942	+ ·19	74·208	·118	+ ·08	·430	·268	— ·24	45·318	·890	+ ·09
·231	·945	+ ·21	·232	·120	— ·03	96·326	·872	+ ·16	·361	·895	+ ·17
·256	·947	+ ·11	75·207	·220	— ·09	·355	·875	+ ·23	·434	·824	+ ·10
·281	·949	+ ·16	·231	·223	— ·09	·377	·877	+ ·10	57·272	·115	— ·05
·307	·952	+ ·19	76·205	·322	— ·39	98·325	·076	+ ·01	·310	·119	— ·01
44·203	·942	+ ·13	·228	·325	— ·30	·349	·079	+ ·08	58·259	·216	— ·15
·228	·047	+ ·20	77·199	·424	— ·37	·372	·081	+ ·13	61·240	·521	— ·49
·253	·049	+ ·05	·223	·427	— ·25	·396	·084	+ ·09	·264	·524	— ·36
·279	·052	+ ·04	78·206	·527	— ·34	·419	·086	+ ·17	62·221	·622	— ·12
·304	·054	+ ·14	·217	·407	— ·15	·439	·088	+ ·03	·244	·624	— ·19
45·208	·147	— ·04	·228	·529	— ·13	·453	·090	+ ·09	·340	·634	— ·24
·234	·149	— ·11	79·221	·631	— ·20	·467	·091	— ·01	·361	·636	— ·18
·259	·152	— ·10	85·203	·244	— ·25	·481	·092	+ ·16	63·233	·726	— ·10
·283	·155	— ·05	86·203	·347	— ·31	·495	·094	+ ·24	·250	·727	— ·20
·307	·157	— ·07	87·201	·449	— ·37	·509	·095	+ ·03	·406	·743	— ·08
46·216	·250	— ·15	88·198	·551	— ·30	·522	·097	+ ·19	·430	·746	— ·08
·242	·252	— ·17	89·196	·653	— ·34	4200·325	·281	— ·35	64·326	·838	+ ·04
·269	·256	— ·17	90·195	·756	— ·05	·348	·284	— ·13	·350	·840	+ ·02
·294	·258	— ·28	91·194	·858	+ ·21	·372	·286	— ·13	·423	·847	+ ·06
47·208	·352	— ·25	4141·479	·253	— ·21	·395	·288	— ·13	66·239	·033	+ ·16
48·227	·456	— ·36	·503	·255	— ·18	·419	·291	— ·18	77·268	·163	— ·06
·240	·458	— ·30	·527	·258	— ·11	·442	·293	— ·14	·278	·164	— ·08
·253	·459	— ·34	·551	·260	— ·26	01·338	·385	— ·25	·289	·165	— ·03
·266	·460	— ·36	·571	·263	— ·16	·362	·388	— ·30	80·195	·463	— ·31
49·196	·556	— ·42	68·470	·018	+ ·08	·386	·390	— ·28	81·201	·566	— ·35
55·199	·171	— ·10	·482	·019	+ ·08	·408	·392	— ·25	82·202	·669	— ·20
56·199	·273	— ·23	·496	·021	+ ·17	·456	·397	— ·16	·224	·671	— ·23
·226	·276	— ·16	·507	·022	+ ·16	02·410	·495	— ·27	84·196	·873	+ ·03
57·210	·377	— ·30	69·393	·113	— ·04	·432	·497	— ·40	·282	·882	+ ·14
·244	·378	— ·25	·417	·115	+ ·14	04·353	·694	— ·14	·244	·980	+ ·03
·272	·383	— ·23	·440	·117	+ ·01	·377	·696	— ·06	·267	·983	+ ·08
58·201	·478	— ·35	·462	·119	— ·02	·396	·698	— ·05	·290	·985	+ ·14
·228	·481	— ·35	·480	·121	— ·01	·421	·701	— ·10	86·225	·081	+ ·09
·253	·483	— ·34	·496	·123	— ·07	·445	·703	— ·10	·249	·083	+ ·02

TABLE 3 (*continued*).

