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COMMUNICATIONS FROM THE OBSERVATORY AT LEIDEN.

Provisional discussion of a high excentricity Algol star in Centaurus, by *J. de Kort.*

The variability of the star, which is the subject of the present note, was discovered by OOSTERHOFF.

The variable was estimated by him in 1928 on 296 Franklin-Adams plates. His comparison stars were

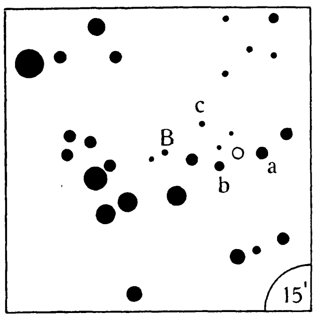

FIGURE 1.

	steps
a	−·69
b	·00
c	+·25

The variable turned out to be an eclipsing binary, but no satisfactory period was then found.

In 1936 the number of plates had been increased considerably. The star was then estimated by the writer on all the 457 plates available. The same comparison stars were used:

	steps
a	1·0
b	7·4
c	11·6

All plates taken during the eclipses and several others at normal brightness, altogether 223 plates, were measured with the Leiden Schilt microphotometer. Two plates had to be excluded from the measurements because the images on them were too dense, four others because the images were elongated. The scale of photographic magnitudes is provisional only (*B.A.N.* No. 190, p. 195). The zeropoint was deduced from a comparison with 10 stars of the adjacent S. A. 193 of KAPTEYN [1]), the mean reductions to the international system as published in *Groningen Publ.* 43, Table F, were applied. The magnitudes of the comparison stars are

	m
a	11·55
b	12·31
B	12·33
c	12·37

The mean error of a photometric measurement computed from 41 measurements which decidedly were made during normal brightness, is $\pm$ ᵐ·06.

The step values of the estimates made by OOSTERHOFF and the writer, denoted by s_O and s_K respectively, are reduced to this scale by the aid of the following linear formulae obtained graphically:

$$\text{magn.} = 12{\cdot}20 + {\cdot}9 \quad s_O$$
$$\text{magn.} = 11{\cdot}63 + {\cdot}075\ s_K \ ^{2})\text{.}$$

For the photometric measurements and the estimates the relative weights 3 and 1 respectively were adopted.

A period of $4^d{\cdot}211$ satisfied approximately all the minima observed, but not all the estimates of maximum brightness, of which several occurred at times, when the star according to the assumed period ought to be in minimum.

It was finally found that the real period is three times the one tried above and that the system shows a large excentricity, which manifests itself not only by the fact that the odd minima are asymmetrically placed with respect to the even ones, but also by the different widths of the two minima. From the observations on the descending and rising branches the period $12^d{\cdot}63524 \pm {}^d{\cdot}00007$ m.e. was derived. The phases were accordingly computed from the heliocentric Julian Days by means of the formula

$$\text{phase} = {}^{d-1}{\cdot}0791437 \times (\text{J. D.} - 2420000).$$

The individual observations during the eclipses and their weighted means are given in Table 1.

All available observations, collected into 53 mean points of weights 30 or 12, are recorded in Table 2 and plotted in Fig. 2 [3]).

[1]) *H. A.* Vol. **103**.

[2]) To explain the bad accordance of the magnitudes of the comparison stars b and c, the hypothesis of variability was tried, but not found confirmed.

[3]) Observations marked with an asterisk in Table 1 and three observations at other phases were not used for the mean lightcurve; if marked by a dagger the photometric measurement was not taken into account.

TABLE 1.

