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The period and light curve of the variable star 87.1906 Draconis.

$16^h 33^m 43.3$ $+58^\circ 2' 36''$ 1900.0.

By *Naozo Ichinohe*.

This star was added to my observing list of variable stars Dec. 14 of 1906. But as the right ascension of the star is $16^h 34^m$, it was necessary to wait until the early morning in order to avoid the possible disturbance by the thick sky near the horizon. From this cause, combined with the unfavorable condition of the sky, I could not observe the star often at first, notwithstanding that it was remarked by Prof. Ceraski to be a short period variable when he announced the star in A. N. 4110.

In February of this year the condition of sky was very favorable here so that I thought it would be possible to determine the period of the star. Then I decided to observe the star on every clear night. The observations up to Febr. 22 were found to be satisfied with the period of nearly four days. But the following observations on Febr. 24 as well as Febr. 25, made this value very doubtful. When I made three observations on March 3, I found the first estimate was $0^m.4$ brighter than the other two, and these two were of the minimum brightness. March 4 and 5 also showed the minimum; the first estimate on March 8 gave the minimum again. Then I suspected that the period of the star might be within a day, and decided immediately to follow the star through the whole night, and soon it was found that the light changes with great rapidity.

On March 10 I began to observe the star as soon as possible, although its altitude was very low. Fortunately the comparison stars are very near to the variable, so that the

correction for extinction may be neglected without involving any serious error. The observations on March 8 and 10 gave me an approximate value of the period, about eleven hours. To establish this period I made another series of observations on March 14 from the early evening to the dawn. On reducing the observations after several trials, the period was found to be $0^d.4428 = 10^h 37^m 35^s$. The period satisfies all my observations up to March 19.

The variable is very near to a star *A* which is AG Hels 8895 = BD 58°1650, mag. 7.1. I measured the differences of α and δ for the variable star (*v*) as well as the three comparison stars, *a*, *b* and *c*, with the micrometer of the 12-inch telescope. The following are the means of the results on March 14, 16, and 17:

	<i>A. b</i>	<i>A. v</i>	<i>v. a</i>	<i>a. c</i>
Pos. Angle	$135^\circ 6'$	$342^\circ 4'$	$276^\circ 5'$	$263^\circ 0'$
Distance	$15^R.448$	$23^R.220$	$9^R.476$	$17^R.903$

The value of one revolution of the micrometer screw being $9^s.552$, the above results give the following α and δ :

	<i>b-A</i>	<i>v-A</i>	<i>a-v</i>	<i>c-v</i>
$\Delta\alpha$	$+12^s.98$	$-8^s.44$	$-11^s.33$	$-21^s.38$
$\Delta\delta$	$-1' 47''.2$	$+3' 31''.4$	$+10''.3$	$-20''.8$

Bringing the position of the star *A* to 1900.0, we have

$$A \quad 16^h 33^m 51.70 \quad +57^\circ 59' 4''.4.$$

Then it follows:

<i>c</i>	$16^h 33^m 10.55$	$+58^\circ 2' 25''.3$	$11^m 54$	28.0
<i>a</i>	$16 \ 33 \ 31.93$	$+58 \ 2 \ 46.1$	10.71	8.5
<i>v</i>	$16 \ 33 \ 43.26$	$+58 \ 2 \ 35.8$	—	—
<i>b</i>	$16 \ 34 \ 4.68$	$+57 \ 57 \ 17.2$	11.34	3.6

The magnitudes of these comparison stars are derived from the observed steps, taking my value of a step ($= 0^m.128$) and assuming the magnitude $9^m.3$ of the star BD 58°1657 according to the same catalogue. The last column expresses the brightnesses of the stars *a*, *b* and *c* in terms of steps.

The range of variation in the magnitude of 87.1906 Draconis is given as $9^m.6-10^m.8$ by Professor Ceraski. By my observations it is from $10^m.9$ to $11^m.6$, so that there is quite a large difference between the two. At the same time, the position of this star given above does not closely agree with that given by Professor Ceraski; the difference being about 1' in both α and δ . But as I could not see any other star in this position, I think the variable is identical

with 87.1906 Draconis.

The position of the variable, being transformed into longitude and latitude, gives:

$$\lambda = 210^\circ 26'.6 \quad \beta = 76^\circ 58'.2 \quad 1907.0.$$

Then, the reduction to the sun were calculated as follows:

1906 Dec. 10	$-0^d.001$	1907 Febr. 8	$0^d.000$
» 20	-0.001	» 18	0.000
» 30	0.000	» 28	0.000
1907 Jan. 9	0.000	Mar. 10	$+0.001$
» 19	0.000	» 20	$+0.001$
» 29	0.000	» 30	$+0.001$

