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1990 COMET HANDBOOK

Ephemeris Computations by Syuichi Nakano

Introduction by Daniel W. E. Green

*Special annual volume of elements and ephemerides
for short-period comets and the brighter long-period comets*

The *International Comet Quarterly* (*ICQ*) is a non-profit journal devoted to news and observation of comets. Regular issues are published 4 times per year (January, April, July, and October), with an annual *Comet Handbook* of ephemerides published as a special fifth issue in the second half of the year (beginning in 1990, the first half of the year). The *ICQ* is published in part by the Department of Physics and Astronomy at Appalachian State University in Boone, North Carolina. The *ICQ* is indexed in *Astronomy and Astrophysics Abstracts* and in *Science Abstracts Section A*.

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INTRODUCTION

This is the fourth edition of the *ICQ Comet Handbook*, a collection of up-to-date (as of September 1989) orbital elements and ephemerides to aid observers in locating comets for the coming year. Syuichi Nakano has compiled the ephemerides in this *Handbook* following collaboration with B. G. Marsden and D. W. E. Green. The content of this *Handbook* is similar that of Nakano's annual *Handbook* published in Japan by the Oriental Astronomical Association (OAA) under the direction of T. Seki. The accompanying text differs between the two editions (the OAA version being written in Japanese and having different content), and several of the ephemerides differ in the length of arc; the *ICQ* edition has also eliminated ephemerides for a few comets which have been considered lost for many years. Also, beginning with this edition, only elements and ephemerides for long-period comets predicted to be brighter than mag ~ 18 or 19 are included. The *ICQ Comet Handbook* will be published earlier in the year, to aid observers for planning purposes, and it will thus be necessary to consult the *IAUCs* and *MPCs* for elements and ephemerides of newly-discovered comets (see last paragraph of this "Introduction").

Pages H3-H5 of this issue contain the orbital elements for the 48 comets included in this *Handbook*, listed in order of T (the time of perihelion). The bottom of page H5 then lists an **alphabetical Index** for locating individual ephemerides (which are not listed in the same order as the elements are).

Orbital Elements. The top-half of each of pages H3-H5 contains orbital elements for the comets with the columns containing the following information: (1) *No.* is the orbit number; (2) T/ET is the time of perihelion in Ephemeris Time (last two digits of year; month; date); (3) q (*AU*) is the perihelion distance; (4) e is the orbital eccentricity; (5) P is the orbital period in years; (6) *Peri.* is the argument of perihelion; (7) *Node* is the longitude of the ascending node; (8) *Inc.* is the orbital inclination (these three angles are for equinox 1950.0); (9) *Epoch* is provided with year, month, and date; (10) *Obs.* is the number of astrometric observations used in the orbital computations; (11) dT is the correction to T in days for a periodic-comet recovery; (12) *Arc* is the arc of time spanned by the observations used in the calculation (Ma = March, My = May, Ja = January, Je = June, Jl = July, etc.); and (13) *Per.* indicates the planets whose perturbations were allowed for (ME-PL = Mercury-Pluto). The bottom-half of each of pages H3-H5 contains the following supplemental information, by column: (1) comet number, to identify easily with the orbital elements on the top-half of the page; (2) *Comet Name*, where $P/$ indicates "periodic comet" (one with orbital period < 200 years); (3) *Calculator* of the orbital elements; (4) *References*, or sources, of the (published) orbital elements (NK and KC represent Nakano's and Kobayashi's personal circulars, respectively; MPC stands for *Minor Planet Circulars*; *IAUC* = *IAU Circulars*), including year in which calculation or publication was made; (5) *m.e.* is the mean error of the observations with respect to the elements, in arcsec; (6-7) $H1$, $K1$ are the comet's estimated total magnitude (m_1) parameters, to satisfy the equation

$$m_1 = H_o + 5 \log \Delta + 2.5n \log r, \quad \text{where } H_o = H1 \text{ and } 2.5n = K1; \quad (8-9) \quad H2, K2 \text{ are the comet's estimated nuclear magnitude } (m_2) \text{ parameters, replacing } m_1 \text{ with } m_2, H_o \text{ with } H2, \text{ and } 2.5n \text{ with } K2 \text{ in the above equation;}$$
 (10) Y/L is the provisional-letter designation of comets which have been discovered or recently recovered (last two digits of year plus letter); (11) *NG* indicates that nongravitational forces have been taken into account in the orbital calculations (II means style-II parameters were solved for); and (12) *Remarks* contain further information, such as values of $1/a$ at the given epoch, sources of these or other (similar) orbital elements, or values of T found by others (if it is stated that the elements are "from" another orbit, this indicates that the orbit has simply been integrated forward without utilizing further observations). Some elements are integrated to 1990 epochs if published epochs are in another year.

(Cont. on page H52)

No. T/ ET	q (AU)	e	P	Peri.	Node	Inc.	Epoch	Obs.	ΔT	Arc	Per.
01 86 Feb. 09.44451	0.5809592	0.9675827	75.9	111.68707	58.12765	162.24729	90 Nov. 05	7469		1835 - 1989	ME-PL
02 87 Aug. 17.53785	3.0273397	0.2923382	8.85	181.38039	243.57094	5.19307	87 Sept.02	25		86 Se 29-89 Ma 26	ME-PL
03 87 Aug. 30.48447	2.0714325	0.3984222	6.39	357.88591	125.66018	3.75579	87 Sept.02	113	0.00	1960 - 1982	ME-PL
04 87 Nov. 07.27408	0.8689556	0.9947358		73.91102	267.38484	34.08793	87 Nov. 21	477		87 Au 12-88 Ap 13	ME-PL
05 88 May 09.96986	1.8693072	0.5030078	7.29	13.01884	119.14784	8.13847	88 Apr. 29	114	+0.02	1928 - 1973	ME-PL
06 88 May 21.41868	3.0528328	0.3220443	9.56	210.42954	213.82582	4.36805	88 June 08	42		87 Se 24-88 Fe 19	ME-PL
07 88 Sept.10.24873	3.4705103	0.1410927	8.12	9.62176	91.41474	4.23763		54		89 Ja 03-89 Ma 10	
08 88 Oct. 12.18795	2.4088763	0.3414199	7.00	195.69584	15.00241	24.38642	88 Oct. 06	16	+0.01	1975 - 1982	ME-PL
09 88 Oct. 31.80184	1.8945966	0.9987126		351.55662	156.39214	52.41666	88 Nov. 15	81		89 Ja 02-89 Je 03	ME-PL
10 89 Feb. 04.19678	1.2919823	0.6246689	6.39	177.06800	138.80172	19.42840	89 Feb. 03	87	-0.06	1970 - 1982	ME-PL
11 89 June 12.46577	2.4742703	1.0005385		232.14021	114.55626	97.69728	89 June 03	98		88 Je 11-89 Ap 18	ME-PL
12 89 June 18.39443	1.2996848	0.6302539	6.59	11.38213	50.35512	7.11451	89 June 03	212	0.00	1969 - 1983	ME-PL
13 89 Aug. 19.90114	1.2609642	0.6335127	6.38	172.32103	92.74940	22.27306	89 Aug. 22	29	0.00	1964 - 1983	ME-PL
14 89 Sept.11.93841	0.4787422	0.9719594	70.5	129.62476	310.87639	19.33097	89 Oct. 01	86		1847 - 1989	ME-PL
15 89 Sept.24.97985	2.4715442	0.3143992	6.84	196.93778	67.86766	10.37247	89 Oct. 01	88		1954 - 1982	ME-PL
16 89 Oct. 10.50465	1.6796187	0.6142346	9.09	73.61664	341.71719	12.19792	89 Oct. 01	15		1980 - 1989	ME-PL
17 89 Oct. 26.72546	5.7717586	0.0446625	14.9	49.89710	312.12285	9.36734	89 Nov. 10	430		1957 - 1986	ME-PL
18 89 Nov. 03.13874	2.3483567	0.4098031	7.94	183.54068	215.52509	6.67268	89 Nov. 10	28	0.00	1973 - 1982	ME-PL
19 89 Nov. 11.92132	0.6424184	1.0		150.57378	274.81816	90.15060		45		89 Au 24-89 Se 24	ME-PL
20 89 Nov. 28.41038	1.5558286	0.5013221	5.51	208.92499	59.05962	9.49779	89 Nov. 10	78	0.00	1973 - 1984	ME-PL
No.Comet Name	Calculator	References	m.e.	H1	K1	H2	K2	Y/L	NG	Remarks	
01 P/Halley	Yeomans D.K.	IHW 61	1.21	5.5	8.0	8.5	10.0	82i	II		
02 P/Parker-Hartley	Nakano S.	NK 531	1.12	9.5	10.0	8.0	15.0	89i	II	$\Delta P = \pm 1.00$ day.	
03 P/Schwassmann-Wachmann 2	Nakano S.	NK 482	1.41	7.6	10.0	14.0	10.0	86h	II	Also MPC 10521, HBAA 1987.	
04 Bradfield 1987 XXIX	Kobayashi T.	MPC 14903	1.27	5.7	6.2	10.0	5.0	87s	II	$1/a = +0.00060581 \pm 0.0000034$	
05 P/Reinmuth 1	Marsden B.G.	MPC 10524	0.0	10.0	15.0	15.0	5.0	87r	II	Also HBAA 1988.	
06 P/Shoemaker-Holt 1	Green D.W.E.	MPC 13460	0.8	8.5	10.0	14.0	5.0	87z			
07 P/Helin-Roman-Crockett	Marsden B.G.	MPC 14460	-	7.0	10.0	11.0	5.0	89b			
08 P/Longmore	Nakano S.	NK 493	0.90	11.0	10.0	15.0	5.0	87c1		Also MPC 11519.	
09 Yanaka	Nakano S.	MPC 14747	1.48	6.5	10.0	8.5	10.0	89a	II	$1/a = +0.0006795 \pm 0.0000395$	
10 P/d'Arrest	Marsden B.G.	MPC 11501	1.8	8.5	6.5	16.0	5.0	87k	II	Also HBAA 1988.	
11 Shoemaker-Holt-Rodriguez	Kobayashi T.	MPC 14904	0.92	6.0	10.0	9.0	5.0	88h		$1/a = -0.0002176 \pm 0.0000057$	
12 P/Churyumov-Gerasimenko	Kobayashi T.	KC 28	1.30	9.5	10.0	14.5	10.0	88i	II		
13 P/Pons-Winnecke	Kobayashi T.	KC 32	1.22	10.0	15.0	16.0	5.0	89g	II	Also MPC 12123, HBAA 1989.	
14 P/Brorsen-Metcalf	Yeomans D.K.	MPC 14747	2.0	7.8	8.0	14.0	5.0	89o	II		
15 P/Gunn	Marsden B.G.	MPC 11502	1.4	5.0	15.0	10.0	10.0		II	Also HBAA 1988.	
16 P/Lovas 1	Green D.W.E.	IAUC 4813	1.3	10.0	15.0	14.0	10.0	89p			
17 P/Schwassmann-Wachmann 1	Kobayashi T.	MPC 11510	1.39	6.0	10.0	9.0	8.0			Also HBAA 1988.	
18 P/Gehrels 2	Green D.W.E.	MPC 12124	0.8	10.0	15.0	13.0	10.0	89n		Also HBAA 1989.	
19 Okazaki-Levy-Rudenko	Marsden B.G.	MPC 15215	-	7.0	10.0	11.0	5.0	89r			
20 P/Clark	Nakano S.	NK 502	1.44	10.5	15.0	15.5	10.0	89h	II	Also MPC 12128, HBAA 1989.	

No. T/ ET	q (AU)	e	P	Peri.	Node	Inc.	Epoch	Obs.	ΔT	Arc	Per.
21	90 Jan. 20.39284	1.5851475	0.5429862	6.46	162.82616	120.28850	4.72054	90 Jan. 29	144	-0.06	1970 - 1983
22	90 Feb. 08.22290	1.0680211	0.6557443	5.46	61.58493	140.86930	9.22905	90 Jan. 29	37	1973 - 1979	ME-PL
23	90 Apr. 02.56198	1.8136363	0.6632271	12.5	162.83820	181.81370	18.72237	90 Apr. 19	20	77 Se 13-78 Ja 31	ME-PL
24	90 May 17.88599	2.5172492	0.3432686	7.50	353.22426	248.01581	14.08745	90 May 29	46	1983 - 1989	ME-PL
25	90 May 19.34312	0.9362731	0.6940149	5.35	198.77059	69.27130	11.41096	90 May 29	244	1930 - 1979	ME-PL
26	90 June 21.60047	1.6257753	0.5977503	8.13	338.31328	259.39485	29.83261	90 July 08	19	82 J1 11-82 Se 11	ME-PL
27	90 July 07.52013	2.2225447	0.3663413	6.57	92.99887	70.39020	6.19127	90 July 08	39	84 Ma 02-84 My 07	ME-PL
28	90 July 08.57487	1.4356950	0.5807541	6.34	147.74159	299.95363	7.04652	90 July 08	7	78 Fe 11-78 Ma 14	ME-PL
29	90 Sept. 12.77713	0.5412532	0.8218841	5.30	325.73539	88.66115	4.22456	90 Sept. 26	46	1969 - 1980	ME-PL
30	90 Oct. 28.56645	0.3308855	0.8502192	3.28	186.24429	334.04097	11.93911	90 Nov. 05	86	1973 - 1987	ME-PL
31	90 Nov. 18.96313	2.3125613	0.3661482	6.97	208.27665	116.67362	13.66447	90 Nov. 05	44	1963 - 1984	ME-PL
32	90 Nov. 22.60779	2.2153825	0.4866280	8.96	131.83466	315.02756	9.00711	90 Nov. 05	142	1963 - 1989	ME-PL
33	90 Dec. 16.89679	1.5780575	0.5409785	6.37	41.57379	135.57498	3.24939	90 Dec. 15	100	+0.02	1978 - 1986
34	90 Dec. 28.92960	1.9503637	0.4655654	6.97	355.57785	108.18334	20.55357	90 Dec. 15	42	1976 - 1984	ME-PL
35	91 Feb. 22.67740	1.3551155	0.6916097	9.21	84.84777	313.71777	9.24995	91 Mar. 05	47	1973 - 1982	ME-PL
36	91 Apr. 04.82921	1.6078356	0.5390504	6.51	186.97471	254.17122	18.47303	91 Apr. 14	73	1971 - 1985	ME-PL
37	91 Apr. 24.71262	2.4009095	0.5526613	12.4	134.14746	148.43988	6.61946	91 Apr. 14	99	1954 - 1979	ME-PL
38	91 Apr. 28.75213	1.7954501	0.4515362	5.92	179.47127	38.30062	25.56510	91 Apr. 14	11	85 Je 13-85 Au 14	ME-PL
39	91 May 26.02201	1.8500610	0.5370330	7.99	47.06857	355.49636	19.92887	91 May 24	56	1951 - 1976	ME-PL
40	91 July 06.92766	1.7743892	0.5404394	7.59	138.67541	336.63545	10.17657	91 July 03	23	1968 - 1984	ME-PL

