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COMMUNICATIONS FROM THE OBSERVATORY AT LEIDEN.

Estimates of 7 southern variable stars made by C. A. M. Snelders on Franklin-Adams plates, discussed by *Ejnar Hertzsprung.*

On Johannesburg plates taken by H. van Gent a number of variable stars have been estimated by C. A. M. Snelders. For seven of these objects, given in Table 1, periods and lightcurves were derived. Three of them are situated near the southern pole of the Milky Way and the other four in the constellation Puppis. The total number of estimates used in the present note is 1721.

TABLE 1.

name of star	α(1875)	δ(1875)	number of plates	period	m.e.	reciprocal period	epoch phase	epoch J. D. 2420000 +	brightness in steps max.	brightness in steps min.	brightness in pg. magn. max.	brightness in pg. magn. min.
	h m s	° ′		d	d	d^{-1}	P	d	s	s	m	m
SV Cet	0 28 41	− 23 20·1	139	·2920935 ± ·0000011		6·8472	min. ·378	5887·425	·20	·70	14·8	15·2
UV Scl	0 49 53	− 27 3·7	160	·52056 ± ·00003		1·921	max. ·155	5854·323	− ·18	·52	13·3	13·9
UW Scl	0 57 16	− 26 11·4	155	·575096 ± ·000013		1·738839	max. ·27	5852·336	·20	1·05	13·7	14·4
WW Pup	7 36 30	− 20 50·5	318	5·51663		·18127	R ·137	5991·82	− ·22	·92	9·8	11·3
WZ Pup	7 55 2	− 23 21·7	319	5·02704 ± ·00034		·198924	max. ·83	5996·41	− ·21	·65	10·3	11·2
AI Pup	7 55 31	− 22 10·4	317	·773126 ± ·000011		1·2934	min. ·255	5950·406	·53	1·23	13·5	14·0
AK Pup	7 59 43	− 20 59·1	313	·512053 ± ·000014		1·9529	max. ·23	5998·376	− ·07	1·08	12·4	14·0

In what follows J. D. is meant to be hel. M. astr. T. Grw.

The phases were computed from the formula

phase = reciprocal period × (J. D. − 2420000).

SV Cet

The comparison stars used for this faint variable of the W UMa type are

	s	m′	O—C s
a	·00	·00	− ·02
b	·41	·29	+ ·04
c	·80	·67	− ·04
d	1·07	·84	+ ·02

The plates were also measured in the Schilt photometer by C. J. Kooreman. The provisional magnitudes, m', thus obtained, are connected with the scale of steps, s, by the formula

$$s = 1{\cdot}233\,m' + {\cdot}018 \quad \text{or} \quad m' = {\cdot}811\,s - {\cdot}014$$

as found from the comparison stars.

On the other hand, if the mean values of brightness on the two scales as given in Table 2 are compared with each other, the relation is found to be

$$s = 1{\cdot}094\,m' + {\cdot}113 \quad \text{or} \quad m' = {\cdot}914\,s - {\cdot}103.$$
$$\pm\ {\cdot}078 \qquad \pm\ {\cdot}012 \ \text{(m. c.)}$$

TABLE 2.

| phase	SNELDERS	KOOREMAN	$\dfrac{S + 2K}{3}$
n P	s	m′	m′	m′
10 ·029	·24	·13	·09	·10
10 ·088	·24	·13	·16	·15
10 ·163	·36	·22	·25	·24
10 ·237	·56	·37	·35	·35
10 ·303	·55	·37	·49	·45
10 ·378	·67	·46	·51	·49
10 ·448	·70	·48	·46	·47
10 ·526	·48	·31	·33	·33
10 ·604	·39	·24	·26	·26
10 ·680	·26	·15	·12	·13
10 ·778	·20	·10	·08	·09
10 ·842	·17	·08	·07	·08
10 ·913	·21	·11	·09	·09
9 ·962	·23	·12	·11	·11

No difference in the depth of even and odd minima was noted.

The reciprocal periods $5^{d^{-1}}{\cdot}85$ and $7^{d^{-1}}{\cdot}85$ were also tried, but proved to be less satisfactory than the one adopted here, viz. $6^{d^{-1}}{\cdot}85$. At any rate the epoch given in Table 1 is only $^{d}{\cdot}001$ different from that of an actually observed minimum (J. D. 2425887·424). This example again shows the desirability of having observations of variable stars made alternately at different longitudes within a short interval of time.

In the scale of the provisional magnitudes, m', the mean error of one estimate is $\pm\ ^{m'}\cdot 114$ and of a magnitude derived from one plate measured in the Schilt photometer $\pm\ ^{m'}\cdot 085$.

Mean values of phase and brightness for 14 groups are given in Table 2, in which the last column contains means of the estimates by SNELDERS (transferred to the scale of provisional magnitudes, m') and the measures by KOOREMAN, the latter counted with double weight. These last mean values are represented graphically in Figure 1.