No.	1906-07	Gr. M. T.	Julian Day	Bright- ness	Phase	See- ing	No.	1907	Gr. M. T.	Julian Day	Bright- ness	Phase	See- ing
			2417							2417			
1	Dec. 14	21 ^h 15 ^m	559.884	1 st 8	0.0000	3	47	Mar. 10	21 ^h 38 ^m	645.902	2 st 0	0.115	4
2	" 18	22 30	563.937	2.4	0.068	4	48	" 10	22 20	645.931	1.5	0.144	4
3	Jan. 5	20 5	581.837	7.4	0.256	4	49	" 14	12 57	649.541	7.2	0.211	3
4	" 8	22 48	584.950	6.0	0.269	4	50	" 14	13 25	649.560	7.2	0.230	3
5	" 25	19 12	601.800	5.5	0.293	3	51	" 14	13 45	649.574	7.3	0.244	3
6	Febr. 5	19 15	612.802	6.1	0.225	3	52	" 14	14 22	649.600	7.0	0.270	4
7	" 9	18 6	616.754	5.9	0.192	2	53	" 14	14 57	649.624	6.0	0.294	4
8	" 16	18 40	623.778	1.6	0.131	4	54	" 14	15 27	649.645	4.6	0.315	4
9	" 17	18 20	624.764	5.2	0.231	3	55	" 14	16 18	649.680	3.0	0.350	4
10	" 19	16 0	626.667	2.0	0.363	2	56	" 14	16 32	649.690	2.8	0.360	4
11	" 20	15 15	627.636	2.3	0.003	2	57	" 14	16 56	649.706	1.6	0.376	4
12	" 20	20 37	627.860	4.8	0.228	3	58	" 14	17 12	649.718	2.0	0.388	4
13	" 20	22 25	627.935	5.7	0.303	3	59	" 14	17 39	649.736	1.6	0.406	4
14	" 20	23 37	627.985	5.5	0.353	3	60	" 14	18 3	649.753	1.9	0.423	4
15	" 21	18 14	628.761	7.1	0.243	3	61	" 14	18 21	649.766	1.9	0.436	4
16	" 22	15 50	629.661	6.7	0.257	3	62	" 14	18 38	649.777	0.5	0.003	4
17	" 24	19 35	631.817	0.6	0.199	3	63	" 14	19 6	649.797	0.7	0.023	4
18	" 25	15 30	632.657	1.0	0.154	3	64	" 14	19 26	649.811	0.6	0.038	4
19	" 26	16 1	633.675	6.5	0.286	4	65	" 14	19 59	649.834	1.6	0.061	4
20	Mar. 3	14 30	638.606	5.1	0.346	4	66	" 14	20 24	649.851	1.5	0.078	4
21	" 3	17 0	638.710	1.8	0.007	4	67	" 14	20 59	649.875	2.3	0.102	4
22	" 3	18 32	638.774	1.5	0.069	4	68	" 14	21 32	649.898	2.4	0.125	4
23	" 4	16 56	639.695	1.5	0.107	4	69	" 14	22 1	649.918	2.5	0.145	4
24	" 5	15 27	640.646	0.5	0.172	4	70	" 14	22 26	649.936	3.8	0.163	4
25	" 8	17 25	643.728	1.5	0.155	4	71	" 14	22 36	649.943	3.0	0.170	4
26	" 8	19 55	643.832	5.7	0.259	4	72	" 15	17 18	650.722	0.8	0.064	2
27	" 8	20 20	643.848	6.6	0.275	4	73	" 15	18 27	650.770	1.6	0.112	2
28	" 8	20 47	643.867	6.1	0.294	4	74	" 15	19 12	650.801	0.5	0.143	2
29	" 8	21 33	643.899	5.0	0.326	4	75	" 15	20 27	650.853	3.8	0.195	2-3
30	" 8	22 5	643.921	4.6	0.348	4	76	" 15	21 12	650.884	6.0	0.226	2-3
31	" 8	22 42	643.947	4.4	0.374	4	77	" 15	22 25	650.935	6.9	0.281	2-3
32	" 8	23 12	643.968	3.5	0.395	4	78	" 16	18 39	651.778	6.3	0.234	3
33	" 10	13 5	645.546	4.0	0.201	2	79	" 16	19 50	651.827	5.9	0.283	3
34	" 10	13 24	645.559	7.1	0.214	3	80	" 16	20 46	651.866	4.9	0.322	3
35	" 10	14 28	645.604	6.4	0.260	3	81	" 16	21 36	651.901	4.5	0.357	3
36	" 10	14 55	645.623	6.7	0.279	3	82	" 19	15 23	654.642	1.7	0.442	2
37	" 10	16 8	645.673	4.6	0.329	4	83	" 19	13 52	654.579	1.8	0.379	2
38	" 10	16 44	645.698	3.4	0.354	4	84	" 19	17 45	654.741	0.8	0.098	2
39	" 10	16 54	645.705	3.1	0.361	4	85	" 19	18 34	654.775	0.5	0.122	2
40	" 10	17 24	645.726	3.1	0.382	4	86	" 19	19 24	654.809	1.3	0.166	3
41	" 10	17 46	645.741	2.4	0.397	4	87	" 19	19 31	654.814	2.7	0.171	3
42	" 10	18 37	645.777	1.9	0.433	4	88	" 19	20 5	654.838	6.0	0.195	3
43	" 10	19 17	645.804	1.5	0.017	4	89	" 19	20 35	654.859	6.4	0.216	3
44	" 10	19 58	645.833	0.8	0.046	4	90	" 19	21 0	654.876	7.0	0.233	3
45	" 10	20 37	645.860	0.8	0.073	4	91	" 19	21 23	654.892	6.6	0.249	3
46	" 10	20 56	645.873	1.8	0.086	4							