heliocentric Julian Day	phase	photometric measurement	estimate by OOSTERHOFF	estimate by DE KORT	weighted mean	weight
d	P	m	m	m	m	
2423788·5641	·8410		12·43	12·25	12·34	2
3801·5072	·8653	11·94	12·09	12·19	12·02	5
3940·3421	·8533	12·30	12·16	12·19	12·25	5
* 3944·3311	·1690	11·97	11·89	11·71	11·90	5
* 3965·2796	·8269	11·96	11·92	11·86	11·93	5
3990·2149	·8004	11·82 †	11·89	11·81	11·83	5
3990·2384	·8022	11·83 †	11·89	11·86	11·85	5
3991·2120	·8793	11·78	11·79	11·71	11·77	5
3991·2356	·8812	11·69	11·89	11·71	11·73	5
3995·2120	·1959	11·76	11·89	11·84	11·80	5
4260·2321	·1705	12·01	12·05	11·81	11·98	5
4260·2556	·1723	12·10	12·11	12·19	12·12	5
4260·2792	·1743	12·10	12·11	11·99	12·08	5
4260·3027	·1761	12·06	12·20	12·19	12·11	5
4260·3262	·1780	12·32	12·32	12·50	12·36	5
4260·3498	·1798	12·40	12·16	12·31	12·33	5
4260·3733	·1817	12·25	12·34	12·58	12·33	5
4260·4031	·1841	12·13	11·99	12·03	12·08	5
4281·2258	·8321	12·03	11·95	12·05	12·02	5
4285·3153	·1557	11·80	11·85	11·79	11·81	5
4285·3378	·1575	11·90	11·93	11·79	11·88	5
4294·1862	·8578	12·11		12·24	12·14	4
4294·2025	·8591	12·09	12·32	12·19	12·16	5
4294·2253	·8609	12·19	12·43	12·40	12·28	5
4294·2939	·8663	11·99	12·02	11·99	12·00	5
4294·3161	·8681	11·99	12·20	12·03	12·04	5
4294·3853	·8735	11·97	11·99	12·03	11·99	5
4294·4075	·8753	11·96	11·93	11·99	11·96	5
4298·3715	·1890	11·98	11·97	12·03	11·99	5
4298·3950	·1909	11·87	11·93	11·89	11·89	5
4559·4508	·8518	12·10	12·12	12·05	12·09	5
4559·4750	·8537	12·13	12·27	12·07	12·15	5
4559·4993	·8556	12·12	12·20	12·19	12·15	5
4559·5228	·8575	12·22	12·16	12·09	12·18	5
5330·2970	·8594	12·14	12·20	11·83	12·09	5
5330·3247	·8616	12·07	12·05	11·90	12·03	5
5330·3933	·8670	12·03	11·89	11·91	11·98	5
5330·5581	·8801	12·00	11·81	11·80	11·92	5
5355·2465	·8340	12·11	12·16	11·98	12·09	5
5355·2700	·8359	12·17	12·20	12·19	12·18	5
5380·2938	·8164	11·71	11·92	11·91	11·79	5
5380·3173	·8182	11·89 †	11·93	11·80	11·88	5
5380·3347	·8196		11·79	11·83	11·81	2
5380·3582	·8215	11·87	11·93	11·84	11·88	5
5381·2904	·8952	11·81	11·85	11·79	11·81	5
5381·3133	·8970	11·76	11·81	11·84	11·79	5
5385·2275	·2068	11·71	11·89	11·95	11·79	5
2425393·2401	·8410	12·09	12·05	12·29	12·12	5
5393·2630	·8428	12·20	12·02	12·07	12·14	5
5393·2858	·8446	12·28	12·02	12·25	12·22	5
5393·3080	·8464	12·26	12·25	12·19	12·24	5
5393·3530	·8499	12·24	12·12	12·03	12·17	5
5393·3751	·8517	12·18	12·11	12·19	12·17	5
5393·3980	·8535	12·15	12·16	12·19	12·16	5
5393·4209	·8553	12·06	12·07	11·89	12·03	5
5393·4430	·8570	12·10	12·16	12·09	12·11	5
* 5418·2720	·8221	12·00	11·89	11·71	11·92	5
5435·2268	·1640	11·73	11·85	11·80	11·77	5
5435·2490	·1657	11·74	11·89	11·83	11·79	5
5835·2107	·8202	11·83		12·03	11·88	4
5835·2325	·8219	11·85		11·79	11·84	4
5836·2034	·8987	11·78 †		11·84	11·80	4
6029·4053	·1894	11·96		12·19	12·02	4
6029·4240	·1909	11·87		12·01	11·90	4
6029·5144	·1981	11·82		11·79	11·81	4
6113·1990	·8212	11·96		11·86	11·93	4
6113·2208	·8229	11·91		11·71	11·86	4
6126·3277	·8602	12·07		11·99	12·05	4
6126·3438	·8615			11·90	11·90	1
6471·2579	·1593	11·82		11·79	11·81	4
6471·4724	·1763	12·16		12·12	12·15	4
6479·3950	·8033	11·81		11·71	11·79	4
6479·4165	·8050	11·78		11·86	11·80	4
6480·2408	·8702	11·97		11·95	11·97	4
6480·2524	·8719	12·03		12·04	12·03	4
6480·4696	·8883	11·73		11·83	11·76	4
6926·2366	·1680	11·85		11·83	11·85	4
7520·3508	·1884	11·96		12·10	12·00	4
7520·3702	·1899	11·88		11·89	11·88	4
7604·2843	·8312	12·15		11·95	12·10	4
7604·3501	·8364	12·15		11·98	12·11	4
7604·3716	·8381	12·18		12·10	12·16	4
8008·2150	·7998	11·80		11·79	11·80	4
8008·2867	·8054	11·86		11·77	11·84	4
8008·3081	·8071	11·80		11·71	11·78	4
8008·3296	·8088	11·80		11·83	11·81	4
8013·2089	·1950	11·87		11·98	11·90	4
8013·2710	·1999	11·77		11·71	11·76	4
8248·3700	·8065	11·79		11·79	11·79	4
8248·3922	·8083	11·87		11·83	11·86	4
8249·4761	·8941	11·82 †		11·71	11·79	4
8249·4975	·8958	11·89 †		11·71	11·85	4
8287·2939	·8871	11·81		11·86	11·82	4
8287·3119	·8885	11·90		11·86	11·89	4

