# Discussion of C. J. Kooreman's photographic measures of WW Puppis,

## by *Ejnar Hertzsprung*.

The measures used here of this variable of the $\delta$ Cep type are those made by C. J. Kooreman in the Schilt photometer (*B.A.N.* No. 348) on 357 Franklin-Adams plates.

The provisional magnitudes (*B.A.N.* No. 318), for each plate, of the variable v and the 3 comparison stars a, b and c (the average values of $\Delta m_{\mathrm{pr}}$ were b—a = 1·11 and c—b = ·81) were reduced by the formula $m_v = 2\cdot37$ (v—b)/(c—a). The difference in magnitude between the comparison stars a and c was found to be $2^m\cdot37$ from two plates taken with a grating in front of the objective. The corresponding range of WW Pup is $1^m\cdot5$, which is probably too large for the normal photographic range of a variable of this type with a period of $5^d\cdot5$. It is possible that the effective wavelength of well exposed focal images as measured in the Schilt photometer is abnormally short because the penumbra of strong focal images owing to the secondary spectrum is formed by light of relatively short wavelength. Anyhow this does not affect the epoch derived from the lightcurve.
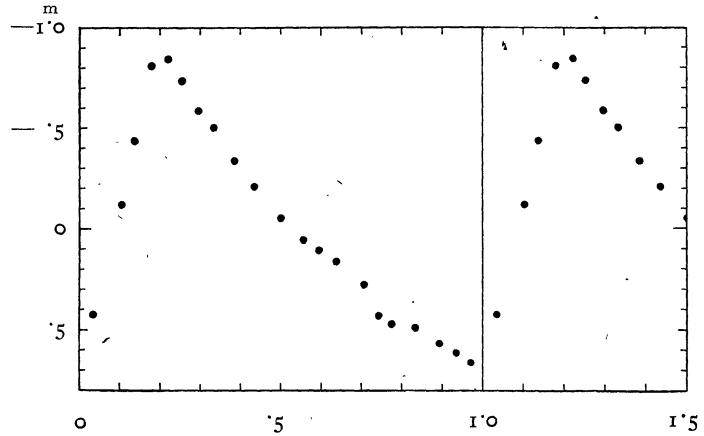


The period was determined by the aid of 36 observations on the upper part of the rising branch of the lightcurve, where late observations are available, as indicated in Table 1. The mean error of one such epoch is $\pm$ $^d\cdot044$. The result of a least squares solution is:

$$\text{J.D. hel. } (m = 0, \text{asc}) = 2425561\cdot3916 + 5\cdot516724 \text{ E} - \cdot497 \, m$$
$$\pm \; \cdot000038 \quad \pm \cdot040 \text{ (m.e.).}$$

rising and the descending branch of the lightcurve are separated by $^P\cdot25$. The mean epoch of the first of these points is J.D. hel. 2426449·763 $\pm$ ·008 (m.e.). The corresponding phase is $^P\cdot129$. The maximum occurs $^P\cdot07$ or $^d\cdot386$ later.

Mean values of phase and brightness for 21 groups of 17 observations each are given in Table 2. The mean error of one such mean brightness is $\pm$ ·023 $m$ and of a single observation $\pm$ ·094 $m$.

A lightcurve derived from the estimates made by C. A. M. Snelders is given in *B.A.N.* No. 293, p. 121. This lightcurve shows on the lower part of its descending branch a secondary wave, the existence of which is not confirmed by the measures.

### TABLE 1.

| J.D. — 2420000 | epoch E | brightness $m'$ | O—C $d$ | J.D. — 2420000 | epoch E | brightness $m'$ | O—C $d$ |
|---|---|---|---|---|---|---|---|
| 5561·509 | 0 | —·15 | ·043 | 5997·424 | 79 | —·48 | —·027 |
| ·531 | | —·24 | 20 | 6030·300 | 85 | —·12 | — 73 |
| 5644·277 | 15 | —·33 | — 29 | ·322 | | —·19 | — 86 |
| ·299 | | —·36 | — 22 | 91·256 | 96 | —·53 | — 5 |
| ·321 | | —·36 | 0 | ·278 | | —·69 | — 62 |
| ·407 | | —·52 | 6 | 6102·244 | 98 | —·32 | 54 |
| ·429 | | —·57 | 3 | ·277 | | —·57 | — 37 |
| ·498 | | —·63 | 42 | 6306·380 | 135 | —·36 | 52 |
| 55·251 | 17 | —·07 | 40 | ·471 | | —·65 | — 1 |
| ·329 | | —·17 | 69 | ·494 | | —·71 | — 8 |
| ·375 | | —·34 | 30 | 7365·483 | 327 | —·21 | 18 |
| ·456 | | —·58 | — 8 | ·505 | | —·26 | 16 |
| ·477 | | —·54 | 33 | 8656·219 | 561 | ·06 | — 25 |
| ·499 | | —·55 | 50 | ·258 | | —·03 | — 30 |
| ·521 | | —·62 | 37 | 8965·290 | 617 | —·10 | 30 |
| 5997·270 | 79 | —·18 | — 32 | ·312 | | —·30 | — 47 |
| ·294 | | —·34 | — 88 | ·357 | | —·21 | 43 |
| ·402 | | —·48 | — 49 | ·424 | | —·34 | 45 |

The phases were calculated from the formula: phase = $^{d^{-1}}\cdot181267$ (J.D. hel. M. astr. T. Grw. — 2420000).

The two points at $m = - \cdot36$ respectively on the

### TABLE 2.

| P | $m'$ | P | $m'$ | P | $m'$ |
|---|---|---|---|---|---|
| ·0339 | ·425 | ·3330 | — ·501 | ·7056 | ·278 |
| ·1021 | — ·120 | ·3849 | — ·339 | ·7416 | ·431 |
| ·1374 | — ·436 | ·4341 | — ·208 | ·7740 | ·474 |
| ·1795 | — ·808 | ·5002 | — ·052 | ·8307 | ·492 |
| ·2203 | — ·842 | ·5565 | ·054 | ·8919 | ·572 |
| ·2525 | — ·737 | ·5950 | ·108 | ·9332 | ·616 |
| ·2962 | — ·586 | ·6368 | ·164 | ·9701 | ·662 |