

DET KGL. DANSKE VIDENSKABERNES SELSKAB  
MATEMATISK-FYSISKE MEDDELELSER, BIND XXII, Nr. 1

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THE ORBIT OF COMET  
DU TOIT-NEUJMIN-DELPORTE  
(1941 e)

BY

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I KOMMISSION HOS EJNAR MUNKSGAARD

1945



Comet 1941 e was discovered by DU TOIT on July 18th, 1941, by NEUJMIN on July 25th and by DELPORTE on August 19th. It was observed until October 20th, and 54 accurate observations are available. Several provisional orbits have been computed; the basis of this improvement is the following system, computed by GROSCH:

$$\left. \begin{array}{l}
 \text{Osculation 1941 Aug. 29.0 U.T.} \\
 T = 1941 \text{ July } 21.18766 \text{ U.T.} \\
 \omega = 69^{\circ}10'33''.3 \\
 \Omega = 229 \ 37 \ 7 \ .2 \\
 i = 3 \ 14 \ 49 \ .4 \\
 e = 0.5789569 \\
 \mu = 0^{\circ}.18099891 \\
 a = 3.0951760 \\
 P = 5^y.4456
 \end{array} \right\} \text{I}$$

From these elements I computed the following ephemeris. The perturbations from Jupiter were taken into account with the aid of ENCKE's method. It gives  $\alpha_{1950.0}$  and  $\delta_{1950.0}$  when  $t$ —light time is used as argument.

1941		$\alpha_{1950.0}$	$\delta_{1950.0}$	$r$	$\Delta$	Light time
July 20	20 <sup>h</sup>	1 <sup>m</sup> 28 <sup>s</sup> .87	— 6°44'52".7	1.303	0.294	0. 0017
	21	2 57 .44	35 14 .8			
	22	4 25 .82	26 1 .8			
	23	5 54 .03	17 14 .0			
	24	7 22 .09	8 51 .9			
	25	8 50 .03	6 0 55 .4	1.304	0.295	0 .0017
	26	20 10 17 .86	— 5 53 25 .1			

1941	$\alpha_{1950.0}$	$\delta_{1950.0}$	$r$	$\Delta$	Light time
Aug. 16	20 <sup>h</sup> 40 <sup>m</sup> 52 <sup>s</sup> .76	- 4°48'31".9			
17	42 19 .65	49 6 .7			
18	43 46 .52	49 56 .0			
19	45 13 .40	50 58 .5	1.344	0.345	0.0020
20	46 40 .32	52 13 .3			
21	48 7 .26	53 39 .7			
22	49 34 .30	55 16 .5			
23	51 1 .41	57 2 .8			
24	52 28 .63	4 58 57 .6	1.359	0.365	0.0021
25	53 55 .98	5 1 0 .1			
26	55 23 .47	3 9 .2			
27	56 51 .13	5 23 .9			
28	58 18 .94	7 43 .5			
29	20 59 46 .95	10 7 .0	1.376	0.388	0.0022
30	21 1 15 .12	12 33 .5			
31	2 43 .48	15 2 .3			
Sept. 1	4 12 .01	17 32 .7			
2	5 40 .72	20 3 .7			
3	21 7 9 .57	- 5 22 35 .2	1.395	0.414	0.0024
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Sept. 7	21 13 6 .40	- 5 32 29 .3			
8	14 35 .92	34 52 .3	1.416	0.444	0.0026
9	16 5 .58	37 11 .9			
10	17 35 .37	39 27 .6			
11	19 5 .28	41 39 .0			
12	20 35 .31	43 45 .7			
13	22 5 .49	45 47 .1	1.438	0.476	0.0027
14	23 35 .82	47 42 .9			
15	25 6 .30	49 32 .6			
16	26 36 .92	51 16 .0			
17	28 7 .71	52 52 .7			
18	29 38 .67	54 22 .3	1.462	0.513	0.0030
19	31 9 .80	55 44 .3			
20	32 41 .11	56 58 .8			
21	34 12 .62	58 5 .2			
22	35 44 .33	59 3 .4			
23	37 16 .25	5 59 53 .0	1.487	0.553	0.0032
24	38 48 .39	6 0 33 .7			
25	40 20 .74	1 5 .6			
26	41 53 .30	1 28 .3			
27	43 26 .07	1 41 .9			
28	44 59 .07	1 46 .1	1.514	0.596	0.0034
29	21 46 32 .20	- 6 1 40 .8			