No. Comet Name	Calculator	References	m.e.	H1	K1	H2	K2	Y/L	NG	Remarks
21 P/Kopff	Kobayashi T.	KC 29	1.19	3.0	26.0	13.5	10.0	88k	II	Also MPC 12123, HBAA 1989.
22 P/Tuttle-Giacobini-Kresák	Marsden B.G.	MPC 12135	1.9	10.0	40.0	18.0	5.0			Also HBAA 1989.
23 P/Sanguin	Green D.W.E.	MPC 12125	0.9	12.0	15.0	16.0	10.0			$\Delta P = \pm 1.8$ days, (NK 371).
24 P/Russell 3	Marsden B.G.	IAUC 4710	1.1	8.0	15.0	12.0	10.0	89d		Also MPC 14154.
25 P/Schwassmann-Wachmann 3	Landgraf W.	MPC 12122	1.4	12.0	15.0	15.0	10.0		II	Also HBAA 1989.
26 P/Peters-Hartley	Nakano S.	NK 503	0.99	12.0	15.0	16.0	10.0			$\Delta P = \pm 1.81$ days, HBAA 1989.
27 P/Russell 4	Marsden B.G.	MPC 12136	1.2	9.0	15.0	16.0	10.0			$\Delta P = \pm 0.47$ day (NK 468).
28 P/Tritton	Green D.W.E.	MPC 12125	0.9	12.5	15.0	16.5	10.0			$\Delta P = \pm 10.2$ days, HBAA 1990.
29 P/Honda-Mrkos-Pajdušáková	Nakano S.	MPC 12128	1.38	13.5	20.0	18.0	15.0		II	Also HBAA 1990.
30 P/Rucke	Nakano S.	NK 519	1.46	9.8	(*)	14.5	5.0		II	Also MPC 12577, HBAA 1989.
31 P/Johnson	Kobayashi T.	KC 31	1.07	7.5	15.0	13.0	10.0		II	Also MPC 12123, HBAA 1989.
32 P/Kearns-Kwee	Kobayashi T.	MPC 15215	1.15	7.5	15.0	11.5	10.0	89u		
33 P/Wild 2	Green D.W.E.	MPC 12125	0.9	6.5	15.0	13.0	10.0	89t		Also HBAA 1990.
34 P/Taylor	Marsden B.G.	MPC 12136	1.6	11.0	15.0	15.0	10.0			Also MPC 13045.
35 P/Swift-Gehrels	Nakano S.	NK 512	1.19	8.5	30.0	15.0	10.0			
36 P/Wolf-Harrington	Szutowicz S.	AA 37, 179	2.17	8.0	15.0	13.5	10.0		II	Also MPC 13057.
37 P/Van Biesbroeck	Marsden B.G.	MPC 13042	0.8	8.0	15.0	13.5	5.0			Another prediction on NK 518.
38 P/Hartley 1	Nakano S.	NK 505	0.59	13.0	15.0	17.0	10.0			$\Delta P = \pm 3.74$ days, MPC 13045.
39 P/Arend	Marsden B.G.	MPC 13042	1.3	9.5	15.0	15.0	10.0		II	
40 P/Harrington-Abell	Nakano S.	NK 516	1.17	13.5	15.0	16.0	5.0			Also MPC 13045.

No. T/ ET	q (AU)	e	P	Peri.	Node	Inc.	Epoch	Obs.	ΔT	Arc	Per.
41 91 July 22.01268	0.1255478	0.9583692	5.24	14.52911	93.82273	60.14704	91 July 03	73		86 My 13-89 Ap 06	ME-PL
42 91 Aug. 30.53152	1.4975172	0.5763206	6.65	22.75577	96.18457	10.50322	91 Aug. 12	86		1965 - 1985	ME-PL
43 91 Sept. 14.80058	2.8464260	0.2597138	7.54	26.52994	80.14554	3.19919	91 Sept. 21	8		77 Fe 13-77 Ma 12	ME-PL
44 91 Oct. 02.71803	1.4378217	0.6000520	6.82	329.05878	121.45197	17.88774	91 Sept. 21	89		1951 - 1986	ME-PL
45 91 Nov. 16.19368	1.5933855	0.5781845	7.34	203.95376	198.88006	9.09095	91 Oct. 31	82		1961 - 1985	ME-PL
46 91 Dec. 18.84531	1.9858468	0.4704026	7.26	18.78676	339.24824	26.23656	91 Dec. 10	65		84 Se 22-85 Fe 19	ME-PL
47 92 Jan. 27.82173	2.3563219	0.5937580	14.0	263.19695	129.74580	5.08240	92 Jan. 19	226		77 Au 19-78 De 03	ME-PL
48 92 Aug. 05.93495	3.5721440	0.1473143	8.57	88.93837	76.83822	6.62823	92 Aug. 06	139		1975 - 1987	ME-PL
49 93 July 25.43093	3.4269953	0.1507491	8.11	231.87839	242.33357	1.10252	93 Aug. 01	40		1975 - 1986	ME-PL

No. Comet Name	Calculator	References	m.e.	H1	K1	H2	K2	Y/L	NG	Remarks
41 P/Machholz	Green D.W.E.	MPC 14748	(1989)	0.9	13.0	12.0	14.5	5.0		
42 P/Tsuchinshan 1	Szutowicz S.	AA 36, 323	(1986)	1.63	12.0	15.0	16.0	10.0		
43 P/Skiff-Kosai	Nakano S.	NK 501	(1987)	0.30	8.5	15.0	12.0	10.0	II	Also MPC 13057.
44 P/Arend-Rigaux	Green D.W.E.	MPC 13040	(1988)	1.0	10.0	15.0	15.5	5.0		$\Delta P = \pm 1.56$ days.
45 P/Faye	Marsden B.G.	MPC 13042	(1988)	1.4	9.0	15.0	14.0	5.0	II	
46 P/Shoemaker 1	Nakano S.	NK 511	(1987)	1.11	8.0	15.0	12.0	10.0		$\Delta P = \pm 0.25$ day, Also MPC 13046
47 P/Chernykh	Nakano S.	NK 515	(1987)	1.22	7.0	15.0	11.0	10.0		$\Delta P = \pm 0.39$ day, Also MPC 14592
48 P/Smirnova-Chernykh	Nakano S.	NK 520	(1987)	1.20	5.0	15.0	10.0	10.0		Also MPC 14593.
49 P/Gehrels 3	Nakano S.	NK 494	(1986)	0.80	6.0	15.0	11.0	10.0		

Note 1: $m_1 = 9.8 + 5 \log(\delta) + 2.5(r_{12} - 1)$

INDEX TO EPHEMERIDES (comets listed alphabetically: long-period comets first, short-period comets second):

Bradfield 1987 XXIX	7	P/Harrington-Abell	42	P/Schwassmann-Wachmann 1	19
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P/Gehrels 3	51	P/Russell 3 (1989d)	26	P/Wolf-Harrington	40
P/Gunn	17	P/Russell 4	30		
P/Halley (1986 III)	6	P/Sanguin	25		

T/ET	Date/	Oh	ET	R.A. (1950)	Decl.	h^m	q (AU)	e	Peri.	P	Node	Inc.	Tail(AU)	Epoch
1986	Feb.	9	4445	0.580959	0.967583	75.9	111.6871	58.1277	162.2473	5.0				
$m1 = 5.5+5\log(\delta)+8.0\log(r)$ $m2 = 8.5+5\log(\delta)+10.0\log(r)$														
Date/	Oh	ET	R.A. (1950)	Decl.	h^m	q (AU)	e	Peri.	P	Node	Inc.	Tail(AU)	Epoch	
1989	Dec.	10	09 49.21	-06 10.3	09 51.22	-06 21.5	11.817	12.106	-0.19	-0.5	19.5 24.7	2.8/259	104.8	4.5 296/0.08 112 .90
		20	09 47.35	-06 15.8	09 49.36	-06 26.9	11.716	12.161	-0.24	-0.1	19.5 24.7	3.5/268	114.8	4.2 299/0.07 30 .50
1990	Jan.	30	09 44.97	-06 17.2	09 46.99	-06 28.4	11.629	12.216	-0.28	+0.3	19.5 24.7	4.2/274	124.7	3.8 304/0.06 144 .04
		9	09 42.15	-06 14.5	09 44.18	-06 25.6	11.560	12.270	-0.32	+0.7	19.5 24.7	4.8/278	134.6	3.3 310/0.06 73 .94
		19	09 38.98	-06 07.6	09 41.00	-06 18.6	11.514	12.324	-0.34	+1.1	19.5 24.7	5.2/282	144.0	2.7 318/0.05 61 .49
		29	09 35.54	-05 56.5	09 37.57	-06 07.4	11.496	12.378	-0.36	+1.5	19.5 24.7	5.5/286	152.6	2.1 332/0.04 161 .06
Feb.		8	09 31.98	-05 41.6	09 34.01	-05 52.5	11.507	12.432	-0.36	+1.8	19.6 24.8	5.6/289	158.9	1.6 354/0.03 37 .96
		18	09 28.41	-05 23.5	09 30.45	-05 34.2	11.549	12.486	-0.34	+2.1	19.6 24.8	5.5/292	160.6	1.5 26/0.03 93 .48
		28	09 24.97	-05 02.8	09 27.01	-05 13.5	11.623	12.539	-0.32	+2.2	19.6 24.8	5.3/295	156.8	1.8 55/0.03 130 .09
Mar.		10	09 21.78	-04 40.4	09 23.82	-04 50.9	11.727	12.593	-0.28	+2.3	19.6 24.8	4.9/299	149.5	2.3 73/0.04 19 .98
		20	09 18.93	-04 17.1	09 20.97	-04 27.5	11.859	12.646	-0.24	+2.3	19.7 24.9	4.3/303	140.8	2.9 84/0.05 126 .46
		30	09 16.51	-03 53.7	09 18.56	-04 04.1	12.016	12.699	-0.19	+2.3	19.7 24.9	3.7/308	131.4	3.4 91/0.06 91 .14
Apr.		9	09 14.58	-03 31.1	09 16.63	-03 41.3	12.194	12.752	-0.14	+2.1	19.8 25.0	3.0/315	121.9	3.8 96/0.06 45 .99
		19	09 13.17	-03 09.9	09 15.21	-03 20.1	12.389	12.804	-0.09	+1.9	19.8 25.0	2.3/325	112.4	4.2 100/0.07 156 .43
		29	09 12.28	-02 50.7	09 14.33	-03 00.8	12.595	12.857	-0.04	+1.7	19.9 25.1	1.8/342	102.9	4.4 104/0.07 53 .20
May		9	09 11.92	-02 33.9	09 13.97	-02 44.1	12.808	12.909	+0.01	+1.4	19.9 25.1	1.4/ 8	93.5	4.5 107/0.07 77 .99
		19	09 12.06	-02 19.9	09 14.11	-02 30.1	13.023	12.962	+0.06	+1.1	20.0 25.2	1.4/ 39	84.3	4.5 110/0.07 154 .37
		29	09 12.66	-02 08.9	09 14.72	-02 19.1	13.235	13.014	+0.10	+0.8	20.0 25.3	1.7/ 63	75.2	4.3 113/0.06 21 .26
June		8	09 13.69	-02 01.0	09 15.74	-02 11.2	13.440	13.065	+0.14	+0.5	25.3	2.1/ 77	66.3	4.1 116/0.06 108 1.00
		18	09 15.07	-01 56.2	09 17.12	-02 06.5	13.634	13.117	+0.17	+0.2	25.4	2.6/ 86	57.6	3.7 119/0.05 122 .30
		28	09 16.77	-01 54.6	09 18.82	-02 04.8	13.813	13.169	+0.20	-0.1	25.4	2.9/ 93	49.0	3.3 124/0.05 25 .31
July		8	09 18.72	-01 55.8	09 20.77	-02 06.2	13.974	13.220	+0.21	-0.4	25.4	3.2/ 97	40.7	2.9 129/0.04 138 1.00
		18	09 20.87	-01 59.9	09 22.92	-02 10.3	14.114	13.271	+0.23	-0.7	25.5	3.5/101	32.8	2.4 136/0.03 86 .22
		28	09 23.15	-02 06.6	09 25.20	-02 17.1	14.231	13.322	+0.24	-0.9	25.5	3.6/104	25.6	1.9 147/0.03 53 .35
Aug.		7	09 25.50	-02 15.7	09 27.55	-02 26.3	14.324	13.373	+0.24	-1.1	25.5	3.7/108	19.7	1.5 165/0.02 164 1.00
		17	09 27.87	-02 26.9	09 29.92	-02 37.5	14.391	13.424	+0.23	-1.3	25.6	3.7/111	16.6	1.2 192/0.02 50 .15
		27	09 30.19	-02 39.9	09 32.24	-02 50.6	14.432	13.475	+0.22	-1.4	25.6	3.6/114	17.9	1.3 223/0.02 82 .38
Sept.		6	09 32.41	-02 54.4	09 34.46	-03 05.2	14.447	13.525	+0.21	-1.6	25.6	3.5/117	23.0	1.7 245/0.02 149 .99
		16	09 34.46	-03 10.0	09 36.51	-03 20.9	14.437	13.575	+0.18	-1.6	25.6	3.2/121	30.0	2.1 258/0.03 19 .10
		26	09 36.30	-03 26.4	09 38.35	-03 37.3	14.403	13.626	+0.16	-1.7	25.6	2.9/126	37.9	2.6 267/0.04 111 .40
Oct.		6	09 37.86	-03 43.1	09 39.91	-03 54.1	14.346	13.676	+0.12	-1.7	25.6	2.5/132	46.4	3.0 273/0.04 115 .97
		16	09 39.09	-03 59.7	09 41.14	-04 10.7	14.270	13.726	+0.09	-1.6	25.6	2.0/141	55.2	3.4 278/0.05 27 .07
		26	09 39.94	-04 15.6	09 42.00	-04 26.7	14.178	13.775	+0.04	-1.5	25.6	1.6/156	64.3	3.7 281/0.05 140 .42
Nov.		5	09 40.38	-04 30.5	09 42.44	-04 41.7	14.072	13.825	0.00	-1.3	25.6	1.3/181	73.6	3.9 285/0.06 79 .93
		15	09 40.37	-04 43.9	09 42.43	-04 55.0	13.958	13.874	-0.05	-1.1	25.6	1.3/213	83.1	4.1 288/0.06 57 .05
		25	09 39.88	-04 55.2	09 41.94	-05 06.3	13.841	13.924	-0.10	-0.9	25.6	1.7/239	92.8	4.1 291/0.06 164 .44
Dec.		5	09 38.90	-05 04.0	09 40.97	-05 15.1	13.725	13.973	-0.14	-0.6	25.6	2.2/255	102.6	3.9 294/0.06 42 .90
		15	09 37.46	-05 09.8	09 39.53	-05 21.0	13.617	14.022	-0.19	-0.3	25.6	2.8/265	112.4	3.7 298/0.05 89 .04
		25	09 35.57	-05 12.4	09 37.65	-05 23.5	13.520	14.071	-0.23	+0.1	25.6	3.4/271	122.3	3.4 302/0.05 145 .49
1991	Jan.	4	09 33.28	-05 11.5	09 35.36	-05 22.6	13.441	14.120	-0.26	+0.4	25.6	3.9/276	132.1	3.0 308/0.04 16 .86
		14	09 30.66	-05 07.0	09 32.75	-05 18.1	13.383	14.168	-0.29	+0.8	25.6	4.4/281	141.7	2.5 315/0.04 122 .04
		24	09 27.79	-04 59.0	09 29.88	-05 10.6	13.352	14.217	-0.30	+1.1	25.7	4.6/284	150.5	2.0 327/0.03 108 .54
Feb.		3	09 24.77	-04 47.8	09 26.87	-04 58.6	13.349	14.265	-0.31	+1.4	25.7	4.8/287	157.6	1.5 346/0.02 39 .83
		13	09 21.71	-04 33.6	09 23.81	-04 44.3	13.376	14.313	-0.30	+1.7	25.7	4.8/290	161.0	1.3 15/0.02 153 .03