FIGURE 1, SV Cet
$^1/_3$ (SNELDERS + 2 KOOREMAN)
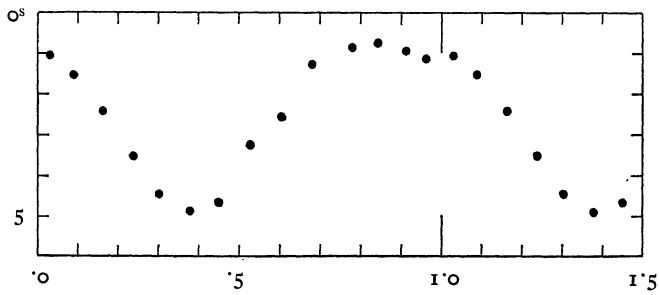
SV Cet is another (compare RV CVe in the north), but not surprising example of a faint variable of the W UMa type situated near the pole of the galaxy.
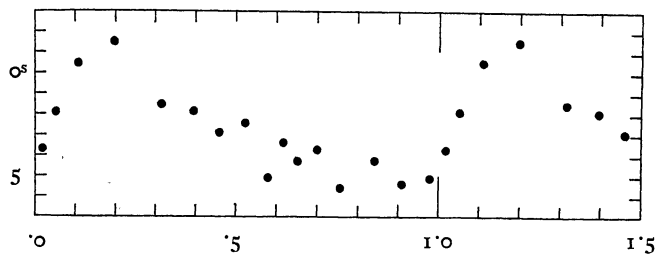
UV Scl

The comparison stars used for this variable of the RR Lyr type are a ($^s\cdot 00$), b ($^s\cdot 40$) and c ($^s\cdot 86$).

Mean values of phase and brightness for 16 groups are given in Table 3 and Figure 2.

TABLE 3.
UV Scl

n	P	s	n	P	s
10	·019	·38	10	·578	·51
10	·053	·19	10	·616	·34
10	·108	— ·05	10	·654	·43
10	·197	— ·15	10	·701	·37
10	·316	·15	10	·758	·56
10	·395	·19	10	·841	·43
10	·458	·29	10	·908	·54
10	·523	·24	10	·980	·52

FIGURE 2, UV Scl

UW Scl

The comparison stars used for this variable of the RR Lyr type, which was estimated both by SNELDERS and H. KLEIBRINK, are:

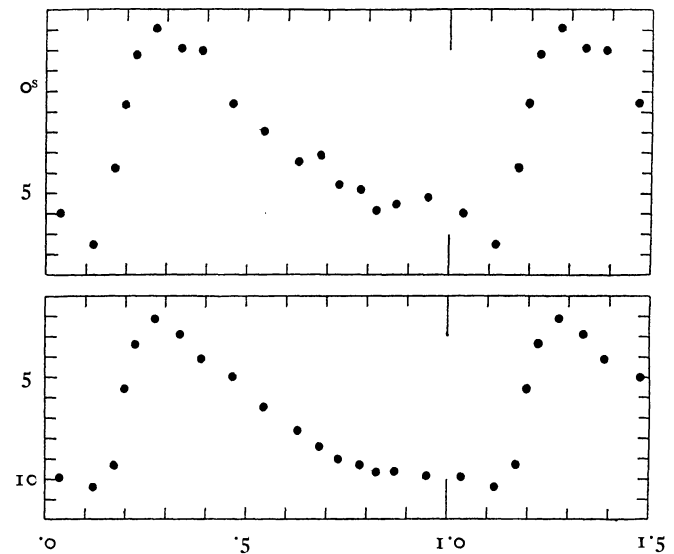| SNELDERS		KLEIBRINK	
	s		s
a_S	·00	A_K	·00
b_S	·42	a_K	·46
c_S	·76	b_K	·72
d_S	1·13	d_K	·92
		c_K	1·04

It will be noted that the comparison star d_K was found brighter than c_K. From the diagrams it can be seen that b_S is identical with d_K and c_S with c_K. The relation between the two scales is about $K = \cdot 51 + \cdot 89\ S$.

Mean values of phase and brightness for 17 groups are given in Table 4 and Figure 3 separately for each

TABLE 4.
UW Scl

n	phase	SNELDERS	KLEIBRINK	n	phase	SNELDERS	KLEIBRINK
	P	s	s		P	s	s
10	·036	·60	·99	10	·543	·19	·65
10	·118	·75	1·04	10	·628	·35	·76
5	·171	·38	·93	10	·682	·32	·84
5	·198	·06	·56	10	·729	·46	·90
5	·224	— ·18	·34	10	·783	·48	·93
10	·273	— ·31	·21	10	·822	·59	·97
10	·335	— ·21	·29	10	·870	·55	·97
10	·388	— ·20	·41	10	·950	·52	·99
10	·465	·06	·50				

FIGURE 3, UW Scl
upper diagram: estimates by SNELDERS
lower   „   :   „   „ KLEIBRINK

of the two observers. The mean error of a single estimate is found to be $\pm$ ^{s}·166 for SNELDERS and $\pm$ ^{s}·082 for KLEIBRINK, the latter value corresponding to $\pm$ ^{s}·095 in the scale of SNELDERS. It therefore appears that the estimates made by KLEIBRINK are in this case the more accurate.