1941		$\alpha_{1950.0}$	$\delta_{1950.0}$	$r$	$\Delta$	Light time
Oct. 11	22 <sup>h</sup>	5 <sup>m</sup> 21 <sup>s</sup> .40	- 5°48'19".2			
	12	6 56 .25	46 11 .5			
	13	8 31 .21	43 54 .6	1.600	0.747	0.0043
	14	10 6 .28	41 28 .5			
	15	11 41 .44	38 53 .4			
	16	13 16 .72	36 9 .1			
	17	14 52 .10	33 16 .1			
	18	22 16 27 .59	- 5 30 14 .0	1.631	0.805	0.0046

The following table gives the observations. The weights  $p$  were found from curves drawn with  $\Delta\alpha$  and  $\Delta\delta$  as ordinates and times as abscissae.

No.	$t$ —light time	$\alpha_{1950.0}$	$\delta_{1950.0}$	O—C		$p$	
				$\Delta\alpha \cos \delta$	$\Delta\delta$		
1	July 21.94483	20 <sup>h</sup> 4 <sup>m</sup> 21 <sup>s</sup> .18	- 6°26'28".0	+ 6 <sup>s</sup> .23	+ 3".9	1	Würzburg
2	22.00337	4 26 .5-	25 56 .-	+ 0 .4-	+ 4 .-	0	Sonneberg
3	22.03198	4 27 .58	25 25 .9	- 1 .06	+ 18 .6	1	Würzburg
4	24.91471	8 41 .82	1 24 .3	- 0 .71	+ 10 .7	1	—
5	24.98025	8 47 .69	0 45 .8	- 0 .60	+ 18 .8	1	—
6	25.03649	8 50 .7-	6 0 50 .-	- 2 .5-	- 12 .-	0	Sonneberg
7	Aug. 17.97581	43 45 .6-	4 49 59 .-	+ 1 .2-	- 4 .-	2	—
8	19.85465	46 27 .84	52 4 .5	+ 0 .16	- 2 .8	4	Uccle
9	19.89066	46 30 .43	52 4 .3	- 0 .38	+ 0 .2	4	—
10	20.85883	47 54 .59	53 27 .3	- 0 .40	- 0 .5	4	—
11	20.88549	47 57 .20	53 32 .4	- 0 .10	- 3 .2	4	—
12	20.90261	47 58 .80	53 32 .5	+ 0 .01	- 1 .7	4	—
13	22.87201	50 49 .81	56 51 .1	- 0 .45	- 2 .4	4	—
14	22.89635	50 52 .17	57 54 .3	- 0 .21	- 3 .0	4	—
15	22.90210	50 52 .79	57 6 .9	- 0 .09	- 14 .9	4	—
16	23.96282	52 26 .0-	4 59 17 .-	+ 0 .6-	- 24 .-	0	Torino
17	24.86235	53 43 .50	5 0 42 .5	- 0 .45	+ 0 .3	4	Uccle
18	24.90509	53 47 .80	0 39 .0	+ 0 .12	+ 9 .1	1	Torino
19	26.92494	56 44 .48	5 15 .5	- 0 .06	- 1 .8	4	Uccle
20	27.17961	57 6 .8-	5 53 .-	- 0 .1-	- 4 .-	3	Yerkes
21	27.86642	58 6 .6-	7 15 .-	- 0 .6-	+ 10 .-	2	Barcelona
22	27.95347	58 14 .67	7 36 .9	- 0 .18	0 .0	4	Uccle
23	28.11264	58 28 .67	8 0 .5	- 0 .17	- 1 .0	3	Washington
24	28.26938	58 42 .6-	8 22 .-	0 .0-	0 .-	3	Yerkes
25	28.90777	20 59 38 .56	9 56 .1	- 0 .26	- 2 .5	4	Uccle
26	30.90056	21 2 35 .10	14 41 .5	+ 0 .42	+ 5 .9	1	Torino
27	31.92046	4 4 .31	17 20 .7	- 0 .65	0 .0	2	Posen
28	Sept. 1.85346	5 29 .87	19 58 .8	+ 2 .16	- 17.3	0	—
29	8.82855	15 50 .02	36 45 .1	- 0 .18	+ 3 .1	4	Uccle
30	9.82287	21 17 19 .30	- 5 38 59 .2	- 0 .16	+ 4 .6	1	Torino