P/Parker-Hartley 1989i Orbit by Nakano S. NK 531 (1989)

T/ET	1987 Aug.	17.5378	q (AU)	3.027340	e	0.292338	P	8.85	Peri.	181.3804	Node	Inc.	5.1931	Tail(AU)	0.200	Epoch	1987 Sep.	2.0
Date/ Oh ET	R.A.(1950)	Decl.	h	m	s	R.A.(App.)	Decl.	h	m	s	Daily motion	Magnitude	Mot./PA	Elong.	P	PA/Tail	Moon Age	
m1 = 9.5+5log(delta)+10.0log(r)																		
1990 Jan.	19	13 28.84	-13 43.0	13	30.99	-13 55.5	4.639	4.783	+0.20	-1.7	19.6	21.5	3.4/121	92.5	11.9	292/0.49	4	.49
29	13 30.83	-14 00.4	13	32.98	-14 12.8	4.500	4.803	4.803	+0.06	-1.0	19.6	21.5	1.3/136	102.1	11.6	292/0.49	130	.06
Feb.	8	13 31.46	-14 09.9	13	33.63	-14 22.4	4.366	4.822	-0.07	-0.1	19.5	21.4	1.1/264	112.0	10.9	293/0.48	90	.96
18	13 30.72	-14 11.1	13	32.89	-14 23.6	4.242	4.842	-0.21	+0.8	19.5	21.4	3.2/284	122.2	9.9	294/0.45	35	.48	
28	13 28.61	-14 03.5	13	30.78	-14 16.1	4.134	4.861	-0.34	+1.6	19.4	21.4	5.2/288	132.7	8.6	296/0.40	169	.09	
Mar.	10	13 25.25	-13 47.4	13	27.42	-14 00.1	4.045	4.879	-0.44	+2.4	19.4	21.4	6.9/290	143.5	6.9	298/0.33	53	.98
20	13 20.85	-13 23.3	13	23.01	-13 36.1	3.980	4.898	-0.51	+3.1	19.4	21.3	8.1/292	154.5	5.0	302/0.24	70	.46	
30	13 15.70	-12 52.5	13	17.86	-13 05.4	3.943	4.916	-0.55	+3.6	19.4	21.4	8.8/294	165.4	2.9	310/0.14	149	.14	
Apr.	9	13 10.18	-12 16.7	13	12.33	-12 29.8	3.936	4.934	-0.55	+3.8	19.4	21.4	8.9/295	174.9	1.0	353/0.05	15	.99
19	13 04.69	-11 38.5	13	06.84	-11 51.6	3.959	4.952	-0.51	+3.8	19.4	21.4	8.4/297	170.2	2.0	86/0.09	107	.43	
29	12 59.61	-11 00.3	13	01.76	-11 13.5	4.013	4.970	-0.43	+3.6	19.5	21.5	7.3/299	159.7	4.0	101/0.19	106	.20	
May	9	12 55.29	-10 24.7	12	57.43	-10 38.0	4.095	4.987	-0.33	+3.1	19.5	21.5	5.8/302	148.9	6.0	106/0.28	22	.99
19	12 51.96	-09 53.9	12	54.09	-10 07.2	4.202	5.004	-0.22	+2.5	19.6	21.6	4.0/307	138.4	7.7	108/0.35	147	.37	
29	12 49.79	-09 29.4	12	51.92	-09 42.7	4.330	5.021	-0.09	+1.7	19.7	21.7	2.2/321	128.2	9.1	110/0.40	66	.26	
June	8	12 48.85	-09 12.2	12	50.97	-09 25.6	4.475	5.037	+0.03	+0.9	19.8	21.8	1.0/24	118.4	10.2	111/0.43	57	1.00
18	12 49.14	-09 02.8	12	51.26	-09 16.1	4.633	5.053	+0.15	+0.2	19.9	21.9	2.2/86	108.8	11.0	112/0.45	175	.30	
28	12 50.62	-09 01.1	12	52.74	-09 14.4	4.799	5.069	+0.26	-0.6	20.0	22.0	3.9/99	99.6	11.4	112/0.45	31	.31	
July	8	12 53.20	-09 06.8	12	55.33	-09 20.1	4.969	5.085	+0.36	-1.3	20.0	22.1	5.5/103	90.7	11.5	113/0.44	89	1.00

Bradfield 1987 XXIX 1987s Orbit by Kobayashi T. MPC 14903 (1989)

T/ET	1987 Nov.	7.2741	q (AU)	0.868956	e	0.994736	P	Peri.	Node	Inc.	Tail(AU)	Epoch					
								73.9110	267.3848	34.0879	0.200	1987 Nov. 21.0					
m1 = 5.7+5log(delta)+ 6.2log(r)																	
Date/ Oh ET	R.A.(1950)	Decl.	h	m	s	R.A.(App.)	Decl.	h	m	s	Daily motion	Magnitude	Mot./PA	Elong.	P	PA/Tail	Moon Age
m2 = 10.0+5log(delta)+ 5.0log(r)+0.03(phase)																	
1989 Dec.	10	08 06.86	-01 36.3	08 08.91	-01 43.3	7.694	8.354	-0.36	- 1.1	15.8	19.2	5.6/258	129.4	5.2	302/0.13	86	.90
	20	08 03.22	-01 47.6	08 05.27	-01 54.4	7.667	8.432	-0.41	- 0.6	15.9	19.2	6.2/265	138.8	4.4	310/0.11	56	.50
	30	07 59.09	-01 53.2	08 01.15	-01 59.8	7.666	8.510	-0.44	0.0	15.9	19.2	6.6/270	147.4	3.6	322/0.09	156	.04
1990 Jan.	9	07 54.68	-01 53.0	07 56.74	-01 59.4	7.692	8.588	-0.45	+ 0.6	15.9	19.2	6.8/275	154.2	2.9	340/0.07	49	.94
	19	07 50.18	-01 47.2	07 52.24	-01 53.4	7.748	8.665	-0.44	+ 1.1	16.0	19.2	6.7/279	157.5	2.5	7/0.06	88	.49
	29	07 45.80	-01 36.4	07 47.86	-01 42.4	7.835	8.742	-0.41	+ 1.5	16.0	19.3	6.3/284	155.7	2.7	35/0.07	138	.06
Feb.	8	07 41.74	-01 21.4	07 43.80	-01 27.2	7.952	8.819	-0.36	+ 1.8	16.1	19.3	5.7/289	149.9	3.2	56/0.08	24	.96
	18	07 38.16	-01 03.2	07 40.23	-01 08.9	8.097	8.895	-0.30	+ 2.0	16.1	19.4	4.9/295	141.8	3.9	69/0.09	119	.48
	28	07 35.20	-00 42.9	07 37.28	-00 48.4	8.268	8.971	-0.22	+ 2.1	16.2	19.5	4.0/302	132.9	4.6	78/0.11	102	.09
Mar.	10	07 32.96	-00 21.6	07 35.04	-00 27.0	8.460	9.047	-0.15	+ 2.1	16.3	19.6	3.1/314	123.6	5.2	84/0.12	41	.98
	20	07 31.47	-00 00.3	07 33.55	-00 05.6	8.669	9.122	-0.07	+ 2.0	16.3	19.7	2.3/332	114.2	5.7	89/0.13	148	.46
	30	07 30.76	+00 20.1	07 32.84	+00 14.8	8.891	9.197	0.00	+ 1.9	16.4	19.7	1.9/ 2	104.9	6.0	94/0.13	65	.14
Apr.	9	07 30.79	+00 38.8	07 32.88	+00 33.5	9.120	9.272	+0.07	+ 1.6	16.5	19.8	2.0/ 34	95.7	6.2	97/0.13	72	.99
	19	07 31.54	+00 55.3	07 33.63	+00 49.9	9.352	9.347	+0.14	+ 1.4	16.6	19.9	2.5/ 57	86.7	6.2	101/0.13	156	.43
	29	07 32.93	+01 09.0	07 35.02	+01 03.6	9.582	9.421	+0.20	+ 1.1	16.6	20.0	3.1/ 70	77.8	6.0	104/0.12	33	.20
May	9	07 34.91	+01 19.5	07 37.00	+01 14.0	9.807	9.495	+0.25	+ 0.7	16.7	20.0	3.8/ 79	69.2	5.7	108/0.11	101	.99
	19	07 37.39	+01 26.8	07 39.48	+01 21.2	10.021	9.569	+0.29	+ 0.4	16.8	20.1	4.4/ 85	60.8	5.3	112/0.10	132	.37
	29	07 40.29	+01 30.7	07 42.38	+01 24.9	10.224	9.642	+0.32	0.0	16.8	20.1	4.9/ 90	52.7	4.8	116/0.09	23	.26

T/ET	q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch								
1987 Aug. 30.4845	2.071433	0.398422	6.39	357.8859	125.6602	3.7558	0.200	1987 Sep. 2.0								
m1 = 7.6+5log(delta)+10.0log(r)																
m2 = 14.0+5log(delta)+10.0log(r)																
Date/	Oh	ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	Delta	r	Daily motion	Magnitude	Mot./PA	Elong.	P	PA/Tail	Moon Age	
			h^m	$^{\circ}$	h^m	$^{\circ}$			$\frac{m}{m}$	$\frac{ml}{ml}$						
1989 Dec.	10	18	20.07	-21 56.0	18 22.46	-21 54.9	5.463	4.533	+1.06	+0.4	17.9 24.3	14.7/ 89	3.7	83/0.13	126 .90	
	20	18	30.65	-21 52.4	18 33.04	-21 50.7	5.516	4.550	+1.06	+0.7	17.9 24.3	14.8/ 88	2.1	79/0.07	99 .50	
	30	18	41.27	-21 45.7	18 43.66	-21 43.4	5.548	4.566	+1.06	+1.0	17.9 24.3	14.8/ 87	2.3	50/0.02	21 .04	
1990 Jan.	9	18	51.84	-21 36.1	18 54.22	-21 33.2	5.559	4.582	+1.04	+1.2	17.9 24.3	14.6/ 86	1.3	277/0.04	157 .94	
	19	19	02.24	-21 23.8	19 04.62	-21 20.2	5.547	4.597	+1.01	+1.5	17.9 24.3	14.2/ 85	2.3	269/0.10	75 .49	
	29	19	12.37	-21 09.0	19 14.75	-21 04.9	5.515	4.612	+0.98	+1.7	17.9 24.3	13.8/ 83	4.5	266/0.16	50 .06	
Feb.	8	19	22.14	-20 52.4	19 24.50	-20 47.7	5.462	4.627	+0.93	+1.8	17.9 24.3	13.2/ 82	29.3	6.0	264/0.21	172 .96
	18	19	31.42	-20 34.3	19 33.78	-20 29.1	5.389	4.640	+0.87	+1.9	17.9 24.3	12.4/ 82	37.2	7.4	263/0.26	50 .48
	28	19	40.13	-20 15.3	19 42.49	-20 09.7	5.299	4.654	+0.80	+1.9	17.9 24.3	11.5/ 81	45.2	8.7	261/0.31	81 .09
Mar.	10	19	48.15	-19 56.2	19 50.50	-19 50.1	5.192	4.667	+0.72	+1.9	17.9 24.3	10.4/ 80	53.3	9.8	260/0.36	143 .98
	20	19	55.37	-19 37.6	19 57.72	-19 31.2	5.071	4.679	+0.63	+1.7	17.8 24.2	9.1/ 79	61.5	10.8	260/0.41	24 .46
	30	20	01.69	-19 20.4	20 04.02	-19 13.6	4.939	4.691	+0.53	+1.5	17.8 24.2	7.6/ 79	69.9	11.5	259/0.45	115 .14
	9	20	06.96	-19 05.3	20 09.30	-18 58.3	4.798	4.702	+0.41	+1.2	17.7 24.1	6.0/ 78	78.5	12.0	258/0.48	114 .99
Apr.	19	20	11.10	-18 53.2	20 13.44	-18 45.9	4.652	4.713	+0.29	+0.8	17.7 24.1	4.2/ 78	87.3	12.3	258/0.50	6 .43
	29	20	13.98	-18 44.7	20 16.32	-18 37.3	4.504	4.723	+0.15	+0.4	17.6 24.0	2.2/ 79	96.4	12.2	257/0.52	150 .20
	9	20	15.49	-18 40.6	20 17.83	-18 33.1	4.359	4.733	+0.01	-0.1	17.5 23.9	0.1/121	105.7	11.8	257/0.52	83 .99
May	19	20	15.57	-18 41.3	20 17.92	-18 33.7	4.221	4.742	-0.14	-0.6	17.5 23.9	2.1/254	115.3	11.1	257/0.50	40 .37
	29	20	14.17	-18 47.0	20 16.52	-18 39.5	4.093	4.751	-0.29	-1.1	17.4 23.8	4.2/255	125.3	10.0	257/0.47	173 .26
	8	20	11.29	-18 57.6	20 13.66	-18 50.2	3.981	4.759	-0.42	-1.5	17.4 23.8	6.2/256	135.5	8.6	256/0.41	49 1.00
June	18	20	07.06	-19 12.6	20 09.44	-19 05.4	3.890	4.767	-0.54	-1.8	17.3 23.7	7.9/256	146.1	6.8	256/0.33	80 .30
	28	20	01.66	-19 31.1	20 04.05	-19 24.1	3.822	4.774	-0.63	-2.1	17.3 23.7	9.1/257	157.0	4.8	256/0.24	135 .31
	8	19	55.39	-19 51.8	19 57.79	-19 45.2	3.782	4.781	-0.67	-2.2	17.3 23.7	9.8/257	168.0	2.5	255/0.13	12 1.00
	18	19	48.64	-20 13.3	19 51.05	-20 07.0	3.771	4.787	-0.68	-2.1	17.3 23.7	9.8/257	178.8	0.2	212/0.01	123 .22
	28	19	41.85	-20 34.2	19 44.27	-20 28.3	3.790	4.793	-0.64	-1.9	17.3 23.7	9.1/258	169.6	2.2	84/0.11	97 .35
	7	19	35.48	-20 53.4	19 37.92	-20 47.9	3.840	4.798	-0.55	-1.7	17.3 23.7	7.9/258	158.5	4.4	83/0.22	27 1.00
	17	19	29.94	-21 10.0	19 32.39	-21 04.8	3.917	4.802	-0.44	-1.4	17.4 23.8	6.3/257	147.6	6.5	82/0.31	167 .15
Aug.	27	19	25.56	-21 23.7	19 28.01	-21 18.7	4.019	4.807	-0.30	-1.0	17.4 23.8	4.3/256	136.9	8.3	82/0.39	61 .38
	6	19	22.56	-21 34.0	19 25.01	-21 29.2	4.141	4.810	-0.15	-0.7	17.5 23.9	2.2/251	126.5	9.7	82/0.44	66 .99
	16	19	21.06	-21 41.2	19 23.51	-21 36.4	4.280	4.813	0.00	-0.4	17.6 24.0	0.4/175	116.5	10.8	82/0.48	153 .10
Sept.	26	19	21.08	-21 45.1	19 23.53	-21 40.4	4.431	4.816	+0.15	-0.1	17.7 24.1	2.1/ 92	106.7	11.5	82/0.49	28 .40
Oct.	6	19	22.59	-21 46.0	19 25.03	-21 41.1	4.590	4.818	+0.29	+0.2	17.7 24.1	4.0/ 87	97.2	11.9	82/0.49	104 .97
	16	19	25.48	-21 43.7	19 27.92	-21 38.7	4.751	4.820	+0.42	+0.5	17.8 24.2	5.8/ 85	88.0	11.9	82/0.48	118 .07
	26	19	29.65	-21 38.3	19 32.08	-21 33.1	4.911	4.821	+0.53	+0.9	17.9 24.3	7.4/ 84	79.0	11.7	81/0.45	2 .42
Nov.	5	19	34.95	-21 29.7	19 37.38	-21 24.2	5.065	4.821	+0.63	+1.2	18.0 24.4	8.9/ 83	70.3	11.2	81/0.42	140 .93
	15	19	41.23	-21 18.0	19 43.65	-21 12.1	5.211	4.822	+0.71	+1.5	18.0 24.4	10.1/ 82	61.7	10.4	80/0.38	87 .05
	25	19	48.37	-21 02.9	19 50.77	-20 56.7	5.346	4.821	+0.78	+1.8	18.1 24.5	11.1/ 81	53.3	9.4	80/0.34	31 .44
Dec.	5	19	56.20	-20 44.6	19 58.59	-20 38.0	5.465	4.820	+0.84	+2.1	18.1 24.5	12.0/ 80	45.0	8.3	79/0.29	173 .90
	15	20	04.60	-20 23.1	20 06.98	-20 16.1	5.570	4.819	+0.88	+2.5	18.2 24.6	12.7/ 79	36.8	7.0	78/0.24	60 .04
	25	20	13.45	-19 58.5	20 15.82	-19 51.0	5.656	4.817	+0.92	+2.8	18.2 24.6	13.2/ 78	28.8	5.6	77/0.19	60 .49
1991 Jan.	4	20	22.61	-19 31.0	20 24.97	-19 23.0	5.721	4.814	+0.94	+3.0	18.2 24.6	13.6/ 78	20.8	4.2	77/0.14	156 .86
	14	20	31.99	-19 00.8	20 34.34	-18 52.3	5.765	4.811	+0.95	+3.3	18.2 24.6	13.9/ 77	12.9	2.6	76/0.09	34 .04
	24	20	41.48	-18 28.2	20 43.82	-18 19.3	5.788	4.808	+0.95	+3.5	18.2 24.6	14.0/ 76	5.0	1.0	77/0.03	91 .54
	3	20	50.98	-17 53.6	20 53.30	-17 44.3	5.788	4.804	+0.94	+3.6	18.2 24.6	13.9/ 75	2.8	0.6	250/0.02	128 .83
Feb.	13	21	00.39	-17 17.5	21 02.69	-17 07.8	5.766	4.800	+0.92	+3.7	18.2 24.6	13.8/ 75	10.6	2.2	252/0.07	9 .03