WW Pup = C.P.D. −20°2835, 10^m·5

The comparison stars used for this variable of the δ Cep type are

|	C. P. D.	^{m}	^{m}	^{s}	red. to Internat. scale $^{m'}$
a	− 20°2831	9·4	10·1	·00	·00
b	− 20°2826	9·8	10·7	·32	·41
c	− 20°2829	10·1	11·1	·82	1·10
d	7^{h}35^{m}59^s, − 20°45'·0 (1875)			1·24	1·52

The provisional magnitudes, m', are derived from a few measures made by KOOREMAN in the Schilt photometer. In order to obtain ordinary magnitudes about 10^m·1 has to be added to m'.

Mean values of phase and brightness for 29 groups are given in Table 5 and Figure 4.

TABLE 5.
WW Pup

n	P	^{s}	n	P	^{s}
11	·026	·81	11	·551	·47
11	·063	·74	11	·587	·55
10	·121	·40	11	·612	·57
11	·152	·08	11	·629	·56
11	·176	− ·12	11	·672	·57
11	·211	− ·23	11	·718	·61
11	·243	− ·17	11	·747	·66
11	·263	− ·17	11	·772	·64
11	·298	− ·10	11	·798	·76
11	·321	− ·14	11	·844	·83
11	·360	− ·01	11	·891	·86
11	·396	·07	11	·932	·89
11	·429	·18	11	·956	·80
11	·459	·34	11	·984	1·02
11	·508	·43			

FIGURE 4, WW Pup
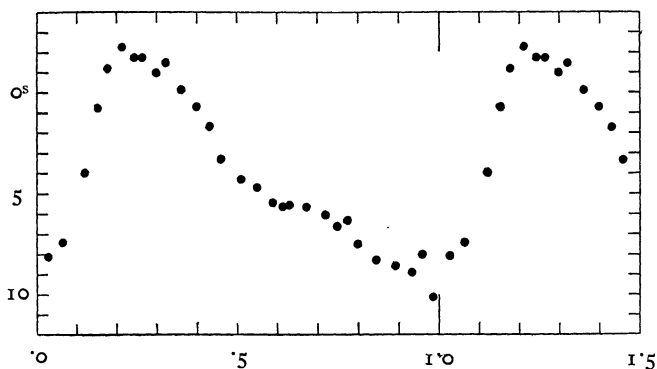
There is a slight indication of a hump on the descending branch of the lightcurve near the phase ·7 in accordance with what could be expected for a

period of about 6 days. But the reality of this secondary wave is in the present case still doubtful.

The maximum is ill pronounced. Another much sharper epoch, equally independent of the scale used, is obtained in the following way. On the lightcurve two points are looked up, one on the ascending and one on the descending branch, separated by a given difference in phase. The phase of the former point, which determines the epoch, is read from the lightcurve. If the difference in phase between the two points is ·3, the phase of the point on the ascending branch is in the present case found to be ·137, corresponding to the mean epoch J. D. 2425991·82.

WZ Pup = C.P.D. −23°3242, 9^m·6

As the character of variation and the period found for this star are the same as that otherwise assigned to CPD − 23°3245, which has been used here as a comparison star and showed no variation, the designation WZ Pup has been transferred to CPD − 23°3242.

The comparison stars used for this variable of the δ Cep type are

	C. P. D.	^{m}	^{s}	adopted ^{m}
a	− 23°3248	9·7	·00	10·5
b	− 23°3246	10·1	·42	10·9
c	− 23°3245	10·2	·80	11·3

The period was derived from 30 observations on the rectilinear part of the rising branch of the lightcurve, for which $\Delta d/\Delta s$ was assumed to be − 1. E.g. on J. D. 2425568·49 the brightness of the variable was found to be ^{s}·28. The epoch corresponding to ^{s}·2 is therefore 5568·49 + ·08 = 5568·57, which value is entered in Table 6. The mean error of one of the 30 such epochs given in Table 6 is $\pm$ ^{d}·074.
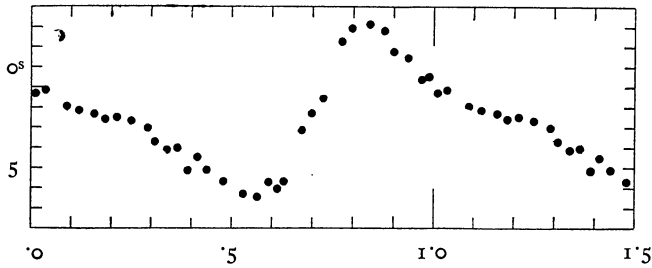
TABLE 6.
WZ Pup