J. D. hel. M. astr. T. Grw. + 2420000	phase	Δ *m*	J. D. hel. M. astr. T. Grw. + 2420000	phase	Δ *m*	J. D. hel. M. astr. T. Grw. + 2420000	phase	Δ *m*	J. D. hel. M. astr. T. Grw. + 2420000	phase	Δ *m*
	P	m		P	m		P	m		P	m
4286·320	·091	+·31	4566·460	·788	+·15	5383·410	·476	—·27	5732·255	·212	—·14
·367	·095	+·02	·484	·791	—·02	84·374	·575	—·20	38·198	·829	+·03
87·249	·186	—·19	86·462	·837	+·08	·402	·578	—·19	·341	·836	+·12
·272	·188	—·14	95·302	·743	—·11	85·367	·677	—·18	·363	·838	+·08
·343	·195	—·13	4627·237	·014	+·11	·390	·679	—·13	40·202	·026	+·16
·367	·197	—·12	42·348	·562	—·24	86·322	·775	+·10	45·264	·545	—·31
88·246	·288	—·33	·374	·565	—·25	·345	·777	+·05	·286	·547	—·29
·270	·290	—·18	48·240	·166	—·08	91·382	·293	—·28	46·254	·646	—·10
·340	·298	—·26	49·244	·269	—·17	·406	·296	—·25	·276	·648	—·14
·364	·300	—·38	50·320	·379	—·26	5406·204	·812	—·06	·298	·651	—·06
89·260	·391	—·19	51·237	·473	—·25	·227	·814	—·03	·321	·653	—·13
·284	·394	—·27	4915·399	·533	—·30	42·234	·502	—·33	·342	·655	—·17
·354	·401	—·27	·427	·536	—·26	46·236	·912	+·14	·364	·658	—·17
·378	·404	—·28	18·438	·845	+·08	47·209	·012	+·14	53·295	·368	—·22
90·267	·495	—·36	·465	·848	+·12	·231	·014	+·18	59·192	·972	+·12
·285	·497	—·31	5025·403	·802	—·02	5561·553	·725	—·03	·267	·979	+·14
91·250	·596	—·22	38·240	·117	+·06	·575	·728	—·07	60·189	·074	+·07
·274	·598	—·23	·265	·120	·00	62·547	·827	+·03	·245	·079	+·11
92·248	·698	—·06	39·190	·215	—·22	·569	·830	+·12	·267	·082	+·12
·271	·700	—·22	·212	·217	—·11	64·547	·032	+·13	·288	·084	+·06
·342	·707	—·07	43·241	·630	—·01	·569	·034	+·13	61·196	·177	—·12
·365	·710	+·05	67·224	·086	+·15	70·519	·645	—·11	·291	·187	—·08
93·245	·800	—·18	·241	·088	+·10	·541	·646	—·19	·345	·192	—·03
·268	·802	+·08	·257	·090	—·02	·563	·648	—·21	66·196	·689	—·17
·339	·810	—·03	·273	·091	+·18	71·504	·745	—·07	72·326	·317	—·11
·362	·812	+·14	·289	·093	+·11	5614·453	·145	+·06	·339	·318	—·18
94·248	·903	+·10	·305	·095	—·04	·475	·147	—·08	·351	·320	—·02
·270	·905	+·19	68·224	·189	—·10	15·399	·242	—·21	73·196	·406	—·25
·338	·912	+·13	·241	·191	—·19	·422	·244	—·25	·218	·408	—·27
·360	·914	+·23	·263	·193	—·12	40·327	·795	—·04	·240	·411	—·21
96·252	·108	+·11	·279	·195	+·01	41·413	·906	—·14	·262	·413	—·27
·274	·110	+·11	78·243	·215	—·21	·483	·913	+·07	·284	·415	—·21
·297	·113	+·01	·263	·217	—·08	·504	·916	+·08	·307	·418	—·27
·321	·115	·00	5319·330	·912	+·18	·573	·923	+·07	·329	·420	—·30
97·256	·211	—·11	20·256	·007	+·18	51·546	·944	+·13	74·189	·508	—·32
·278	·213	—·20	·370	·019	+·17	·568	·947	+·20	·233	·512	—·28
·302	·216	—·08	27·266	·725	—·08	52·545	·047	—·03	·262	·515	—·37
·324	·218	—·19	·298	·728	—·07	·567	·049	+·18	·284	·518	—·31
98·239	·312	—·26	·332	·732	—·02	86·256	·500	—·35	·306	·520	—·26
4537·390	·810	+·02	·356	·734	—·06	·277	·502	—·33	75·200	·612	—·13
38·458	·920	+·13	28·333	·834	+·08	·301	·505	—·43	·230	·615	—·22
·507	·925	+·14	·383	·839	+·14	·323	·507	—·34	·278	·619	—·15
43·422	·428	—·14	29·273	·931	+·15	·345	·509	—·36	·300	·622	—·13
·442	·430	—·36	·301	·934	+·15	·369	·512	—·31	·321	·624	—·03
50·374	·140	—·28	30·270	·033	+·25	5709·257	·856	+·11	·344	·626	—·18
·394	·142	—·08	77·299	·850	+·13	·302	·861	+·08	76·255	·720	—·05
53·435	·454	—·33	·322	·853	+·11	·348	·866	+·02	·277	·722	—·04
·459	·456	—·37	79·351	·061	+·13	·370	·868	+·17	·299	·622	—·11
·486	·459	—·32	·375	·063	·00	16·478	·596	—·14	·321	·726	—·13
58·380	·960	+·12	80·245	·152	+·05	·501	·598	—·18	77·214	·818	+·09
59·322	·057	—·01	·270	·155	—·10	31·204	·105	—·02	·236	·820	—·02
·347	·059	+·16	81·336	·264	—·30	·286	·113	+·12	·276	·824	+·13
·395	·064	+·09	·360	·266	—·24	·355	·120	+·07	89·200	·046	+·17
·420	·067	+·01	82·338	·367	—·21	·377	·122	+·02	91·205	·251	—·23
60·469	·174	—·06	·362	·369	—·15	·423	·127	—·03	·228	·253	—·28
·493	·177	—·06	83·387	·474	—·29	32·202	·207	—·11			