T/ET	1988 May	9.9899	q (AU)	1.869307	e	0.503008	P	7.29	Peri.	13.0188	Node	119.1478	Inc.	8.1385	Tail(AU)	Epoch	1988 Apr. 29.0		
Date/ Oh ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	h	m	Delta	r	Daily motion	m	motion	Magnitude	m1	m2	Mot./PA	Elong.	P	PA/Tail	Moon Age
1990 Apr.	9	19 14.63	-18 55.1	19 17.00	-18 50.8		4.575	4.695	+0.21	+ 0.5		22.0			3.0/ 81	90.7	12.3	263/0.51	102
	19	19 16.73	-18 50.1	19 19.10	-18 45.7		4.448	4.726	+0.06	+ 0.2		22.0			0.9/ 77	99.9	12.1	262/0.52	19
May	29	19 17.37	-18 48.1	19 19.74	-18 43.6		4.324	4.757	-0.09	- 0.1		21.9			1.2/264	109.5	11.5	261/0.51	162
	9	19 16.49	-18 49.3	19 18.87	-18 44.8		4.209	4.786	-0.24	- 0.5		21.8			3.4/262	119.4	10.6	261/0.48	69
	19	19 14.12	-18 53.9	19 16.51	-18 49.6		4.107	4.816	-0.38	- 0.8		21.8			5.4/261	129.6	9.3	260/0.43	55
June	29	19 10.33	-19 01.8	19 12.72	-18 57.7		4.023	4.845	-0.50	- 1.1		21.7			7.2/261	140.1	7.7	259/0.36	157
	8	19 05.29	-19 12.7	19 07.69	-19 08.9		3.962	4.873	-0.60	- 1.3		21.6			8.6/261	150.8	5.8	258/0.28	34
	18	18 59.27	-19 25.8	19 01.69	-19 22.3		3.926	4.900	-0.66	- 1.5		21.5			9.5/261	161.7	3.7	254/0.18	96
	28	18 52.64	-19 40.4	18 55.06	-19 37.2		3.918	4.928	-0.68	- 1.5		21.5			9.8/261	172.4	1.6	240/0.08	119
July	8	18 45.81	-19 55.6	18 48.25	-19 52.8		3.941	4.954	-0.66	- 1.5		21.6			9.4/260	174.7	1.1	121/0.05	7
	18	18 39.23	-20 10.7	18 41.67	-20 08.4		3.994	4.981	-0.59	- 1.5		21.6			8.5/260	164.4	3.2	97/0.15	139
	28	18 33.30	-20 25.3	18 35.75	-20 23.3		4.076	5.006	-0.49	- 1.4		21.7			7.1/259	153.6	5.2	92/0.24	81
Aug.	7	18 28.36	-20 39.0	18 30.82	-20 37.3		4.185	5.031	-0.37	- 1.3		21.8			5.3/256	142.9	7.0	91/0.32	42
	17	18 24.66	-20 51.7	18 27.12	-20 50.2		4.317	5.056	-0.23	- 1.2		21.9			3.4/250	132.4	8.5	90/0.38	174
	27	18 22.34	-21 03.3	18 24.80	-21 02.0		4.468	5.080	-0.09	- 1.1		22.1			1.6/229	122.3	9.7	89/0.41	47
Sept.	6	18 21.47	-21 13.9	18 23.93	-21 12.6		4.634	5.104	+0.05	- 0.9		22.2			1.2/141	112.4	10.5	89/0.43	80
	16	18 22.02	-21 23.2	18 24.48	-21 21.9		4.809	5.127	+0.19	- 0.8		22.3			2.8/107	102.8	11.0	88/0.44	139
	26	18 23.93	-21 31.3	18 26.39	-21 29.9		4.990	5.149	+0.32	- 0.7		22.4			4.5/ 99	93.5	11.2	88/0.43	16

$$m_2 = 15.0 + 5 \log(\delta) + 5.0 \log(r) + 0.03(\text{phase})$$

P/Shoemaker-Holt 1 1987z Orbit by Green D.W.E. MPC 13460 (1988)

T/ET	1988 May	21.4187	q (AU)	3.052833	e	0.322044	P	9.56	Peri.	210.4295	Node	213.8258	Inc.	4.3681	Tail(AU)	0.200	Epoch	1988 June	8.0
Date/ Oh ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	h	m	Delta	r	Daily motion	m	motion	Magnitude	m1	m2	Mot./PA	Elong.	P	PA/Tail	Moon Age
$m1 = 8.5+5\log(\delta)+10.0\log(r)$ $m2 = 14.0+5\log(\delta)+5.0\log(r)+0.03(\text{phase})$																			
1989 Dec.	20	11 34.18	-01 09.6	11 36.24	-01 23.0		4.020	4.188	+0.25	- 2.2	17.7	20.5	4.3/120	93.0	13.6	294/0.64	4	.50	
30	11 36.68	-01 31.5	11 38.75	-01 44.9			3.893	4.216	+0.10	- 1.2	17.7	20.5	2.0/128	102.4	13.2	294/0.64	125	.04	
1990 Jan.	9	11 37.72	-01 43.8	11 39.78	-01 57.2		3.771	4.243	-0.05	- 0.2	17.7	20.4	0.8/254	112.3	12.4	295/0.62	97	.94	
19	11 37.23	-01 45.9	11 39.31	-01 59.3			3.660	4.270	-0.20	+ 0.9	17.6	20.3	3.1/286	122.5	11.2	296/0.58	34	.49	
29	11 35.25	-01 37.3	11 37.33	-01 50.8			3.563	4.297	-0.34	+ 1.9	17.6	20.2	5.4/290	133.2	9.6	297/0.51	161	.06	
Feb.	8	11 31.88	-01 18.5	11 33.97	-01 32.0		3.486	4.324	-0.45	+ 2.8	17.6	20.1	7.3/292	144.1	7.7	299/0.42	58	.96	
18	11 27.37	-00 50.5	11 29.46	-01 04.0			3.433	4.351	-0.53	+ 3.5	17.6	20.0	8.7/294	155.4	5.4	302/0.30	68	.48	
28	11 22.04	-00 15.1	11 24.13	-00 28.6			3.408	4.377	-0.57	+ 4.0	17.6	20.0	9.5/295	166.6	3.0	310/0.17	157	.09	
Mar.	10	11 16.32	+00 24.9	11 18.41	+00 11.5		3.413	4.404	-0.56	+ 4.2	17.6	19.9	8.4/296	175.9	0.9	6/0.05	18	.98	
20	11 10.69	+01 06.6	11 12.78	+00 53.2			3.449	4.430	-0.51	+ 4.0	17.7	20.0	8.7/298	169.0	2.5	93/0.13	105	.46	
30	11 05.58	+01 46.8	11 07.68	+01 33.5			3.515	4.456	-0.42	+ 3.6	17.7	20.1	7.3/300	158.0	4.8	104/0.26	114	.14	
Apr.	9	11 01.37	+02 22.7	11 03.47	+02 09.5		3.609	4.483	-0.30	+ 3.0	17.8	20.3	5.4/303	147.1	7.0	107/0.37	21	.99	
19	10 58.33	+02 52.2	11 00.43	+02 39.1			3.727	4.509	-0.17	+ 2.2	17.9	20.4	3.4/310	136.5	8.8	109/0.45	142	.43	
29	10 56.61	+03 14.0	10 58.71	+03 00.9			3.866	4.534	-0.03	+ 1.3	18.0	20.5	1.4/339	126.2	10.3	110/0.51	72	.20	
May	9	10 56.26	+03 27.3	10 58.36	+03 14.2		4.021	4.560	+0.10	+ 0.5	18.1	20.7	1.6/ 72	116.4	11.4	111/0.54	55	.99	
19	10 57.25	+03 32.1	10 59.35	+03 19.0			4.187	4.586	+0.22	- 0.4	18.2	20.8	3.4/ 96	107.0	12.2	112/0.55	178	.37	
29	10 59.49	+03 28.6	11 01.59	+03 15.4			4.361	4.611	+0.34	- 1.1	18.3	20.9	5.2/103	97.9	12.6	112/0.55	36	.26	
June	8	11 02.89	+03 17.2	11 04.99	+03 04.0		4.538	4.636	+0.44	- 1.9	18.4	21.0	6.9/106	89.2	12.6	113/0.53	86	1.00	