The above table contains all my observations to March 19. The fourth column gives Julian days and fraction, corrected by the reduction to the sun. The brightness is expressed in steps. The phase is calculated with the period 0^d4428 and taking 2417559^d884 as the initial epoch. The last column is the condition of seeing on my scale, 5 being the best.

Arranging these observations in the order of phase, and dividing them into 18 groups, each containing 5 ob-

servations, except one which has 6, the mean brightness and phase are obtained as follows:

Phase	Br.	Phase	Br.	Phase	Br.
0 ^d 003	1 st 4	0 ^d 180	3 st 6	0 ^d 294	6 st 0
0.045	1.1	0.208	5.1	0.328	4.8
0.074	1.6	0.228	5.9	0.352	4.2
0.104	1.6	0.241	6.9	0.367	2.8
0.130	1.4	0.260	6.4	0.388	2.5
0.157	2.0	0.278	6.6	0.428	1.8

Light curve of 87.1906 Draconis.

These are plotted in the accompanying figure. It shows that the light increases very rapidly from minimum to maximum within three hours. It does not halt at the maximum, and soon begins to decrease slowly. After five hours it is at minimum again. During the remaining three hours it stays at the minimum brightness. Thus, the general character of the light-curve resembles that of a short-period variable.

The elements of the variable are as follows:

$$\begin{aligned} \text{Max.} &= 2417560^{\text{d}}134 + 0^{\text{d}}4428 E \\ &= 1906 \text{ Dec. } 15 \ 3^{\text{h}}12^{\text{m}}58^{\text{s}} + 10^{\text{h}}37^{\text{m}}35^{\text{s}} E \\ M - m &= 0^{\text{d}}130 \quad \text{Range } 10^{\text{m}}9 - 11^{\text{m}}6 = 0^{\text{m}}7 \end{aligned}$$

The following ephemeris for this year was calculated with the above formula but only every 70th of maximum of each month is given below.

April 1	22 ^h 3	July 3	22 ^h 0	Oct. 4	21 ^h 7
May 2	22.1	Aug. 3	21.9	Nov. 4	21.6
June 2	22.1	Sept. 3	21.8	Dec. 5	21.5

Multiples of period.

2 P = 0 ^d 21 ^h 25	15 P = 6 ^d 15 ^h 40	40 P = 17 ^d 17 ^h 09
3 P = 1 7.88	20 P = 8 20.55	45 P = 19 22.22
4 P = 1 18.50	25 P = 11 1.68	50 P = 22 3.36
5 P = 2 5.14	30 P = 13 6.82	55 P = 24 8.50
10 P = 4 10.27	35 P = 15 11.95	60 P = 26 13.63

Verkes Observatory, 1907 March 22.

Naozo Ichinohe.

Beobachtung von Jupitertrabanten-Erscheinungen und Sternbedeckungen

auf der k. k. Sternwarte zu Prag im Jahre 1906.

Diese Beobachtungen wurden hauptsächlich von dem zweiten Assistenten, Herrn *Anton Kaiser* (K) am größeren Fraunhofer (Fr, Öffnung 97.6 mm) mit durchweg 115-facher Vergrößerung angestellt. An den Beobachtungen beteiligte sich auch gelegentlich der erste Assistent, Herr *Josef Dörr*

(D), unter Benutzung des kleineren Fraunhofer (fr, Öffnung 83.7 mm) mit 60-facher Vergrößerung.

Für die beobachteten Trabanten-Erscheinungen wurden die Bezeichnungen des Nautical Almanac angesetzt.

I. Jupitertrabanten-Erscheinungen.

1906	Erscheinung	M. Z. Prag	Instr.	Vergr.	Bb.	Bemerkungen
Jan. 3	II Ec R	9 ^h 38 ^m 47 ^s	Fr	115	K	Erstes Auftauchen
		40 39	»	»	»	Volle Lichtstärke
»	III Ec D	10 10 34	»	»	»	Erste bemerkbare Lichtabnahme
		12 59	»	»	»	Verschwinden
»	III Ec R	11 52 7	»	»	»	Erster Lichtschimmer
		56 8	»	»	»	Volles Licht
Jan. 25	I Ec R	11 16 42	»	»	»	Erstes Auftauchen
		19 17	»	»	»	Konstante Lichtstärke
»	»	11 16 56	fr	60	D	Erstes Erscheinen
		19 17	»	»	»	Konstante Helligkeit