TABLE 2.

weight	mean phase	mean brightness
	P	m
30	·014	11·84
30	·028	11·81
30	·085	11·82
30	·099	11·84
30	·110	11·82
12	·147	11·85
12	·158	11·84
12	·168	11·86
12	·173	12·07
12	·176	12·16
12	·180	12·30
12	·186	12·08
12	·189	11·95
12	·192	11·90
12	·197	11·81
12	·209	11·82
12	·225	11·79
30	·239	11·83
30	·267	11·86
30	·298	11·86
30	·315	11·82
30	·334	11·83
30	·386	11·82
30	·404	11·82
30	·427	11·82
30	·461	11·82
30	·476	11·83
30	·487	11·79
30	·501	11·87
30	·514	11·83
30	·534	11·80
30	·551	11·80
30	·583	11·83
30	·626	11·79
30	·638	11·83
30	·678	11·83
30	·706	11·82
30	·724	11·82
30	·770	11·82
30	·785	11·85
30	·793	11·83
30	·803	11·81
30	·816	11·85
30	·828	11·99
30	·841	12·17
30	·852	12·17
30	·857	12·12
30	·862	12·08
30	·871	11·99
30	·885	11·82
30	·907	11·82
30	·941	11·82
30	·972	11·79

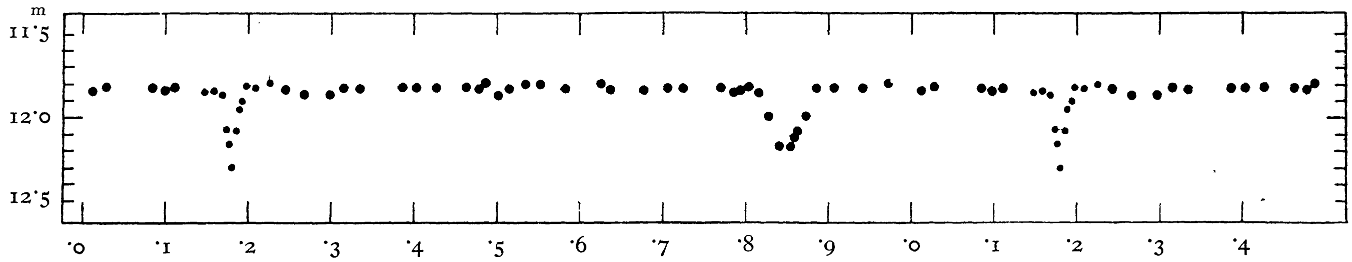

FIGURE 2.