$$m_1 = 8.5 + 5 \log(\delta) + 10.0 \log(r)$$

$$m_2 = 14.0 + 5 \log(\delta) + 5.0 \log(r) + 0.03(\text{phase})$$

T/ET	Date/	Oh	ET	R.A. (1950)	Decl.	R.A. (App.)	Decl.	Delta	r	Daily motion	Magnitude	Mot./PA	Elong.	P	PA/Tail	Moon Age
1988 Oct. 12.1979				h	m	h	m			m	m ¹		°			
				q (AU)	e	P	Peri.	Node	Inc.	Tail (AU)	Epoch					
				2.408876	0.341420	7.00	195.6958	15.0024	24.3864	0.200	1988 Oct. 6.0					
				m1 = 11.0+5log(delta)+10.0log(r)												
				m2 = 15.0+5log(delta)+ 5.0log(r)+0.03(phase)												
1989 Dec.	10	20	27.65	-38 12.2	20 30.25	-38 04.3	4.033	3.418	+1.48	+ 8.6	19.4 21.1	19.6/ 65	45.6	11.9	95/0.56	102 .90
	20	20	42.49	-36 46.1	20 45.03	-36 37.5	4.153	3.450	+1.48	+ 8.6	19.5 21.1	19.9/ 65	39.4	10.4	97/0.48	122 .50
	30	20	57.26	-35 19.8	20 59.75	-35 10.6	4.261	3.482	+1.46	+ 8.6	19.6 21.1	20.0/ 66	33.4	8.9	101/0.40	17 .04
1990 Jan.	9	21	11.87	-33 53.6	21 14.31	-33 43.8	4.355	3.514	+1.44	+ 8.6	19.7 21.1	20.0/ 66	27.6	7.5	107/0.33	129 .94
	19	21	26.24	-32 27.8	21 28.64	-32 17.4	4.435	3.546	+1.41	+ 8.5	19.7 21.2	19.9/ 66	22.5	6.1	117/0.26	102 .49
	29	21	40.34	-31 02.7	21 42.69	-30 51.8	4.499	3.577	+1.38	+ 8.4	19.8 21.2	19.7/ 66	18.3	5.0	131/0.21	26 .06
Feb.	8	21	54.10	-29 38.8	21 56.41	-29 27.5	4.546	3.608	+1.34	+ 8.2	19.9 21.2	19.4/ 66	16.0	4.3	152/0.18	153 .96
	18	22	07.46	-28 16.7	22 09.74	-28 04.9	4.577	3.639	+1.29	+ 8.0	19.9 21.2	19.0/ 66	16.3	4.4	176/0.18	81 .48
	28	22	20.41	-26 56.8	22 22.65	-26 44.7	4.591	3.670	+1.25	+ 7.7	20.0 21.3	18.4/ 66	19.2	5.1	195/0.21	51 .09
Mar.	10	22	32.88	-25 40.0	22 35.09	-25 27.5	4.588	3.701	+1.20	+ 7.3	20.0 21.3	17.8/ 66	23.8	6.2	209/0.26	163 .98
	20	22	44.84	-24 26.6	22 47.02	-24 13.9	4.568	3.731	+1.14	+ 6.9	20.0 21.4	17.1/ 67	29.2	7.5	218/0.31	60 .46
	30	22	56.24	-23 17.5	22 58.40	-23 04.6	4.531	3.761	+1.08	+ 6.4	20.0 21.4	16.2/ 67	35.3	8.8	224/0.37	79 .14
Apr.	9	23	07.03	-22 13.4	23 09.17	-22 00.3	4.479	3.790	+1.01	+ 5.9	20.0 21.5	15.3/ 68	41.7	10.1	229/0.43	147 .99
	19	23	17.14	-21 14.9	23 19.27	-21 01.7	4.413	3.820	+0.94	+ 5.2	20.0 21.5	14.1/ 69	48.3	11.3	232/0.49	37 .43
	29	23	26.51	-20 22.8	23 28.62	-20 09.4	4.333	3.849	+0.85	+ 4.5	20.0 21.5	12.9/ 70	55.2	12.4	235/0.54	108 .20
May	9	23	35.05	-19 37.8	23 37.15	-19 24.3	4.241	3.877	+0.76	+ 3.7	20.0 21.5	11.4/ 71	62.4	13.3	237/0.60	124 .99
	19	23	42.68	-19 00.5	23 44.77	-18 46.9	4.139	3.906	+0.66	+ 2.9	20.0 21.5	9.8/ 73	69.7	14.1	240/0.64	19 .37
	29	23	49.27	-18 31.6	23 51.36	-18 18.0	4.030	3.934	+0.54	+ 2.0	20.0 21.4	8.0/ 76	77.3	14.6	242/0.68	136 .26
June	8	23	54.71	-18 11.8	23 56.79	-17 58.2	3.914	3.961	+0.42	+ 1.0	19.9 21.4	6.0/ 80	85.2	14.8	244/0.71	98 1.00
	18	23	58.86	-18 01.3	00 00.94	-17 47.6	3.797	3.989	+0.27	+ 0.1	19.9 21.3	3.9/ 89	93.4	14.7	247/0.73	35 .30
	28	00	01.58	-18 00.4	00 03.67	-17 46.7	3.680	4.016	+0.12	- 0.8	19.9 21.3	1.9/117	102.0	14.3	249/0.73	158 .31
July	8	00	02.74	-18 08.8	00 04.83	-17 55.1	3.567	4.042	-0.05	- 1.7	19.8 21.2	1.8/203	110.9	13.6	252/0.72	69 1.00
	18	00	02.24	-18 25.7	00 04.34	-18 11.9	3.463	4.069	-0.22	- 2.4	19.8 21.1	4.0/233	120.1	12.5	256/0.68	69 .22
	28	00	00.01	-18 49.8	00 02.12	-18 36.0	3.372	4.095	-0.39	- 2.9	19.8 21.0	6.3/242	129.6	11.0	260/0.61	147 .35
Aug.	7	23	56.08	-19 18.6	23 58.20	-19 04.8	3.298	4.120	-0.55	- 3.1	19.7 20.9	8.3/248	139.3	9.2	267/0.53	37 1.00
	17	23	50.59	-19 49.2	23 52.72	-19 35.4	3.246	4.145	-0.68	- 2.9	19.7 20.9	10.0/253	148.8	7.3	276/0.42	108 .15
	27	23	43.82	-20 18.2	23 45.96	-20 04.4	3.219	4.170	-0.76	- 2.4	19.7 20.8	11.0/257	157.4	5.3	293/0.31	116 .38
Sept.	6	23	36.19	-20 41.7	23 38.34	-20 28.0	3.220	4.194	-0.80	- 1.5	19.8 20.8	11.3/262	163.0	4.0	323/0.23	22 .99
	16	23	28.22	-20 56.6	23 30.39	-20 43.0	3.250	4.218	-0.77	- 0.4	19.8 20.8	10.8/268	162.1	4.2	3/0.24	147 .10
	26	23	20.49	-21 00.6	23 22.67	-20 47.0	3.310	4.242	-0.70	+ 0.8	19.9 20.9	9.8/274	155.3	5.7	29/0.32	81 .40
Oct.	6	23	13.52	-20 52.6	23 15.72	-20 39.1	3.398	4.265	-0.58	+ 2.0	20.0 21.0	8.3/284	146.2	7.5	43/0.42	55 .97
	16	23	07.76	-20 32.6	23 09.96	-20 19.2	3.512	4.288	-0.43	+ 3.1	21.2	6.8/297	136.3	9.2	52/0.50	159 .07
	26	23	03.47	-20 01.6	23 05.68	-19 48.3	3.647	4.311	-0.26	+ 4.1	21.3	5.5/317	126.3	10.7	57/0.55	47 .42
Nov.	5	23	00.82	-19 21.0	23 03.02	-19 07.7	3.799	4.333	-0.10	+ 4.9	21.4	5.1/344	116.5	11.8	61/0.59	94 .93
	15	22	59.82	-18 32.3	23 02.01	-18 19.0	3.964	4.354	+0.06	+ 5.5	21.6	5.6/ 8	106.8	12.6	64/0.60	130 .05
	25	23	00.39	-17 37.0	23 02.57	-17 23.7	4.137	4.375	+0.20	+ 6.1	21.7	6.7/ 26	97.4	12.9	66/0.59	18 .44
Dec.	5	23	02.41	-16 36.3	23 04.58	-16 23.1	4.313	4.396	+0.33	+ 6.5	21.8	8.0/ 36	88.3	12.9	67/0.57	129 .90
	15	23	05.71	-15 31.5	23 07.88	-15 18.2	4.490	4.417	+0.44	+ 6.8	21.9	9.4/ 43	79.4	12.7	69/0.54	101 .04
	25	23	10.14	-14 23.2	23 12.30	-14 09.9	4.662	4.437	+0.54	+ 7.1	21.9	10.6/ 48	70.8	12.1	70/0.50	22 .49
1991 Jan.	4	23	15.52	-13 12.4	23 17.66	-12 59.0	4.827	4.456	+0.62	+ 7.3	22.0	11.6/ 51	62.3	11.3	71/0.45	160 .86
	14	23	21.69	-11 59.6	23 23.83	-11 46.1	4.981	4.475	+0.68	+ 7.4	22.0	12.5/ 54	54.1	10.3	72/0.40	75 .04
	24	23	28.51	-10 45.4	23 30.64	-10 31.8	5.122	4.494	+0.73	+ 7.5	22.1	13.2/ 55	46.0	9.1	73/0.34	51 .54
Feb.	3	23	35.86	-09 30.2	23 37.98	-09 16.6	5.247	4.513	+0.77	+ 7.6	22.1	13.7/ 57	38.1	7.7	75/0.29	164 .83
	13	23	43.60	-08 14.6	23 45.72	-08 00.9	5.356	4.531	+0.80	+ 7.6	22.1	14.2/ 58	30.3	6.3	77/0.23	49 .03

T/ET	1988 Oct. 31.8018		q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch					
			1.894597	0.998713		351.5566	156.3921	52.4167	0.200	1988 Nov. 15.0					
	m1 = 6.5+5log(delta)+10.0log(r)		m2 = 8.5+5log(delta)+10.0log(r)												
Date/	Oh	ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	Delta	r	Daily motion	Magnitude	Mot./PA	Elong.	P	PA/Tail	Moon Age
1989 Dec.	10		17 10.95	+21 19.1	17 12.64	+21 16.2	5.480	4.823	+1.07	- 0.4	17.0 19.0	15.0/ 91	8.2	2/0.29	122
	20		17 21.65	+21 14.8	17 23.34	+21 12.5	5.553	4.909	+1.03	+ 0.6	17.1 19.1	14.4/ 87	8.2	351/0.28	85
	30		17 31.95	+21 21.1	17 33.64	+21 19.3	5.613	4.995	+0.98	+ 1.7	17.2 19.2	13.8/ 83	8.3	340/0.29	58
1990 Jan.	9		17 41.77	+21 37.8	17 43.45	+21 36.5	5.660	5.080	+0.92	+ 2.7	17.3 19.3	13.1/ 78	8.5	330/0.29	130
	19		17 50.99	+22 04.3	17 52.67	+22 03.6	5.696	5.165	+0.85	+ 3.6	17.4 19.4	12.4/ 73	8.8	321/0.30	72
	29		17 59.53	+22 40.1	18 01.20	+22 39.8	5.720	5.250	+0.77	+ 4.4	17.5 19.5	11.6/ 67	9.1	312/0.31	73
Feb.	8		18 07.27	+23 24.3	18 08.93	+23 24.5	5.733	5.335	+0.69	+ 5.2	17.6 19.6	10.7/ 61	9.4	304/0.31	127
	18		18 14.13	+24 16.1	18 15.78	+24 16.7	5.737	5.419	+0.59	+ 5.8	17.6 19.6	9.9/ 54	9.6	296/0.32	60
	28		18 19.99	+25 14.2	18 21.63	+25 15.1	5.733	5.503	+0.48	+ 6.3	17.7 19.7	9.0/ 45	9.8	289/0.33	92
Mar.	10		18 24.77	+26 17.3	18 26.39	+26 18.5	5.723	5.587	+0.36	+ 6.6	17.8 19.8	8.2/ 36	10.0	282/0.34	114
	20		18 28.37	+27 23.7	18 29.98	+27 25.1	5.709	5.670	+0.24	+ 6.8	17.8 19.8	7.5/ 25	10.0	274/0.34	54
	30		18 30.73	+28 31.7	18 32.32	+28 33.1	5.693	5.754	+0.11	+ 6.7	17.9 19.9	6.9/ 12	10.0	267/0.34	110
	Apr.	9	18 31.78	+29 38.9	18 33.35	+29 40.4	5.678	5.836	-0.03	+ 6.4	17.9 19.9	6.4/357	9.9	259/0.33	96
	19		18 31.51	+30 43.1	18 33.06	+30 44.7	5.666	5.919	-0.16	+ 5.9	18.0 20.0	6.2/341	9.7	251/0.33	58
	29		18 29.94	+31 41.9	18 31.48	+31 43.4	5.661	6.001	-0.28	+ 5.1	18.0 20.0	6.2/325	10.0	242/0.32	121
	May	9	18 27.15	+32 32.7	18 28.67	+32 34.0	5.664	6.083	-0.39	+ 4.0	18.1 20.1	6.3/310	9.0	233/0.30	78
	19		18 23.28	+33 13.1	18 24.79	+33 14.3	5.678	6.165	-0.48	+ 2.8	18.2 20.2	6.6/296	11.4	223/0.29	73
	29		18 18.52	+33 41.1	18 20.03	+33 42.0	5.705	6.246	-0.54	+ 1.4	18.2 20.2	6.8/282	118.1	211/0.28	118
	June	8	18 13.15	+33 55.1	18 14.66	+33 55.7	5.747	6.327	-0.57	- 0.1	18.3 20.3	7.1/270	120.8	199/0.27	64
18		18 07.48	+33 54.2	18 08.98	+33 54.6	5.805	6.408	-0.57	- 1.6	18.4 20.4	7.2/258	122.4	7.7	187/0.26	95
July	28		18 01.81	+33 38.4	18 03.33	+33 38.5	5.881	6.488	-0.53	- 3.0	18.5 20.5	7.3/246	7.6	174/0.25	102
	8		17 56.48	+33 08.5	17 58.00	+33 08.3	5.974	6.568	-0.47	- 4.3	18.6 20.6	7.3/235	7.6	161/0.24	60
	18		17 51.73	+32 25.9	17 53.27	+32 25.5	6.084	6.648	-0.39	- 5.3	18.6 20.6	7.3/223	7.6	149/0.24	115
Aug.	28		17 47.80	+31 32.6	17 49.35	+31 32.0	6.210	6.728	-0.30	- 6.2	18.7 20.7	7.2/212	7.8	138/0.24	82
	7		17 44.82	+30 31.0	17 46.40	+30 30.2	6.352	6.807	-0.19	- 6.7	18.8 20.8	7.2/201	7.9	127/0.24	69
	17		17 42.90	+29 23.5	17 44.49	+29 22.7	6.506	6.886	-0.09	- 7.1	18.9 20.9	7.2/189	8.0	118/0.24	123
Sept.	27		17 42.04	+28 12.6	17 43.66	+28 11.8	6.672	6.964	+0.02	- 7.2	19.1 21.1	7.2/178	8.1	109/0.24	64
	6		17 42.24	+27 00.6	17 43.89	+26 59.8	6.846	7.043	+0.12	- 7.1	19.2 21.2	7.3/167	8.2	101/0.23	88
	16		17 43.45	+25 49.4	17 45.11	+25 48.6	7.027	7.121	+0.21	- 6.9	19.3 21.3	7.5/157	8.1	94/0.22	115
26		17 45.59	+24 40.7	17 47.27	+24 40.1	7.211	7.199	+0.30	- 6.5	19.4 21.4	7.6/148	8.0	87/0.21	52	
Oct.	6		17 48.58	+23 36.1	17 50.28	+23 35.6	7.395	7.276	+0.37	- 6.0	19.5 21.5	7.9/139	7.8	80/0.20	110
	16		17 52.31	+22 36.5	17 54.02	+22 36.2	7.577	7.354	+0.44	- 5.4	19.6 21.6	8.1/131	7.5	73/0.19	97
	26		17 56.68	+21 43.0	17 58.41	+21 43.0	7.754	7.431	+0.49	- 4.7	19.7 21.7	8.3/124	6.7	66/0.18	51
Nov.	5		18 01.59	+20 56.3	18 03.33	+20 56.5	7.924	7.508	+0.53	- 4.0	19.7 21.7	8.5/118	6.3	58/0.16	129
	15		18 06.94	+20 16.8	18 08.69	+20 17.3	8.083	7.584	+0.57	- 3.2	19.8 21.8	8.6/112	5.6	50/0.15	77
	25		18 12.62	+19 44.8	18 14.37	+19 45.7	8.231	7.660	+0.59	- 2.4	19.9 21.9	8.7/106	5.1	41/0.14	62
Dec.	5		18 18.52	+19 20.7	18 20.29	+19 21.9	8.364	7.736	+0.60	- 1.6	20.0 22.0	8.7/101	4.7	30/0.13	135
	15		18 24.55	+19 04.4	18 26.33	+19 05.9	8.482	7.812	+0.61	- 0.9	22.1	8.6/ 95	5.4	19/0.12	59
	25		18 30.62	+18 55.8	18 32.40	+18 57.6	8.583	7.888	+0.60	- 0.1	22.1	8.5/ 90	4.8	7/0.11	81
1991 Jan.	4		18 36.62	+18 54.8	18 38.40	+18 57.0	8.667	7.963	+0.58	+ 0.6	22.2	8.3/ 85	4.7	354/0.11	123
	14		18 42.46	+19 01.1	18 44.24	+19 03.6	8.732	8.038	+0.56	+ 1.3	22.3	8.0/ 80	4.8	341/0.11	46
	24		18 48.05	+19 14.3	18 49.83	+19 17.1	8.780	8.113	+0.52	+ 2.0	22.3	7.7/ 75	4.9	328/0.11	103
	Feb.	3	18 53.29	+19 34.0	18 55.07	+19 37.0	8.810	8.187	+0.48	+ 2.5	22.4	7.3/ 69	5.2	317/0.12	104
13		18 58.11	+19 59.4	18 59.89	+20 02.7	8.824	8.262	+0.43	+ 3.1	22.4	6.8/ 63	5.4	307/0.12	44	

P/d'Arrest

1987k

Orbit by Marsden B.G.

MPC 11501

(1987)

: T is corrected by -0.06 day.