No.	$t$ —light time	$\alpha_{1950.0}$	$\delta_{1950.0}$	O—C		$p$	
				$\Delta\delta \cos\delta$	$\Delta\delta$		
31	Sept. 11.05975	21 <sup>h</sup> 19 <sup>m</sup> 10 <sup>s</sup> .24	$-5^{\circ}41'52''.9$	$-0^{\text{s}}.42$	$-6.2$	3	Yerkes
32	11.81540	20 20 .76	43 20 .1	$+2.08$	$+2.6$	0	Uccle
33	11.84068	20 22 .30	43 22 .5	$+1.34$	$+3.3$	0	—
34	12.06600	20 41 .05	43 56 .5	$-0.21$	$-2.6$	3	Yerkes
35	15.81748	26 19 .57	50 34 .5	$-0.80$	$+23.1$	0	Uccle
36	15.84882	26 23 .57	50 50 .3	$+0.36$	$+10.5$	1	Torino
37	16.85134	27 53 .87	52 49 .0	$-0.33$	$-10.3$	1	—
38	17.81158	29 21 .17	54 3 7	$-0.35$	$+2.3$	4	Uccle
39	17.83023	29 22 .78	54 4 6	$-0.44$	$+3.0$	4	—
40	19.82196	32 24 .67	56 41 .8	$-0.17$	$+4.3$	4	—
41	19.84004	32 26 .75	56 57 .2	$+0.26$	$-9.8$	1	Torino
42	21.83026	35 28 .10	58 50 .2	$-0.65$	$+3.9$	4	Uccle
43	21.86139	35 31 .24	58 54 .3	$-0.37$	$+1.5$	2	Posen
44	22.87949	37 5 48	59 55 .8	$+0.32$	$-8.4$	1	Torino
45	22.91306	37 8 00	5 59 46 .5	$-0.25$	$+2.5$	3	Wien
46	23.81120	38 30 .41	6 0 27 .8	$-0.57$	$-1.1$	4	Uccle
47	23.84927	38 34 .55	0 36 7	$+0.06$	$-8.6$	1	Torino
48	23.89737	38 38 .45	0 28 1	$-0.47$	$+1.8$	3	Wien
49	24.92442	40 13 .23	1 2 5	$-0.52$	$+1.0$	3	—
50	25.83195	41 37 .23	1 20 3	$-0.50$	$+4.8$	4	Uccle
51	26.99327	43 14 .49	1 41 6	$-10.96$	$+0.2$	0	Wien
52	27.84472	21 44 43 .56	6 1 48 .1	$-1.07$	$-2.0$	4	Uccle
53	Oct. 12.79599	22 8 10 .14	5 44 25 .8	$-1.69$	$-2.5$	4	—
54	15.79004	22 12 54 .58	$-5 36 47 .4$	$-2.13$	$-3.0$	4	—

Then the following normal-places were formed:

No.	$t$ —light time	$\alpha_{1950.0}$	$\delta_{1950.0}$	O — C		$\sqrt{p}$	Observations
				$\Delta\alpha \cos\delta$	$\Delta\delta$		
I	July 23.96660	20 <sup>h</sup> 7 <sup>m</sup> 18 <sup>s</sup> .61	$-6^{\circ} 8'55''.3$	$-0^{\text{s}}.54$	$+13''.0$	2.0	1—6
II	Aug. 21.70963	20 49 8 .89	$-4 54 50 .1$	$-0.13$	$-2.8$	6.3	7—18
III	28.67058	20 59 17 .77	$-5 9 19 .7$	$-0.17$	$-0.4$	5.1	19—27
IV	Sept. 10.44429	21 18 15 .06	$-5 40 27 .4$	$-0.25$	$-0.9$	3.3	28—34
V	18.00066	21 29 38 .49	$-5 54 20 .5$	$-0.24$	$+1.9$	3.9	35—41
VI	23.96431	21 38 44 .57	$-6 0 31 .6$	$-0.53$	$+0.8$	5.4	42—52
VII	Oct. 14.26302	22 10 29 .49	$-5 40 51 .4$	$-1.91$	$-2.8$	2.8	53—54

and the equations of condition were found to be:

$$\begin{aligned}
 &+ 19.8224dM_0 + 41.0626du + 0.51675de - 0.04082dp + 1.01137dq + 4.31135dr = -8''.1 \\
 &+ 15.7863 + 313.934 + 4.02330 - 0.45481 + 0.94913 + 3.55031 = -2.0 \\
 &+ 14.3172 + 346.377 + 4.43659 - 0.52502 + 0.87727 + 3.27142 = -2.6 \\
 &+ 11.6652 + 375.150 + 4.79515 - 0.61045 + 0.72435 + 2.76488 = -3.8 \\
 &+ 10.23307 + 377.840 + 4.82050 - 0.63687 + 0.63137 + 2.48949 = -3.6 \\
 &+ 9.20276 + 374.803 + 4.77272 - 0.64718 + 0.56032 + 2.29043 = -8.0
 \end{aligned}$$

+ 6.40185	+ 346.345	+ 4.36920	- 0.63363	+ 0.34979	+ 1.74653	= -28 .7
+ 4.57092	+ 186.914	+ 2.11522	+ 0.17072	- 4.22992	+ 1.00660	= +13 .0
+ 4.69369	+ 225.102	+ 2.65361	+ 1.55773	- 3.25082	+ 1.15823	= - 2 .8
+ 4.44765	+ 218.084	+ 2.59019	+ 1.73256	- 2.89496	+ 1.12026	= - 0 .4
+ 3.86734	+ 198.156	+ 2.38399	+ 1.89444	- 2.24793	+ 1.00705	= - 0 .9
+ 3.49852	+ 184.847	+ 2.23945	+ 1.91311	- 1.89657	+ 0.92817	= + 1 .9
+ 3.21337	+ 174.481	+ 2.12452	+ 1.89822	- 1.64344	+ 0.86535	= + 0 .8
+ 2.36517	+ 143.986	+ 1.77517	+ 1.73495	- 0.95776	+ 0.67534	= - 2 .8

In solving this system I obtained the result:

$$\begin{aligned}
 dM_0 &= - 9''.342 \\
 d\mu &= - 8.4836 \\
 de &= + 661.46 \\
 dp &= - 7.05 \\
 dq &= - 44.94 \\
 dr &= + 52.63
 \end{aligned}$$

and the new elements:

$$\left. \begin{aligned}
 &\text{Osculation 1941 Aug. 29.0 U.T.} \\
 &T = 1941 \text{ July 21.20200 U.T.} \\
 &\omega = 69^\circ 17' 2''.0 \\
 &\Omega = 229 \ 39 \ 2 \ .9 \\
 &i = 3 \ 15 \ 26 \ .5 \\
 &e = 0.5821638 \\
 &\mu = 0^\circ.17864235 \\
 &a = 3.1223369
 \end{aligned} \right\} 1950.0 \quad \text{II}$$

Although the substitution of the improvements in the equations of condition were in good accordance with the normal-places this did not apply to the direct computation from the new elements, as the improvements were too great. The new residuals were:

No.	O - C	
	$\Delta\alpha \cos \delta$	$\Delta\delta$
I.....	+ 0 <sup>s</sup> .17	+ 4'' .8
II.....	+ 0 .59	+ 5 .5
III.....	+ 0 .55	+ 7 .0
IV.....	+ 0 .63	+ 3 .9
V.....	+ 0 .82	+ 5 .7
VI.....	+ 0 .76	+ 4 .4
VII.....	+ 0 .68	+ 4 .1

