Estimates of UW and UZ Carinae on Johanesburg plates

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Estimates of UW and UZ Carinae on Johannesburg plates, by *Axel V. Nielsen.* *)

The periods and other characteristics of the two variables of the δ Cephei type UW and UZ Carinae have been given in *Harvard Circular* **170**, which was issued in 1912. Since then these two stars do not seem to have received any attention.

Both stars being present on the plates taken with the Franklin Adams instrument Professer HERTZSPRUNG suggested to me to estimate their brightness from this material during my visit to the Leiden observatory. The comparison stars used are

	C. P. D.	brightness in steps.
UW Car.	-59° 2135 ($10^{m}.0$)	—
a	-58 2204 (9.3)	$^{s}.00$
b	-58 2221 (9.9)	.57
c	-59 2145 (10.0)	.98
UZ Car.	-60 2033 (9.4)	—
a	-60 2026 (9.0)	.00
b	-60 2024 (9.7)	.77

The only one of these stars, for which the spectrum, viz. B9, is given in the H.D., is C.P.D. $-60°$2026. In *H. C.* **170** the spectra of both variables is given as G. The difference in colour between the variable and the comparison star occasionally affected the certainty of the estimate for the reason mentioned in *B.A.N.* **147**, p. 177.

A preliminary test having shown that the periods given in *H. C.* **170** only needed immaterial corrections, the phases were calculated according to the formulae

for UW Car: phase $= {}^{d^{-1}}.18706$ (J.D. hel. M. astr. T. Grw. $-$ 2420000)
and for UZ Car: phase $= {}^{d^{-1}}.192134$ (J.D. hel. M. astr. T. Grw. $-$ 2420000).

The estimates were then arranged according to phase and divided into groups of between 22 and 40 observations each.

Some care was taken to arrange the groups in such a way that seriously discordant observations compensated each other. The smoothness of the curve is thus somewhat flatterred, though the sequence of phases has not been violated in any case.

The mean error of a single estimate has been derived from the difference between two observations following each other in phase. The mean square of this difference is

$$\text{for UW Car: } {}^{s^2}.0034 = 2\ (\pm {}^{s}.13)^2$$
$$\text{and for UZ Car: } {}^{s^2}.0040 = 2\ (\pm {}^{s}.14)^2.$$

The shape of both lightcurves is normal for δ Cephei variables of similar periods.

A copy of the Harvard estimates on which the contents of *H. C.* **170** is based, was for comparison put at my disposal by Professor HERTZSPRUNG.

The comparison between the magnitude scale of *H. C.* **170** and my scale of steps was effected in the following way. On both of the two slightly smoothed lightcurves two points of equal brightness separated by a certain fraction of the period, one on the ascending, and one on the descending branch of the lightcurve, were looked up. The brightness in steps and the magnitude on the Harvard scale thus obtained were assumed to correspond to each other. In this way the following formulae were obtained

$$\text{for UW Car: } m = 9.30 + 1.67\,s - .74\,s^2$$
$$\text{and for UZ Car: } m = 9.46 + 1.38\,s$$

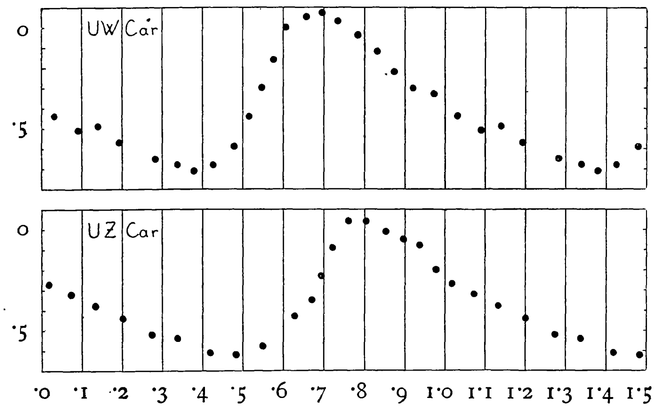
According to these results my curves were transformed to the Harvard scale of magnitudes. After that the difference in phase between the old and the new curve was found by reading off the shift necessary to bring the two curves to coincidence as nearly as possible.

The required shift was taken to be the one, which gave the minimum sum of the squares of the differences between the ordinates of the two curves.

*) Mr. NIELSEN, a student of Aarhus, has been a visitor to this observatory from the middle of May to the end of June of the present year.

The new lightcurves are in both cases earlier than given by the phases calculated according to the formulae given above, viz:

for UW Car by .032 of the period or $^{d}.173$
and for UZ Car by .035 of the period or $^{d}.184$.



The final result from the Harvard observations has with sufficient accuracy been reduced to the sun by the addition of $+ {}^{d}.002$.

The mean epoch of the Harvard observations is J. D. 2415000 and of the Johannesburg plates used J. D. 2424000, the difference being 9000^{d}, or for both stars 1700 periods. The new periods therefore are

for UW Car: $1/.18706 - .173/1700 = 5^{d}.34578$
and for UZ Car: $1/.192134 - .184/1700 = 5.20459$

The independent periods given in *H. C.* **170** are $5^{d}.3458$ and $5^{d}.2047$ respectively.

Derived in the way described above the mean error of a single Harvard magnitude was found to be

for UW Car: $\pm \overset{m}{.10}$
and for UZ Car: $\pm .13$.

Comparing these figures with those given above we find that the individual estimates on the Johannesburg plates have only about half the weight (.46) of one Harvard magnitude. As the number of the Johannesburg plates is about double that of the Harvard series the total weight is nearly the same in both cases. The periods found here by comparing the old and new series have, owing to the comparatively long interval in time, a weight about 16 times as large as that of the periods given in *H. C.* **170** and derived from the old Harvard observations alone.

I want to express my thanks to Professor HERTZSPRUNG for his kind and valuable advise during the preparation of this paper.

Mean lightcurves for UW Carinae derived from

Johannesburg plates

n	P	s
30	.031	+ .44
40	.090	.51
40	.140	.49
40	.193	.57
40	.283	.65
40	.339	.68
30	.379	.71
30	.426	.68
30	.479	.59
20	.515	.44
20	.546	.30
20	.576	+ .16
20	.606	.00
30	.656	− .05
30	.695	.07
30	.733	− .03
30	.782	+ .04
30	.831	.12
30	.872	.22
30	.920	.30
27	.971	+ .33
637		

Harvard observations

n	P	m
30	.072	9.87
30	.197	9.96
30	.314	10.05
30	.424	10.05
20	.524	9.98
10	.573	.85
10	.599	.59
10	.644	.22
30	.722	.16
30	.826	.40
28	.936	9.64
258		

Mean lightcurves for UZ Carinae derived from

Johannesburg plates

n	P	s
40	.017	+ .27
40	.072	.32
40	.133	.38
40	.201	.44
40	.274	.52
40	.338	.54
40	.419	.61
40	.484	.62
40	.550	.58
30	.629	.43
30	.670	.35
20	.694	.23
20	.721	+ .09
30	.760	− .04
30	.804	− .04
30	.852	+ .01
30	.897	.05
31	.937	.08
22	.979	+ .20
633		

Harvard observations

n	P	m
30	.043	9.75
30	.129	9.94
30	.238	10.06
30	.352	.20
30	.464	.30
30	.571	.25
20	.641	10.13
10	.706	9.84
20	.766	.60
20	.832	.36
20	.904	.46
20	.968	9.60
290		