T/ET	1989 Feb.	4.1368	q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch				
			1.291982	0.624669	6.39	177.0680	138.8017	19.4284	0.200	1989 Feb. 3.0				
m1 = 8.5+5log(delta)+ 6.5log(r)														
m2 = 16.0+5log(delta)+ 5.0log(r)+0.03(phase)														
Date/	Oh ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	Delta	r	Daily motion	Magnitude	Mot./PA	Elong.	P	PA/Tail	Moon Age
		$^{\circ}$	$'$	$^{\circ}$	$'$	$''$		$''$	m	$''$	$^{\circ}$	$^{\circ}$	$^{\circ}$	$^{\circ}$
1989 Dec.	10	05 30.74	-00 37.2	05 32.81	-00 35.4	2.264	3.188	-0.99	+ 2.6	13.5 20.5	15.0/280	155.7	7.3	342/0.57
	20	05 20.87	-00 11.6	05 22.95	-00 09.3	2.329	3.250	-0.89	+ 4.1	13.7 20.6	14.0/287	155.4	7.2	14/0.54
	30	05 11.96	+00 29.2	05 14.05	+00 32.1	2.423	3.310	-0.73	+ 5.3	13.8 20.8	12.2/296	149.8	8.6	40/0.62
1990 Jan.	9	05 04.66	+01 22.2	05 06.77	+01 25.4	2.544	3.370	-0.53	+ 6.1	14.0 21.0	10.0/308	141.5	10.5	55/0.73
	19	04 59.37	+02 23.4	05 01.49	+02 26.9	2.689	3.429	-0.31	+ 6.6	14.1 21.2	8.1/325	132.2	12.3	65/0.82
	29	04 56.23	+03 29.6	04 58.37	+03 33.3	2.854	3.486	-0.10	+ 6.8	14.3 21.4	7.0/348	122.7	13.7	71/0.88
Feb.	8	04 55.24	+04 37.7	04 57.39	+04 41.4	3.034	3.543	+0.10	+ 6.8	14.5 21.6	6.9/ 12	113.4	14.8	76/0.89
	18	04 56.24	+05 45.3	04 58.41	+05 48.9	3.225	3.599	+0.28	+ 6.5	14.7 21.8	7.7/ 32	104.3	15.4	80/0.88
	28	04 59.03	+06 50.6	05 01.21	+06 54.2	3.424	3.654	+0.44	+ 6.2	14.8 22.0	9.0/ 46	95.5	15.7	83/0.85
Mar.	10	05 03.38	+07 52.5	05 05.57	+07 55.7	3.625	3.708	+0.57	+ 5.7	15.0 22.1	10.2/ 56	87.0	15.5	86/0.80
	20	05 09.06	+08 49.9	05 11.26	+08 52.8	3.825	3.761	+0.68	+ 5.2	15.2 22.2	11.4/ 62	78.8	15.1	88/0.74
	30	05 15.86	+09 42.3	05 18.08	+09 44.9	4.021	3.813	+0.77	+ 4.7	15.3 22.4	12.4/ 67	70.9	14.3	91/0.67
	Apr.	9	05 23.60	+10 29.3	05 25.83	+10 31.4	4.210	3.864	+0.85	+ 4.1	15.4 22.5	13.2/ 72	63.2	13.4
	19	05 32.09	+11 10.6	05 34.33	+11 12.2	4.390	3.914	+0.91	+ 3.5	15.6 22.5	13.8/ 75	55.8	12.2	96/0.53
	29	05 41.18	+11 46.1	05 43.43	+11 47.1	4.558	3.963	+0.96	+ 3.0	15.7 22.6	14.3/ 78	48.5	11.0	99/0.46
	May	9	05 50.74	+12 15.7	05 53.00	+12 16.2	4.713	4.012	+0.99	+ 2.4	15.8 22.7	14.7/ 80	41.4	9.6
	19	06 00.64	+12 39.5	06 02.90	+12 39.4	4.853	4.059	+1.01	+ 1.8	15.9 22.7	14.9/ 83	34.5	8.1	106/0.32
	29	06 10.78	+12 57.6	06 13.05	+12 57.0	4.976	4.106	+1.03	+ 1.3	16.0 22.7	15.1/ 85	27.7	6.6	112/0.25
	June	8	06 21.05	+13 10.1	06 23.32	+13 08.9	5.081	4.152	+1.03	+ 0.7	16.0 22.8	15.1/ 87	21.3	5.1
18	06 31.35	+13 17.3	06 33.63	+13 15.5	5.168	4.197	+1.03	+ 0.2	16.1 22.8	15.0/ 89	15.4	3.7	133/0.14	
July	28	06 41.61	+13 19.5	06 43.89	+13 17.1	5.235	4.241	+1.01	- 0.3	16.2 22.8	14.8/ 91	10.8	2.6	158/0.10
	8	06 51.73	+13 16.9	06 54.01	+13 13.9	5.283	4.285	+0.99	- 0.7	16.2 22.8	14.5/ 92	9.9	2.3	199/0.08
	18	07 01.64	+13 09.9	07 03.91	+13 06.4	5.310	4.327	+0.96	- 1.1	16.3 22.9	14.1/ 94	13.3	3.1	231/0.11
Aug.	28	07 11.25	+12 59.0	07 13.52	+12 54.9	5.317	4.369	+0.92	- 1.4	16.3 23.0	13.6/ 96	18.9	4.3	248/0.16
	7	07 20.47	+12 44.6	07 22.74	+12 40.0	5.304	4.410	+0.88	- 1.7	16.3 23.0	12.9/ 97	25.5	5.7	258/0.21
	17	07 29.22	+12 27.2	07 31.49	+12 22.1	5.272	4.450	+0.82	- 2.0	16.3 23.1	12.2/ 99	32.4	7.0	264/0.26
Sept.	27	07 37.42	+12 07.5	07 39.67	+12 02.0	5.220	4.490	+0.75	- 2.1	16.3 23.1	11.3/101	39.7	8.3	268/0.31
	6	07 44.94	+11 46.2	07 47.20	+11 40.2	5.151	4.528	+0.68	- 2.2	16.3 23.1	10.2/102	47.3	9.4	271/0.35
	16	07 51.71	+11 23.9	07 53.96	+11 17.6	5.066	4.566	+0.59	- 2.2	16.3 23.1	8.9/104	55.1	10.4	274/0.40
26	07 57.60	+11 01.4	07 59.84	+10 54.8	4.967	4.603	+0.49	- 2.2	16.3 23.1	7.5/107	63.2	11.2	276/0.43	

T/ET	q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch						
1989 June 12.4658	2.474270	1.000539		232.1402	114.5563	97.6973	0.200	1989 June 3.0						
m1 = 6.0+5log(delta)+10.0log(r)														
m2 = 9.0+5log(delta)+ 5.0log(r)+0.03(phase)														
Date/ Oh ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	h m	Delta	r	Daily motion	Magnitude	Mot./PA	Elong.	P	PA/Tail	Moon Age
1989 Dec. 10	09 06.17	-65 04.9	09 06.92	-65 14.3		3.141	3.138	-2.64 + 0.3	13.5 14.5	16.7/268	80.8	18.0	306/1.06	112 .90
20 08 39.80	-65 01.8	08 40.41	-65 10.2		3.122	3.202	-2.90 + 4.8	13.5 14.5	19.2/281	85.7	17.8	17.8	321/1.06	71 .50
30 08 10.82	-64 13.7	08 11.35	-64 20.7		3.107	3.268	-2.85 +10.1	13.6 14.6	21.6/294	90.5	17.5	17.5	338/1.04	94 .04
1990 Jan. 9	07 42.29	-62 33.1	07 42.83	-62 38.8		3.101	3.335	-2.52 +15.3	13.7 14.6	23.7/307	95.1	17.1	354/1.02	95 .94
19 07 17.06	-60 00.5	07 17.70	-60 04.9		3.108	3.403	-2.03 +19.7	13.8 14.6	25.4/319	99.0	16.6	16.6	10/0.99	79 .49
29 06 56.80	-56 43.1	06 57.58	-56 46.5		3.134	3.472	-1.49 +23.0	13.9 14.7	26.4/329	101.9	16.1	16.1	26/0.95	102 .06
8 06 41.93	-52 52.6	06 42.86	-52 55.2		3.181	3.543	-0.99 +25.0	14.0 14.7	26.7/338	103.5	15.7	15.7	40/0.92	77 .96
18 06 31.99	-48 42.4	06 33.07	-48 44.5		3.252	3.614	-0.58 +25.8	14.1 14.8	26.4/346	103.6	15.4	15.4	53/0.88	98 .48
28 06 26.22	-44 24.9	06 27.43	-44 26.6		3.347	3.687	-0.24 +25.4	14.3 14.9	25.6/354	102.2	15.2	15.2	65/0.85	93 .09
Mar. 10	06 23.81	-40 10.6	06 25.13	-40 12.3		3.466	3.760	+0.02 +24.3	14.5 15.0	24.3/ 1	99.5	15.1	76/0.82	73 .98
20 06 24.04	-36 07.9	06 25.46	-36 09.5		3.606	3.833	+0.23 +22.6	14.6 15.2	22.8/ 7	95.6	15.0	15.0	85/0.78	117 .46
30 06 26.32	-32 21.9	06 27.82	-32 23.7		3.764	3.908	+0.39 +20.6	14.8 15.3	21.2/ 14	90.8	14.8	14.8	94/0.74	72 .14
Apr. 9	06 30.18	-28 56.3	06 31.76	-28 58.3		3.936	3.982	+0.51 +18.4	15.0 15.4	19.6/ 20	85.4	14.5	101/0.70	84 .99
19 06 35.25	-25 52.3	06 36.88	-25 54.5		4.118	4.058	+0.60 +16.2	15.2 15.5	18.2/ 27	79.6	14.1	14.1	108/0.65	126 .43
29 06 41.22	-23 10.0	06 42.91	-23 12.6		4.304	4.133	+0.67 +14.1	15.3 15.7	16.9/ 34	73.5	13.5	13.5	114/0.60	50 .20
May 9	06 47.87	-20 48.9	06 49.60	-20 51.9		4.492	4.209	+0.71 +12.1	15.5 15.8	15.7/ 40	67.4	12.8	120/0.54	103 .99
19 06 55.00	-18 47.8	06 56.76	-18 51.1		4.678	4.286	+0.74 +10.3	15.7 15.9	14.8/ 46	61.3	12.0	12.0	126/0.49	118 .37
29 07 02.44	-17 05.1	07 04.24	-17 08.8		4.857	4.362	+0.76 + 8.6	15.8 16.0	13.9/ 52	55.4	11.0	11.0	133/0.43	43 .26
June 8	07 10.07	-15 39.4	07 11.89	-15 43.5		5.027	4.439	+0.77 + 7.0	16.0 16.0	13.2/ 58	49.7	10.0	140/0.38	124 1.00
18 07 17.75	-14 29.0	07 19.59	-14 33.6		5.184	4.516	+0.77 + 5.6	16.1 16.1	12.5/ 63	44.5	9.1	9.1	148/0.34	96 .30
28 07 25.40	-13 32.6	07 27.27	-13 37.5		5.327	4.593	+0.75 + 4.4	16.2	11.8/ 68	39.8	8.1	8.1	158/0.29	55 .31
July 8	07 32.92	-12 48.7	07 34.80	-12 54.0		5.453	4.670	+0.73 + 3.3	16.3	11.2/ 73	36.0	7.4	169/0.26	142 1.00
18 07 40.22	-12 15.9	07 42.11	-12 21.6		5.561	4.747	+0.70 + 2.3	16.3	10.5/ 78	33.5	6.8	6.8	182/0.24	69 .22
28 07 47.21	-11 53.1	07 49.11	-11 59.2		5.650	4.824	+0.66 + 1.4	16.4	9.8/ 82	32.5	6.5	6.5	197/0.22	75 .35
Aug. 7	07 53.81	-11 39.1	07 55.72	-11 45.5		5.717	4.902	+0.61 + 0.6	16.4	9.0/ 86	33.3	6.5	212/0.22	146 1.00
17 07 59.94	-11 32.8	08 01.85	-11 39.4		5.764	4.979	+0.56 0.0	16.5	8.2/ 90	35.9	6.8	6.8	226/0.23	43 .15
27 08 05.50	-11 33.0	08 07.42	-11 39.9		5.790	5.056	+0.49 - 0.6	16.6	7.2/ 95	39.9	7.4	7.4	238/0.25	98 .38
Sept. 6	08 10.40	-11 38.7	08 12.32	-11 45.8		5.795	5.134	+0.42 - 1.0	16.6	6.2/ 99	45.1	8.0	248/0.27	128 .99
16 08 14.55	-11 48.7	08 16.48	-11 56.0		5.782	5.211	+0.33 - 1.3	16.7	5.0/105	51.2	8.6	8.6	256/0.29	31 .10
26 08 17.85	-12 01.8	08 19.78	-12 09.3		5.750	5.288	+0.23 - 1.5	16.7	3.7/114	58.1	9.3	9.3	263/0.31	122 .40

T/ET 1989 June 18.3944 q (AU) 1.299685 e 0.630254 P 6.59 Peri. 11.3821 Node 50.3551 Inc. 7.1145 Tail(AU) 0.200 Epoch 1989 June 3.0