Therefore I computed the following new equations of condition from the elements II:

+ 19.98787	$dM_0$	+ 41.1398	$d\mu$	+ 0.51493	$de$	- 0.04044	$dp$	+ 1.00704	$dq$	+ 4.29344	$dr$	= + 2''.	.4
+ 15.93193		+ 316.770		+ 4.03241		- 0.45270		+ 0.94600		+ 3.53893		= + 8	.9
+ 14.45154		+ 349.583		+ 4.44802		- 0.52274		+ 0.87456		+ 3.26146		= + 8	.3
+ 11.77827		+ 378.797		+ 4.80981		- 0.60802		+ 0.72250		+ 2.75767		= + 9	.5
+ 10.33399		+ 381.586		+ 4.83633		- 0.63447		+ 0.62995		+ 2.48351		= + 12	.3
+ 9.29457		+ 378.589		+ 4.78933		- 0.64484		+ 0.55924		+ 2.28537		= + 11	.4
+ 6.46903		+ 350.152		+ 4.38825		- 0.63164		+ 0.34962		+ 1.74401		= + 10	.2
+ 4.60872		+ 188.335		+ 2.12035		+ 0.16916		- 4.21253		+ 1.00231		= + 4	.8
+ 4.73383		+ 226.981		+ 2.66001		+ 1.55099		- 3.24107		+ 1.15390		= + 5	.5
+ 4.48611		+ 219.919		+ 2.59658		+ 1.72556		- 2.88689		+ 1.11621		= + 7	.0
+ 3.90173		+ 199.885		+ 2.39038		+ 1.88755		- 2.24296		+ 1.00376		= + 3	.9
+ 3.53017		+ 186.466		+ 2.24546		+ 1.90662		- 1.89304		+ 0.92527		= + 5	.7
+ 3.24289		+ 176.039		+ 2.13050		+ 1.89177		- 1.64065		+ 0.86281		= + 4	.4
+ 2.38812		+ 145.364		+ 1.78105		+ 1.73030		- 0.95775		+ 0.67376		= + 4	.1

These gave the new improvements and elements:

$$\begin{aligned}
 dM_0 &= - 3''.647 \\
 d\mu &= - 0 .1432 \\
 de &= + 12 .35 \\
 dp &= - 0 .91 \\
 dq &= - 1 .17 \\
 dr &= + 17 .73
 \end{aligned}$$

$$\left. \begin{aligned}
 &\text{Osculation 1941 Aug. 29.0 U. T.} \\
 &T = 1941 \text{ July 21.20767 U. T.} \\
 &\omega = 69^\circ 17' 41'' .3 \\
 &\Omega = 229 \ 38 \ 41 \ .2 \\
 &i = 3 \ 15 \ 27 \ .3 \\
 &e = 0.5822237 \\
 &a = 3.1228007 \\
 &\mu = 0^\circ .17860256 \\
 &P = 5^y .519
 \end{aligned} \right\} \text{III}$$

Hence we get the following residuals between the elements III and the normal-places:



No.	O — C			
	Differentially		Direct	
	$\Delta\alpha \cos \delta$	$\Delta\delta$	$\Delta\alpha \cos \delta$	$\Delta\delta$
I . . . . .	— 0'' .1	— 0'' .2	— 0'' .6	— 0'' .2
II . . . . .	+ 0 .5	— 0 .4	+ 0 .6	— 0 .4
III . . . . .	— 0 .9	+ 1 .2	— 1 .2	+ 1 .2
IV . . . . .	— 1 .3	— 1 .5	— 1 .2	— 1 .4
V . . . . .	+ 1 .1	+ 0 .7	+ 1 .0	+ 0 .8
VI . . . . .	— 0 .1	— 0 .4	— 0 .1	— 0 .4
VII . . . . .	— 1 .3	+ 0 .1	— 1 .3	+ 0 .1

An ephemeris for the opposition in 1946—47 will be published later.