The difference in provisional magnitude between *a* and *c* may be taken as a measure of the gradation of the plate. The statistics of these gradation factors are of interest from a technical point of view. The frequencies of the differences $m_{pr}(c) - m_{pr}(a)$ are therefore given in Table 5 and shown graphically in Fig. 3, separately for plates measured with the diaphragms *d*3 and *d*5. The relative frequencies are well represented by the figures:

	$m_{pr}(c) - m_{pr}(a)$	Gaussian m.e. of the gradation of one plate
diaphragm *d*3	1·34	± ·18
„ *d*5	1·06	± ·18

TABLE 4.

Phase	Δ *m*	number of plates	Sum of relative Weights
P	m		
·016	+ ·148	20	55
·046	+ ·116	18	57
·074	+ ·093	22	56
·091	+ ·103	22	56
·105	+ ·057	21	58
·123	+ ·009	20	56
·145	— ·053	17	56
·173	— ·090	21	58
·193	— ·130	23	57
·213	— ·144	22	57
·238	— ·188	18	57
·263	— ·221	19	57
·288	— ·215	21	57
·311	— ·262	21	57
·357	— ·241	17	58
·395	— ·229	23	56
·412	— ·261	22	57
·440	— ·290	18	58
·480	— ·340	19	58
·504	— ·326	21	58
·523	— ·318	19	56
·551	— ·317	18	57
·589	— ·229	21	58
·622	— ·164	20	59
·646	— ·167	19	57
·671	— ·174	22	57
·701	— ·102	19	56
·726	— ·093	21	59
·754	— ·059	21	58
·804	+ ·016	22	58
·822	+ ·020	21	57
·842	+ ·046	19	57
·857	+ ·083	21	56
·885	+ ·115	19	55
·907	+ ·111	21	54
·929	+ ·133	17	50
·948	+ ·169	17	57
·975	+ ·122	17	54

The final lightcurve represented in Fig. 4 shows a rather marked hesitation on the ascending branch and bears in this respect some resemblance to the lichtcurve of YZ Sagittarii, the period of which variable (9^{d}·55) is nearly the same as that of CR Carinae (9^{d}·76).

In a case like that of CR Carinae it is difficult to decide, which phase should be chosen for the fixing of normal epochs. The well defined minimum,

FIGURE 3.

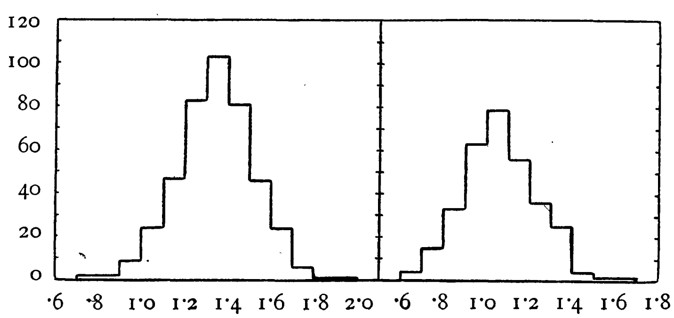


TABLE 5.

$m_{pr.}(c) - m_{pr.}(a)$	Numbers for $d3$	Numbers for $d5$
·60 — ·69	0	4
·70 — ·79	2	15
·80 — ·89	2	33
·90 — ·99	9	63
1·00 — 1·09	24	79
1·10 — 1·19	47	56
1·20 — 1·29	83	36
1·30 — 1·39	103	25
1·40 — 1·49	81	4
1·50 — 1·59	46	2
1·60 — 1·69	24	2
1·70 — 1·79	6	0
1·80 — 1·89	1	0
1·90 — 2·00	1	0

which occurs at about ^{P}·975 seems more convenient than the maximum, which lies at about ^{P}·50.

Another, probably better, way is to indicate the epoch, at which the star on the steep part of the ascending branch of the lightcurve is separated by e. g. ·65 of the period from that point on the descending branch, where the brightness is the same. The corresponding phases are ^{P}·134 and ^{P}·784 respectively.