The minimum excentricity, required by the deviation in phase, ^{P}·168, of a secondary minimum from the middle of two primary minima, is ·26. Owing to the difference in width of the two minima, the real excentricity is considerably larger. The single observations near the minima are shown separately in Fig. 3. From this diagram a ratio $D_2/D_1 = 2·5$ between the widths of the two minima is found. Supposing this ratio to be identical with the inverse ratio between the transversal components of the relative velocities at the moments of minimum brightness, v_1/v_2, which is the ratio between the radii vectores, r_2/r_1, according to KEPLER's laws, the excentricity is found to be ·50 and the phase of periastron ^{P}·1563.

Assuming for simplicity the two components to be equal in every respect, the inclination of the orbit and the sizes of the stars in terms of the semi-major axis of the relative orbit have been chosen so as to make the theoretical light curve fit the observations.

The principal elements obtained in this way are given together in Table 3; the corresponding curve is drawn in Fig. 3.

Rather close limits of the excentricity could be derived, independently of the inclination, the ratio of the radii and the luminosities, with the aid of the method developed in *B.A.N.* No. 237, p. 241 by J. UITTERDIJK, if D_2/D_1 could be determined with greater accuracy (the limits with $D_2/D_1 = 2·5$ are $·49 < e < ·51$).

My thanks are due to Dr. OOSTERHOFF for putting his estimates at my disposal.

TABLE 3.

position	$\alpha(1875) = 11^h33^m26^s·9$; $\delta(1875) = -61°28'·8$	excentricity	·50
int. phot. magn. during normal brightness	$11^m·8$	longitude of periastron	61°
widths of the minima	$D_1 = {}^P·0250$ and $D_2 = {}^P·0625$	inclination	88°
depths of the minima	$A_1 = {}^m·58$ and $A_2 = {}^m·40$	densities of both stars	·09 ☉

radii of both stars ·078 × semi-major axis of the relative orbit
elements of narrow minimum: J.D. $2425056^d·372 \pm {}^d·003$ m.e. + $(12^d·63524 \pm {}^d·00007$ m.e.) E
elements of wide minimum: J.D. $2425317^d·513 \pm {}^d·003$ m.e. + $(12^d·63524 \pm {}^d·00007$ m.e.) E

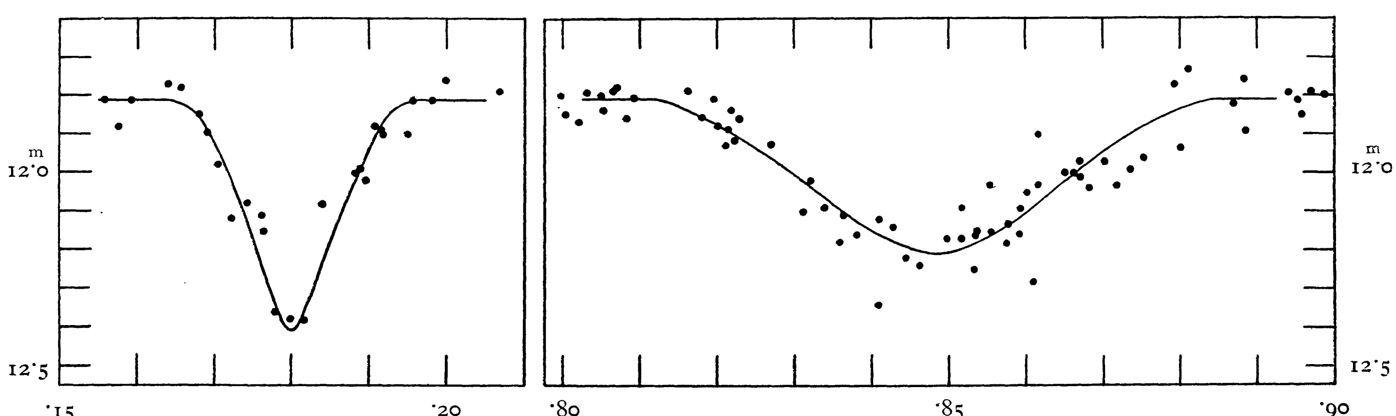

FIGURE 3.