COMMUNICATIONS FROM THE OBSERVATORY AT LEIDEN

Six new variable stars in the V Carinae region, by P. Th. Oosterhoff.

The variables of the present note have been discovered by the writer on plates taken with the Franklin-Adams camera at Johannesburg. They were estimated with the aid of a 10 × eye piece on all available Franklin-Adams plates and on a small number of plates which were taken recently at Johannesburg with the new Rockefeller twin astrophograph of the Leiden Observatory.

The main results are collected in Table 1.

The epoch given in the fifth column refers to primary minimum for the eclipsing variables and to maximum for the RR Lyrae and δ Cephei type variables. For some of the variables more accurate epochs derived for a special phase are given below. The sixth column contains the best period which could be derived. The reciprocal period in the eighth column was actually used for the computation of the phases according to the formula:

\[ \text{phase} = P / (\text{J.D.} - 2420000) \]

The mean error of one estimate given in the tenth column has been computed from the differences in steps between successive observations according to phase. The following column contains a provisional value for the range of the light variation derived from the data of Table 2. The photographic magnitudes of the last two columns are rather uncertain.

The size of the diagrams in Figure 1, on which the variables and the comparison stars are marked, is 7' × 7'.

![Figure 1](image)

### Table 1.

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<th>star</th>
<th>α (1875)</th>
<th>δ (1875)</th>
<th>type</th>
<th>epoch *) - 2420000</th>
<th>period</th>
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<th>reciprocal period used</th>
<th>number of observations</th>
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<th>range</th>
<th>( m_{pg} ) of max.</th>
<th>( m_{pg} ) of min.</th>
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<td>10 23 43'</td>
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<td>6629146 d</td>
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<td>± 75</td>
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<td>14'3</td>
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<td>-61 44'</td>
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<td>6620123</td>
<td>± 0000109</td>
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<td>± 92</td>
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<td>± 74</td>
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<td>-63 30'</td>
<td>δ Cep</td>
<td>456128</td>
<td>5'10179</td>
<td>± 00006</td>
<td>1'196013</td>
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<td>± 00004**</td>
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<td>808</td>
<td>± 86</td>
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<td>± 76</td>
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*) For variables I, III and V the epoch of primary minimum, for the remaining variables the epoch of maximum is given.

**) Estimated mean error.
The differences in steps and in magnitude between the comparison stars are given in Table 2. The latter values were derived from the measurement of the comparison stars on three Rockefeller plates in the Schilt microphotometer. The galvanometer readings were then turned into provisional magnitudes by means of Wesselink's table in B.A.N. No. 318.

The designation J. D., as used in this note, stands for J.D.Hel.M.A.T.Gr.

Remarks about the individual variables.

I: This variable is of the W UMa type. The period has been derived by least squares from observations near primary minimum. The epochs used and the residuals are tabulated in Table Ia. The mean light curve is given in Table Ib.

Table Ib.

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II: The variable is of the RR Lyr type. A provisional period was derived from the observations near maximum, yielding: $d6620138 \pm d0000043$ (m.c.). Phases were computed for the observations on the ascending branch of the light curve with the corresponding reciprocal period $1^{d}1510538$. The ascending branch proved to be practically rectilinear between phases '43 and '49. The J.D. of each observation within this interval was then reduced to brightness $2^m0$ and the new epochs were used for a final solution of the period. Observations at the same epoch were combined, the assigned relative weight being equal to the number of observations. The resulting elements are:

J.D. 2424650$^{d}3017 + 6^{d}6620123$ E

$\pm 22 \pm 9$ (m.c.)

The epochs and their residuals from these elements are listed in Table IIa. The mean light curve is given in Table IIb and Figure II.
A number of spurious minima will therefore hamper the determination of the period. Two multiples of the period could however be determined with certainty. The best minima are indicated by an asterisk in Table IIIa. They yield the intervals 61°-97 and 92°99. Thus 30°99 must be a multiple of the period. A more extensive list of minima provides several multiples of the interval 21°-97. By the aid of these two intervals the period was found to be 1°29. A least squares solution gives the following elements:

\[
\text{J.D.} = 2424560^{d}50 + 1^{d}291954 \pm 6 \text{ (m.e.)}
\]

The epochs used and the residuals from these elements are shown in Table IIIa. A difference in depth between the even and odd minima proves that this period has to be doubled.

The mean light curve computed with the reciprocal period 1°2919507 is given in Table IIIb and Figure III. The mean phase of primary minimum is '965.

### Table IIa.

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### Table IIIa.

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</table>

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IV: This star is a δ Cephei type variable. From 25 maxima the period \( \delta^{2\text{d}}10170 \pm 0.0014 \) (m.e.) was derived. The mean light curve computed with the corresponding reciprocal period is given in Table IVb and Figure IV. It is typical for this period. The ascending branch is practically rectilinear between phases '91 and '00, one step corresponding with δ7108. The observations within this interval were all reduced to a brightness of 6.84. Observations of the same night were combined to a single epoch, the assigned relative weight being equal to their number. The elements derived from these epochs are:

\[
\text{J.D.} \quad 2424560 \pm 688 + \delta^{5\text{d}}.10179 \quad \text{E} \\
\pm 15 \quad \pm 6 \quad \text{(m.e.)}
\]

The details of this solution are given in Table IVa.

<table>
<thead>
<tr>
<th>TABLE IVa.</th>
<th>TABLE IVb.</th>
</tr>
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<tbody>
<tr>
<td>J.D. — 2420000</td>
<td>mean phase</td>
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<tr>
<td>( +d )</td>
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<td>3790.47</td>
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<tr>
<td>3841.29</td>
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<tr>
<td>3877.74</td>
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<td>3882.17</td>
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<td>4285.16</td>
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<td>4360.66</td>
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<td>5652.50</td>
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<td>8141.16</td>
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<td>9096.16</td>
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</table>

V: This variable is of the Algol type. Its range is considerable, but could not be determined as the star is invisible on the plates near minimum. From 27 minima the period was found to be: \( 2d^{2}808595 \pm 0.00010 \) (m.e.). Phases were computed for the observations near minimum with the reciprocal period \( 2d^{5}\cdot3560499 \). From a plot of these observations it became evident that the period needed a positive correction. This has been derived in a graphical way, the corrected period being \( 2d^{2}808617 \) with an estimated mean error of \( 0.000004 \). Phases were then computed with the corresponding reciprocal period and a mean light curve was formed, which is given in Table VA and Figure V. The mean phase of minimum is 588. As a secondary minimum was indicated a new mean light curve was formed by counting the phase for each observation from primary minimum without regard to sign. This light curve is given in Table Vb and is also shown in Figure V.

<table>
<thead>
<tr>
<th>TABLE VA.</th>
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<tr>
<td>mean phase</td>
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<td>p</td>
<td>s</td>
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<tr>
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<td>0.9569</td>
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