It is evident that the form of the lightcurve deviates in its details from a simple sinusoid. Nevertheless a sinusoid, determined according to least squares, will fix an epoch which is practically free of personal interpretation of the form of the lightcurve.

The sinusoid for the lightcurve of CR Carinae thus determined is:

$$\Delta m = -{}^{m}.0969 - {}^{m}.0609 \sin 2\pi P + {}^{m}.2103 \cos 2\pi P.$$

The mean epoch of its maximum (phase ^{P}·455) is J. D. hel. M. astr. T. Grw. 2424348^{d}·45.

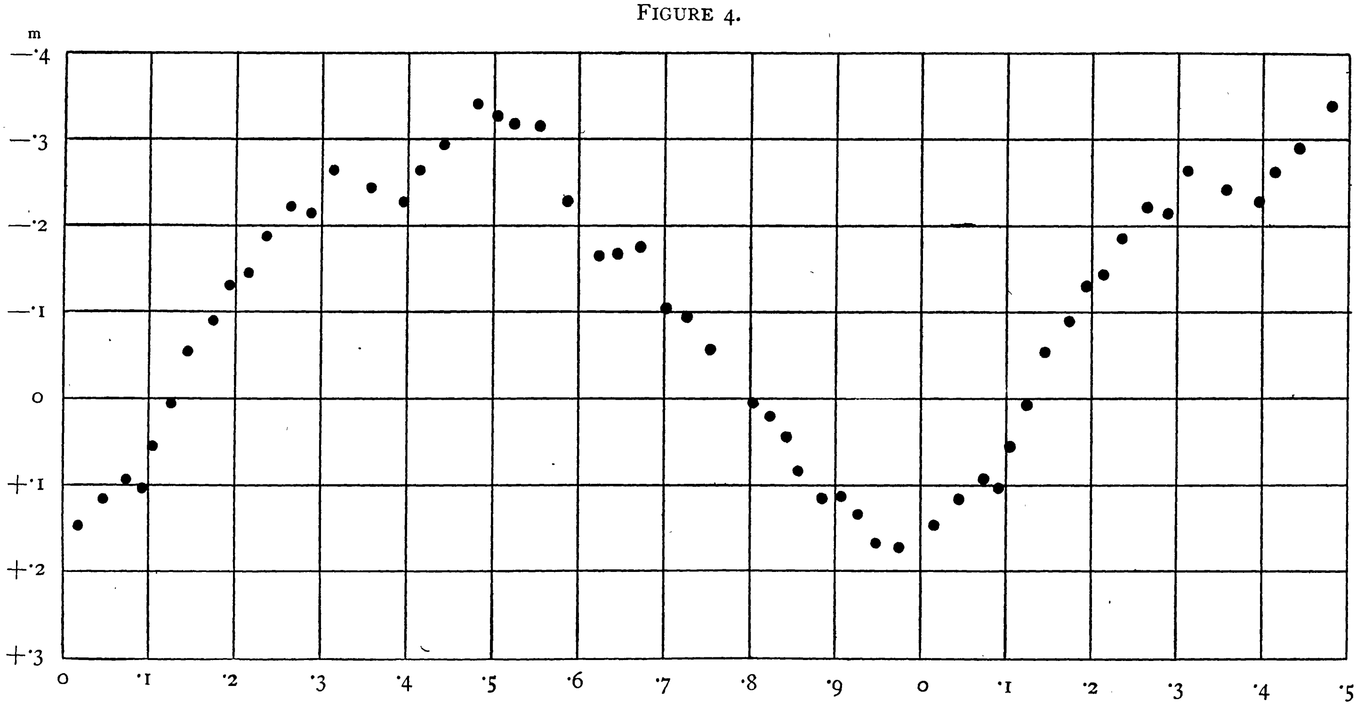
The differences between the plates taken during the same night were not materially smaller than between plates of the same phase from different nights. In fact the mean night error was found to be only $\pm {}^{m}$·02.

Attemps to reveal other systematic errors, than those depending on the kind of plate and size of diaphragm, failed.

No plates were available for a direct determination of the magnitudes of the comparison stars on the international scale. Therefore the following indirect way was tried.

Three pairs of plates were selected, each pair consisting of one plate of the η Carinae region and another plate taken during the same night of the Crux region, which contains the Selected Area 193. On the first of these plates the comparison stars *a*, *b* and *c* were measured and on the second plate 4 standard stars of the Selected Area 193. Supposing that the two plates from the same night do not show

FIGURE 4.



any systematic differences, I found the following mean approximate magnitudes:

m (*a*)	$12^{m}\cdot10$
m (*b*)	$12^{m}\cdot72$
m (*c*)	$13^{m}\cdot39$

Accordingly the range of the variable is from $12^{m}\cdot4$ to $12^{m}\cdot9$.

I want to express my thanks to Prof. HERTZSPRUNG for his advice and help during the preparation of this paper.