Epoch of ^{s}·2 on rising branch J. D.	E	$O–C$	Epoch of ^{s}·2 on rising branch J. D.	E	$O–C$
^{d} 2425568·57	0	^{d} ·08	^{d} 2425739·29	34	^{d} −·11
·49	0	1	·28	34	− 13
5684·12	23	1	5915·46	69	11
·14	23	3	·44	69	9
5704·32	27	10	50·43	76	− 11
·31	27	10	·45	76	− 9
·23	27	1	6035·95	93	− 5
09·27	28	3	·88	93	− 12
·32	28	8	86·29	103	2
14·25	29	− 2	·28	103	1
·24	29	− 3	91·22	104	− 8
19·26	30	− 4	·36	104	6
·28	30	− 1	6101·32	106	− 3
34·32	33	− 6	6277·37	141	7
·34	33	− 4	·39	141	9

Mean values of phase and brightness for 32 groups are given in Table 7 and Figure 5. The shape of the lightcurve is quite normal for a δ Cep variable of this period.

TABLE 7.
WZ Pup

n	P	s	n	P	s
10	·010	·13	10	·530	·63
10	·034	·12	10	·563	·65
10	·087	·20	10	·591	·58
10	·117	·22	10	·612	·61
10	·156	·23	10	·629	·57
10	·183	·26	10	·674	·32
10	·212	·25	10	·699	·24
10	·250	·27	10	·726	·16
10	·290	·30	10	·772	— ·12
10	·308	·37	10	·797	— ·19
10	·336	·41	10	·842	— ·21
10	·364	·40	10	·878	— ·18
10	·390	·51	10	·902	— ·07
10	·413	·45	10	·936	— ·04
10	·438	·51	10	·969	·06
10	·478	·57	9	·987	·05

FIGURE 5, WZ Pup

AI Pup

The comparison stars used for this Algol star are a (^{s}·0), b (^{s}·5), c (1^s·0) and d (1^s·5).

The period was derived from the 14 epochs of minimum contained in Table 8. The mean error of one such epoch is found to be $\pm$ ^{d}·012.
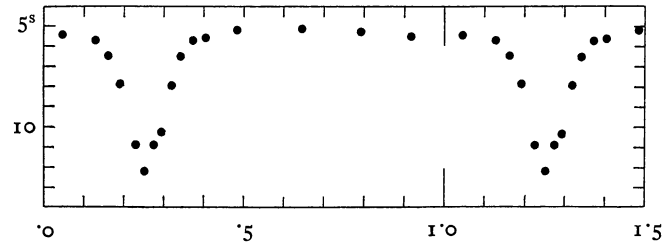
TABLE 8.
AI Pup

minimum J. D.	E	O–C
^{d} 2425561·51	0	^{d} —·01
5643·49	106	2
46·58	110	1
50·42	115	— 1
54·30	120	0
78·26	151	0
5705·30	186	— 2
5950·40	503	0
71·30	530	2
74·37	534	0
6039·31	618	0
63·29	649	1
87·25	680	0
6338·50	1005	— 1

Mean values of phase and brightness for 16 groups are given in Table 9 and Figure 6.

TABLE 9.
AI Pup

n	P	s	n	P	s
30	·046	·54	10	·319	·80
10	·128	·57	10	·342	·65
10	·162	·65	10	·373	·58
10	·191	·79	10	·405	·56
10	·226	1·09	30	·485	·52
10	·251	1·22	50	·646	·51
10	·275	1·09	50	·793	·53
10	·294	1·03	47	·917	·55

FIGURE 6, AI Pup

AK Pup

The comparison stars used for this variable of the RR Lyr type are a (^{s}·00), b (^{s}·44), c (1^s·12) and d (1^s·33).

The period was derived from the 14 epochs of maximum contained in Table 10. The mean error of one of these epochs is $\pm$ ^{d}·024. Mean values of phase and brightness are given for 31 groups in Table 11 and Figure 7.

TABLE 10.
AK Pup

maximum J. D.	E	O–C
^{d} 2425646·58	0	^{d} —·03
53·26	13	— 1
54·32	15	3
55·33	17	2
5717·26	138	— 1
5915·47	525	3
98·37	687	— 2
6002·48	695	— 1
14·29	718	3
36·25	761	— 3
42·41	773	— 2
6241·60	1162	— 1
6303·57	1283	0
33·30	1341	3

FIGURE 7, AK Pup