$$m_2 = 14.5 + 5 \log(\delta) + 10.0 \log(r)$$

$$m_1 = 9.5 + 5 \log(\delta) + 10.0 \log(r)$$

Date/	Oh	ET	R.A. (1950)	Decl.	R.A. (App.)	Decl.	Delta	r	Daily motion	Magnitude	Mot./PA	Elong.	P	PA/Tail	Moon Age
			^{h}	^{m}	^{h}	^{m}			$\frac{m}{m}$	$\frac{m_1}{m_2}$		$^\circ$	$^\circ$	$^\circ$	$^\circ$
1989 Dec.	10	12	21.62	+04 51.6	12 23.67	+04 38.2	2.336	2.279	+0.98	14.9 19.9	15.3/107	74.4	24.6	295/1.89	141 .90
	20	12	31.42	+04 06.1	12 33.46	+03 52.8	2.278	2.352	+0.77	15.0 20.0	11.9/105	82.0	24.5	294/1.93	13 .50
	30	12	39.09	+03 35.7	12 41.14	+03 22.4	2.215	2.426	+0.53	15.1 20.1	8.1/100	90.2	23.9	293/1.94	113 .04
1990 Jan.	9	12	44.40	+03 21.4	12 46.46	+03 08.1	2.149	2.498	+0.28	15.1 20.1	4.2/ 87	98.9	22.9	292/1.91	109 .94
	19	12	47.18	+03 23.4	12 49.23	+03 10.1	2.084	2.570	0.00	15.2 20.2	1.8/ 2	108.4	21.3	291/1.83	24 .49
	29	12	47.21	+03 41.9	12 49.28	+03 28.6	2.025	2.641	-0.28	15.3 20.3	5.3/309	118.5	19.1	289/1.69	146 .06
Feb.	8	12	44.46	+04 15.5	12 46.53	+04 02.1	1.977	2.712	-0.54	15.3 20.3	9.3/300	129.4	16.3	286/1.49	72 .96
	18	12	39.06	+05 01.5	12 41.14	+04 48.0	1.945	2.781	-0.77	15.4 20.4	12.6/295	140.7	13.0	283/1.20	56 .48
	28	12	31.41	+05 55.5	12 33.48	+05 42.0	1.934	2.850	-0.92	15.5 20.5	14.9/292	152.5	9.2	277/0.86	164 .09
Mar.	10	12	22.18	+06 51.6	12 24.26	+06 38.0	1.950	2.917	-0.99	15.6 20.6	15.6/290	163.9	5.4	262/0.50	32 .98
	20	12	12.28	+07 43.4	12 14.37	+07 29.8	1.995	2.984	-0.96	15.7 20.7	14.9/287	171.6	2.8	212/0.25	94 .46
	30	12	02.67	+08 25.6	12 04.76	+08 12.0	2.070	3.049	-0.85	15.9 20.9	12.9/283	166.2	4.5	149/0.39	122 .14
Apr.	9	11	54.21	+08 54.4	11 56.31	+08 40.8	2.174	3.114	-0.67	16.1 21.1	10.1/278	155.6	7.6	131/0.64	16 .99
	19	11	47.49	+09 08.3	11 49.59	+08 54.7	2.304	3.178	-0.47	16.3 21.3	6.9/269	144.7	10.5	124/0.84	133 .43
	29	11	42.81	+09 07.6	11 44.92	+08 54.0	2.457	3.240	-0.25	16.6 21.6	4.0/249	134.2	12.9	120/0.96	80 .20
May	9	11	40.28	+08 53.4	11 42.38	+08 39.9	2.628	3.302	-0.05	16.8 21.8	2.7/197	124.2	14.7	118/1.03	49 .99
	19	11	39.75	+08 27.9	11 41.86	+08 14.4	2.813	3.363	+0.13	17.0 22.0	4.0/151	114.7	15.9	116/1.04	167 .37
	29	11	41.06	+07 52.7	11 43.16	+07 39.2	3.007	3.423	+0.29	17.2 22.2	6.1/135	105.6	16.6	115/1.02	44 .26
June	8	11	43.97	+07 09.6	11 46.06	+06 56.1	3.208	3.482	-0.43	17.4 22.4	8.0/128	97.0	16.8	114/0.98	79 1.00
	18	11	48.23	+06 20.2	11 50.32	+06 06.6	3.411	3.539	-0.54	17.7 22.7	9.7/124	88.8	16.7	113/0.91	153 .30
	28	11	53.63	+05 25.5	11 55.72	+05 11.9	3.614	3.596	+0.64	17.8 22.8	11.2/122	80.9	16.2	113/0.84	15 .31
July	8	11	59.99	+04 26.8	12 02.07	+04 13.2	3.813	3.652	+0.71	18.0 23.0	12.3/120	73.2	15.5	112/0.76	107 1.00
	18	12	07.12	+03 24.9	12 09.20	+03 11.3	4.007	3.707	+0.78	18.2 23.2	13.3/119	65.8	14.5	112/0.68	121 .22
	28	12	14.89	+02 20.6	12 16.97	+02 07.1	4.192	3.761	+0.83	18.4 23.4	14.1/118	58.4	13.3	111/0.60	17 .35
Aug.	7	12	23.18	+01 14.7	12 25.26	+01 01.2	4.367	3.815	+0.87	18.5 23.5	14.7/117	51.2	12.0	111/0.52	134 1.00
	17	12	31.89	+00 07.7	12 33.97	-00 05.7	4.530	3.867	+0.90	18.7 23.7	15.1/116	44.1	10.5	110/0.44	89 .15
	27	12	40.93	-00 59.8	12 43.01	-01 13.1	4.678	3.918	+0.93	18.8 23.8	15.5/116	37.0	8.9	109/0.36	40 .38
Sept.	6	12	50.21	-02 07.2	12 52.30	-02 20.4	4.811	3.969	+0.95	18.9 23.9	15.7/115	29.9	7.3	108/0.29	161 .99
	16	12	59.67	-03 13.9	13 01.76	-03 27.1	4.926	4.019	+0.96	19.0 24.0	15.8/115	22.8	5.6	106/0.22	59 1.10
	26	13	09.25	-04 19.7	13 11.35	-04 32.6	5.023	4.067	+0.96	19.1 24.1	15.7/114	15.8	3.8	102/0.15	63 .40
	6	13	18.86	-05 23.8	13 20.97	-05 36.6	5.101	4.115	+0.96	19.2 24.2	15.6/114	8.8	2.1	94/0.08	165 .97
Oct.	16	13	28.46	-06 25.9	13 30.58	-06 38.5	5.158	4.162	+0.95	19.3 24.3	15.4/113	2.8	0.7	43/0.03	32 .07
	26	13	37.97	-07 25.6	13 40.10	-07 38.0	5.194	4.209	+0.93	19.3 24.3	15.0/112	6.8	1.6	313/0.06	87 .42
Nov.	5	13	47.31	-08 22.3	13 49.45	-08 34.5	5.209	4.254	+0.91	19.4 24.4	14.5/112	14.1	3.2	301/0.12	136 .93
	15	13	56.40	-09 15.7	13 58.56	-09 27.6	5.203	4.299	+0.88	19.4 24.4	13.9/111	21.6	4.9	297/0.18	9 .05
	25	14	05.15	-10 05.4	14 07.33	-10 17.0	5.176	4.342	+0.83	19.4 24.4	13.1/111	29.3	6.4	294/0.24	113 .44
Dec.	5	14	13.46	-10 50.8	14 15.66	-11 02.3	5.129	4.385	+0.78	19.5 24.5	12.1/110	37.3	7.8	293/0.29	105 .90
	15	14	21.23	-11 31.8	14 23.44	-11 43.0	5.063	4.428	+0.71	19.5 24.5	11.0/109	45.4	9.1	291/0.35	23 .04
	25	14	28.32	-12 07.9	14 30.54	-12 18.8	4.980	4.469	+0.63	19.5 24.5	9.7/109	53.7	10.2	290/0.39	142 .49
1991 Jan.	4	14	34.61	-12 38.7	14 36.84	-12 49.5	4.882	4.510	+0.53	19.5 24.5	8.2/108	62.3	11.1	289/0.44	73 .86
	14	14	39.95	-13 04.1	14 42.20	-13 14.6	4.772	4.549	+0.43	19.5 24.5	6.5/108	71.1	11.8	289/0.47	50 .04
	24	14	44.20	-13 23.6	14 46.46	-13 34.0	4.653	4.589	+0.30	19.5 24.5	4.6/107	80.2	12.2	288/0.50	171 .54
Feb.	3	14	47.22	-13 37.0	14 49.49	-13 47.3	4.529	4.627	+0.17	19.4 24.4	2.5/106	89.5	12.3	287/0.52	42 .83
	13	14	48.88	-13 44.1	14 51.16	-13 54.4	4.403	4.664	+0.02	19.4 24.4	0.3/103	99.2	12.1	287/0.52	80 .03

P/Pons-Winnecke 1989g Orbit by Kobayashi T. KC 32 (1987)

T/ET 1989 Aug. 19.9011 q (AU) 1.260964 e 0.633513 P 6.38 Peri. 172.3210 Node 92.7494 Inc. 22.2731 Tail(AU) 0.200 Epoch 1989 Aug. 22.0

m1 = 10.0+5log(delta)+15.0log(r) m2 = 16.0+5log(delta)+ 5.0log(r)+0.03(phase)

Date/	Oh	ET	R.A. (1950)	Decl.	R.A. (App.)	Decl.	Delta	r	Daily motion	Magnitude	Mot./PA	Elong.	P	PA/Tail	Moon Age
			h^m	$^{\circ}$	h^m	$^{\circ}$			m	m_l		$^{\circ}$			
1989 Dec.	10	21	20.71	-33 42.8	21 23.13	-33 32.7	2.148	1.802	+2.93	+13.0	39.2/73	56.5	27.1	83/2.25	90 .9
	20	21	50.02	-31 32.5	21 52.37	-31 21.3	2.289	1.876	+2.69	+14.0	37.5/70	53.4	24.9	83/1.95	136 .5
	30	22	16.93	-29 12.0	22 19.20	-29 00.1	2.432	1.951	+2.48	+14.6	36.0/68	50.0	22.7	83/1.69	29 .04
1990 Jan.	9	22	41.77	-26 46.5	22 43.97	-26 34.0	2.577	2.027	+2.31	+14.7	34.5/66	46.4	20.6	84/1.46	108 .94
	19	23	04.82	-24 19.6	23 06.97	-24 06.7	2.720	2.103	+2.16	+14.6	33.1/65	42.5	18.4	86/1.25	124 .49
	29	23	26.40	-21 54.0	23 28.50	-21 40.8	2.861	2.179	+2.03	+14.2	31.9/64	38.5	16.3	88/1.06	20 .06
Feb.	8	23	46.71	-19 31.7	23 48.79	-19 18.4	2.998	2.254	+1.92	+13.7	30.6/64	34.4	14.3	91/0.89	126 .96
	18	00	05.96	-17 14.4	00 08.01	-17 01.0	3.129	2.329	+1.83	+13.1	29.5/64	30.3	12.3	96/0.74	110 .48
	28	00	24.30	-15 02.9	00 26.33	-14 49.6	3.252	2.404	+1.76	+12.5	28.4/65	26.2	10.5	102/0.60	25 .09
Mar.	10	00	41.85	-12 58.2	00 43.87	-12 45.1	3.367	2.477	+1.68	+11.7	27.4/65	22.3	8.8	110/0.49	144 .98
	20	00	58.70	-11 01.0	01 00.71	-10 48.0	3.471	2.550	+1.62	+10.9	26.3/66	19.0	7.3	122/0.40	94 .46
	30	01	14.93	-09 11.6	01 16.93	-08 58.9	3.563	2.622	+1.56	+10.1	25.3/67	16.6	6.3	138/0.33	45 .14
Apr.	9	01	30.57	-07 30.5	01 32.57	-07 18.1	3.643	2.693	+1.51	+9.3	24.3/68	15.8	5.8	159/0.30	157 .99
	19	01	45.64	-05 58.0	01 47.66	-05 46.0	3.709	2.763	+1.45	+8.4	23.3/69	16.8	6.0	179/0.31	76 .43
	29	02	00.18	-04 34.3	02 02.21	-04 22.6	3.761	2.832	+1.40	+7.5	22.2/70	19.5	6.8	196/0.34	68 .20
May	9	02	14.17	-03 19.6	02 16.20	-03 08.3	3.799	2.900	+1.34	+6.6	21.1/72	23.4	7.9	209/0.40	157 .99
	19	02	27.58	-02 14.0	02 29.62	-02 03.2	3.821	2.967	+1.28	+5.6	20.0/74	28.1	9.2	218/0.46	54 .37
	29	02	40.39	-01 17.6	02 42.44	-01 07.3	3.828	3.033	+1.21	+4.7	18.8/76	33.3	10.6	226/0.52	92 .26
June	8	02	52.53	-00 30.6	02 54.59	-00 20.7	3.821	3.098	+1.14	+3.8	17.5/78	38.9	11.9	231/0.59	143 1.00
	18	03	03.95	+00 07.0	03 06.02	+00 16.4	3.798	3.162	+1.06	+2.8	16.2/80	44.9	13.1	236/0.65	32 .30
	28	03	14.57	+00 35.2	03 16.65	+00 44.2	3.762	3.224	+0.97	+1.9	14.7/83	51.2	14.2	240/0.71	115 .31
July	8	03	24.27	+00 53.9	03 26.36	+01 02.5	3.713	3.286	+0.87	+0.9	13.1/86	57.8	15.2	244/0.77	122 1.00
	18	03	32.95	+01 03.4	03 35.04	+01 11.6	3.652	3.347	+0.75	0.0	11.3/90	64.8	15.9	247/0.82	24 .22
	28	03	40.47	+01 03.7	03 42.57	+01 11.6	3.580	3.407	+0.62	-0.9	9.3/95	72.0	16.5	250/0.86	138 .35
Aug.	7	03	46.47	+00 55.0	03 48.78	+01 02.6	3.501	3.466	+0.47	-1.7	7.3/103	79.7	16.7	253/0.89	96 1.00
	17	03	51.41	+00 37.9	03 53.52	+00 45.3	3.416	3.524	+0.31	-2.5	5.3/118	87.7	16.7	256/0.91	47 .15
	27	03	54.52	+00 13.0	03 56.62	+00 20.3	3.329	3.580	+0.13	-3.2	3.7/148	96.1	16.3	259/0.91	154 .38
Sept.	6	03	55.83	-00 18.6	03 57.93	-00 11.4	3.244	3.636	-0.06	-3.7	3.8/193	104.9	15.5	263/0.89	65 .99
	16	03	55.24	-00 55.5	03 57.34	-00 48.3	3.164	3.691	-0.26	-4.0	5.6/224	114.1	14.4	267/0.85	80 .10
	26	03	52.69	-01 35.7	03 54.78	-01 28.3	3.095	3.745	-0.45	-4.1	7.8/239	123.7	12.9	272/0.78	145 .40
Oct.	6	03	48.22	-02 16.5	03 50.31	-02 08.9	3.041	3.798	-0.62	-3.8	10.0/248	133.4	11.0	279/0.68	34 .97
	16	03	42.04	-02 54.8	03 44.12	-02 46.9	3.007	3.850	-0.76	-3.2	11.8/254	142.9	9.0	288/0.56	115 .07
	26	03	34.48	-03 27.2	03 36.56	-03 18.9	2.998	3.901	-0.84	-2.3	12.8/260	151.5	7.0	303/0.44	115 .42
Nov.	5	03	26.05	-03 50.4	03 28.13	-03 41.7	3.018	3.951	-0.87	-1.2	13.1/265	157.3	5.6	328/0.34	35 .93
	15	03	17.35	-04 01.9	03 19.43	-03 52.9	3.067	4.000	-0.83	+0.2	12.5/271	157.8	5.4	0/0.33	147 .05
	25	03	09.01	-04 00.3	03 11.09	-03 50.9	3.147	4.049	-0.74	+1.5	11.2/278	152.5	6.5	26/0.39	79 .44
Dec.	5	03	01.59	-03 45.5	03 03.68	-03 35.8	3.256	4.096	-0.61	+2.7	9.5/286	144.2	8.1	42/0.47	70 .90
	15	02	55.49	-03 18.5	02 57.59	-03 08.6	3.390	4.143	-0.45	+3.8	7.7/299	134.8	9.7	52/0.54	150 .04
	25	02	51.00	-02 40.9	02 53.10	-02 30.8	3.547	4.188	-0.28	+4.6	6.2/318	125.0	11.1	59/0.59	44 .49
1991 Jan.	4	02	48.21	-01 54.7	02 50.32	-01 44.5	3.720	4.233	-0.11	+5.3	5.5/343	115.2	12.1	64/0.62	106 .86
	14	02	47.11	-01 02.2	02 49.23	-00 51.9	3.907	4.277	+0.05	+5.7	5.8/8	105.6	12.8	67/0.62	125 .04
	24	02	47.62	-00 05.1	02 49.74	+00 05.2	4.100	4.320	+0.20	+6.0	6.7/26	96.3	13.1	70/0.60	21 .54
Feb.	3	02	49.58	+00 54.9	02 51.71	+01 05.0	4.297	4.363	+0.32	+6.1	7.8/38	87.3	13.0	73/0.58	138 .83
	13	02	52.83	+01 56.3	02 54.97	+02 06.3	4.493	4.404	+0.44	+6.2	9.0/47	78.5	12.7	76/0.54	97 .03

1.0

1990 Comet Handbook

Orbit by Marsden B.G. MPC 11502 (1987)

T/ET	1989 Sep. 24.9798	q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch	1.0				
		2.471544	0.314399	6.84	196.9378	67.8677	10.3725	0.200	1989 Oct.					
		m2 = 10.0+5log(delta)+10.0log(r)												
		m1 = 5.0+5log(delta)+15.0log(r)												
Date/	Oh ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	Delta	r	Daily motion	Magnitude	Mot./PA	Elong.	P	PA/Tail	Moon Age
		h m	° ' "	h m	° ' "			m	m1 m2					
1989 Dec.	10	18 36.80	-27 57.6	18 39.30	-27 55.5	3.407	2.515	+2.18	+1.0	13.7 16.7	28.9/ 89	8.2	99/0.45	123 .90
	20	18 58.60	-27 47.9	19 01.09	-27 44.5	3.456	2.527	+2.17	+2.1	13.7 16.7	28.9/ 87	16.2	102/0.34	104 .50
	30	19 20.33	-27 27.3	19 22.80	-27 22.8	3.496	2.540	+2.15	+3.1	13.8 16.8	28.9/ 85	11.4	109/0.24	13 .04
1990 Jan.	9	19 41.85	-26 56.7	19 44.30	-26 51.0	3.527	2.554	+2.12	+4.0	13.8 16.8	28.7/ 83	7.2	129/0.15	147 .94
	19	20 03.04	-26 16.7	20 05.46	-26 09.9	3.547	2.570	+2.08	+4.8	13.9 16.8	28.4/ 81	5.8	174/0.12	87 .49
	29	20 23.81	-25 28.4	20 26.20	-25 20.6	3.557	2.587	+2.03	+5.5	13.9 16.9	28.1/ 80	8.5	212/0.17	35 .06
Feb.	8	20 44.07	-24 33.1	20 46.42	-24 24.4	3.556	2.605	+1.97	+6.1	14.0 16.9	27.6/ 78	13.0	227/0.26	169 .96
	18	21 03.74	-23 32.0	21 06.06	-23 22.5	3.545	2.624	+1.91	+6.5	14.0 16.9	27.1/ 77	18.1	233/0.36	70 .48
	28	21 22.80	-22 26.6	21 25.08	-22 16.2	3.523	2.644	+1.84	+6.8	14.1 17.0	26.5/ 76	23.4	236/0.46	59 .09
Mar.	10	21 41.16	-21 18.2	21 43.41	-21 07.2	3.491	2.665	+1.76	+7.0	14.1 17.0	25.7/ 75	28.9	238/0.56	166 .98
	20	21 58.81	-20 08.3	22 01.03	-19 56.7	3.449	2.687	+1.69	+7.0	14.1 17.0	24.9/ 74	34.4	239/0.66	51 .46
	30	22 15.71	-18 58.4	22 17.90	-18 46.3	3.396	2.710	+1.61	+6.8	14.1 17.0	23.9/ 74	40.1	240/0.76	85 .14
Apr.	9	22 31.81	-17 50.0	22 33.98	-17 37.5	3.335	2.734	+1.53	+6.6	14.2 17.0	22.8/ 74	45.9	240/0.85	145 .99
	19	22 47.08	-16 44.5	22 49.23	-16 31.7	3.264	2.758	+1.44	+6.1	14.2 17.0	21.6/ 74	51.8	241/0.95	31 .43
	29	23 01.46	-15 43.3	23 03.59	-15 30.2	3.185	2.783	+1.34	+5.5	14.2 17.0	20.2/ 75	57.9	242/1.04	112 .20
May	9	23 14.87	-14 47.9	23 16.99	-14 34.6	3.099	2.809	+1.24	+4.8	14.2 16.9	18.6/ 75	64.1	242/1.13	123 .99
	19	23 27.24	-13 59.6	23 29.35	-13 46.2	3.006	2.835	+1.12	+4.0	14.2 16.9	16.8/ 77	70.6	243/1.21	13 .37
	29	23 38.46	-13 19.9	23 40.56	-13 06.3	2.909	2.862	+0.99	+3.0	14.2 16.9	14.8/ 79	77.3	244/1.28	138 .26
June	8	23 48.40	-12 50.0	23 50.49	-12 36.4	2.808	2.889	+0.85	+1.9	14.2 16.8	12.6/ 82	84.3	245/1.34	99 1.00
	18	23 56.91	-12 31.3	23 58.99	-12 17.6	2.705	2.917	+0.69	+0.7	14.1 16.8	10.1/ 86	91.7	246/1.38	30 .30
	28	00 03.80	-12 24.6	00 05.89	-12 10.9	2.603	2.945	+0.51	-0.6	14.1 16.8	7.5/ 95	99.4	248/1.40	161 .31
July	8	00 08.90	-12 30.8	00 10.99	-12 17.1	2.504	2.974	+0.31	-1.9	14.1 16.7	5.0/113	107.6	250/1.39	72 1.00
	18	00 12.02	-12 50.0	00 14.11	-12 36.3	2.411	3.002	+0.10	-3.2	14.1 16.7	3.5/156	116.3	252/1.34	64 .22
	28	00 13.01	-13 21.6	00 15.10	-13 07.8	2.328	3.032	-0.12	-4.2	14.1 16.7	4.6/203	125.4	256/1.24	153 .35
Aug.	7	00 11.79	-14 03.6	00 13.89	-13 49.8	2.260	3.061	-0.34	-4.9	14.1 16.6	6.9/225	134.9	260/1.10	40 1.00
	17	00 08.43	-14 52.9	00 10.53	-14 39.1	2.209	3.090	-0.53	-5.2	14.1 16.6	9.2/235	144.7	267/0.90	103 .15
	27	00 03.15	-15 45.1	00 05.27	-15 31.3	2.179	3.120	-0.67	-4.9	14.1 16.6	10.9/243	154.2	279/0.68	122 .38
Sept.	6	23 56.44	-16 34.5	23 58.56	-16 20.7	2.175	3.150	-0.75	-4.1	14.2 16.7	11.5/249	162.3	302/0.47	19 .99
	16	23 48.93	-17 15.6	23 51.07	-17 01.8	2.197	3.180	-0.75	-2.8	14.2 16.7	11.2/255	165.2	343/0.39	142 .10
	26	23 41.39	-17 43.8	23 43.53	-17 30.1	2.248	3.210	-0.68	-1.2	14.4 16.8	9.8/263	160.3	20/0.49	87 .40
	6	23 34.58	-17 56.1	23 36.73	-17 42.4	2.325	3.240	-0.55	+0.4	14.5 16.9	7.8/273	151.6	39/0.67	49 .97
Oct.	16	23 29.11	-17 51.8	23 31.27	-17 38.2	2.427	3.270	-0.37	+2.0	14.6 17.1	5.7/291	141.9	49/0.82	162 .07
	26	23 25.39	-17 31.6	23 27.55	-17 18.0	2.551	3.300	-0.18	+3.4	14.8 17.2	4.3/324	122.0	55/0.94	53 .42
Nov.	5	23 23.62	-16 57.2	23 25.78	-16 43.6	2.692	3.330	+0.02	+4.6	15.0 17.4	4.6/ 3	122.4	59/1.00	88 .93
	15	23 23.81	-16 10.9	23 25.97	-15 57.3	2.847	3.360	+0.20	+5.6	15.2 17.5	6.3/ 28	113.0	62/1.02	136 .05
	25	23 25.86	-15 14.7	23 28.01	-15 01.1	3.013	3.389	+0.37	+6.4	15.3 17.7	8.4/ 40	104.0	64/1.01	24 .44
Dec.	5	23 29.58	-14 10.6	23 31.72	-13 57.0	3.184	3.419	+0.52	+7.0	15.5 17.9	10.3/ 47	95.3	65/0.98	122 .90
	15	23 34.76	-13 00.3	23 36.90	-12 46.7	3.359	3.449	+0.64	+7.5	15.7 18.0	12.1/ 52	86.9	67/0.92	109 .04
	25	23 41.20	-11 45.1	23 43.33	-11 31.4	3.533	3.478	+0.75	+7.9	15.9 18.2	13.6/ 55	78.8	68/0.85	17 .49
1991 Jan.	4	23 48.70	-10 26.2	23 50.82	-10 12.5	3.703	3.507	+0.84	+8.2	16.0 18.3	14.8/ 57	70.9	69/0.78	152 .86
	14	23 57.06	-09 04.5	23 59.17	-08 50.8	3.868	3.536	+0.91	+8.4	16.2 18.4	15.9/ 58	63.2	70/0.70	84 .04
	24	00 06.15	-07 40.9	00 08.26	-07 27.2	4.025	3.565	+0.97	+8.5	16.3 18.5	16.7/ 60	55.8	72/0.62	42 .54
Feb.	3	00 15.82	-06 16.3	00 17.92	-06 02.6	4.171	3.594	+1.01	+8.5	16.4 18.7	17.3/ 61	48.5	73/0.54	168 .83
	13	00 25.94	-04 51.3	00 28.04	-04 37.7	4.305	3.622	+1.05	+8.5	16.6 18.8	17.8/ 62	41.3	75/0.46	60 .03

T/ET 1989 Oct. 10.5047 q (AU) 1.679619 e 0.614235 P 9.09 Peri. 73.6166 Node 341.7172 Inc. 12.1979 Tail(AU) 0.200 Epoch 1989 Oct. 1.0

m1 = 10.0+5log(delta)+15.0log(r) m2 = 14.0+5log(delta)+10.0log(r)

Date/	0h	ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	h	m	s	Delta	r	Daily	motion	Magnitude	Mot./PA	Elong.	P	PA/Tail	Moon	Age
1989	Dec.	10	07 10.47	+46 36.6	07 13.46	+46 32.5	0.892	1.792	-0.71	-1.7	13.6	16.3	7.5/257	145.4	18.2	238/3.30	63			
		20	07 03.37	+46 19.4	07 06.36	+46 15.7	0.899	1.829	-0.94	-5.3	13.7	16.4	11.1/243	152.7	14.3	219/2.58	79			
		30	06 53.98	+45 26.7	06 56.96	+45 23.5	0.925	1.871	-0.90	-8.6	13.9	16.6	12.9/229	157.4	11.7	192/2.06	151			
1990	Jan.	9	06 44.96	+44 00.5	06 47.91	+43 57.8	0.972	1.917	-0.65	-11.0	14.2	16.8	13.1/214	157.2	11.5	160/1.95	25			
		19	06 38.42	+42 10.2	06 41.32	+42 08.0	1.040	1.966	-0.30	-12.2	14.5	17.0	12.7/196	152.3	13.5	135/2.16	113			
		29	06 35.43	+40 08.1	06 38.27	+40 06.1	1.130	2.017	+0.08	-12.4	14.8	17.3	12.4/176	144.9	16.3	119/2.43	119			
Feb.	8	06 36.25	+38 04.4	06 39.04	+38 02.4	1.239	2.072	+0.42	-11.9	15.2	17.6	12.9/156	136.8	19.0	110/2.62	23				
	18	06 40.50	+36 05.8	06 43.23	+36 03.5	1.366	2.128	+0.71	-11.1	15.6	18.0	14.1/141	128.7	21.3	105/2.68	143				
	28	06 47.59	+34 14.9	06 50.27	+34 12.2	1.507	2.187	+0.94	-10.3	16.0	18.3	15.6/131	120.8	22.9	102/2.64	85				
Mar.	10	06 56.95	+32 32.0	06 59.59	+32 28.8	1.661	2.246	+1.11	-9.6	16.4	18.6	17.1/123	113.2	24.0	100/2.53	51				
	20	07 08.01	+30 56.0	07 10.61	+30 52.2	1.826	2.307	+1.23	-9.1	16.8	18.9	18.4/119	106.0	24.5	99/2.37	168				
	30	07 20.34	+29 25.3	07 22.90	+29 20.8	1.998	2.369	+1.32	-8.7	17.1	19.2	19.5/116	99.0	24.6	99/2.19	54				
Apr.	9	07 33.58	+27 58.2	07 36.10	+27 52.9	2.176	2.432	+1.38	-8.5	17.5	19.5	20.3/114	92.3	24.3	99/2.00	76				
	19	07 47.43	+26 33.4	07 49.91	+26 27.3	2.358	2.495	+1.42	-8.4	17.8	19.8	21.0/113	85.8	23.7	100/1.81	166				
	29	08 01.68	+25 09.5	08 04.12	+25 02.7	2.542	2.559	+1.45	-8.4	18.1	20.1	21.5/112	79.5	22.8	101/1.63	25				
May	9	08 16.15	+23 45.7	08 18.55	+23 38.2	2.727	2.623	+1.46	-8.4	18.5	20.4	21.8/112	73.4	21.6	102/1.45	99				
	19	08 30.70	+22 21.5	08 33.07	+22 13.3	2.910	2.687	+1.45	-8.5	18.8	20.6	22.0/112	67.3	20.3	103/1.29	142				
	29	08 45.25	+20 56.4	08 47.58	+20 47.5	3.090	2.751	+1.45	-8.6	19.0	20.8	22.1/112	61.3	18.9	104/1.13	3				
June	8	08 59.70	+19 30.2	09 02.00	+19 20.7	3.265	2.815	+1.43	-8.7	19.3	21.1	22.1/113	55.4	17.3	105/0.98	120				
	18	09 14.00	+18 02.9	09 16.27	+17 52.8	3.433	2.879	+1.41	-8.8	19.6	21.3	22.1/113	49.5	15.6	106/0.85	115				
	28	09 28.11	+16 34.5	09 30.35	+16 23.9	3.594	2.943	+1.39	-8.9	19.8	21.5	21.9/114	43.6	13.8	107/0.72	25				
July	8	09 42.00	+15 05.2	09 44.21	+14 54.1	3.746	3.007	+1.36	-9.0	20.0	21.6	21.8/114	37.7	11.9	108/0.60	142				
	18	09 55.63	+13 35.1	09 57.81	+13 23.5	3.886	3.070	+1.34	-9.1	21.8	21.5/115	31.8	10.0	108/0.49	87					
	28	10 08.99	+12 04.4	10 11.15	+11 52.5	4.015	3.133	+1.31	-9.1	22.0	21.3/115	25.8	8.1	109/0.38	47					
Aug.	7	10 22.06	+10 33.6	10 24.20	+10 21.3	4.131	3.195	+1.28	-9.1	22.1	20.9/115	19.8	6.2	110/0.28	166					
	17	10 34.82	+09 02.8	10 36.95	+08 50.2	4.232	3.257	+1.24	-9.0	22.3	20.6/116	13.7	4.2	111/0.19	59					
	27	10 47.26	+07 32.5	10 49.37	+07 19.6	4.318	3.318	+1.21	-8.9	22.4	20.1/116	7.4	2.3	113/0.10	69					
Sept.	6	10 59.35	+06 03.0	11 01.45	+05 49.9	4.387	3.379	+1.17	-8.8	22.5	19.6/117	1.2	0.4	131/0.02	168					
	16	11 11.06	+04 34.7	11 13.16	+04 21.5	4.440	3.440	+1.13	-8.7	22.6	19.0/117	5.4	1.6	286/0.07	31					
	26	11 22.37	+03 08.0	11 24.46	+02 54.6	4.475	3.500	+1.09	-8.5	22.7	18.3/117	12.0	3.4	289/0.15	91					
Oct.	6	11 33.23	+01 43.4	11 35.31	+01 29.9	4.491	3.559	+1.04	-8.2	22.8	17.6/118	18.8	5.2	290/0.22	140					
	16	11 43.58	+00 21.2	11 45.67	+00 07.7	4.490	3.618	+0.98	-7.9	22.8	16.7/118	25.7	6.9	291/0.29	5					
	26	11 53.38	-00 57.9	11 55.47	-01 11.5	4.471	3.676	+0.92	-7.6	22.9	15.7/119	32.9	8.4	291/0.36	114					
Nov.	5	12 02.53	-02 13.4	12 04.62	-02 27.0	4.435	3.734	+0.84	-7.1	23.0	14.5/120	40.3	9.9	291/0.42	110					
	15	12 10.96	-03 24.8	12 13.06	-03 38.5	4.382	3.791	+0.76	-6.7	23.0	13.2/120	47.9	11.2	292/0.48	22					
	25	12 18.56	-04 31.6	12 20.66	-04 45.2	4.314	3.848	+0.66	-6.1	23.0	11.7/122	55.9	12.3	292/0.54	140					
Dec.	5	12 25.19	-05 33.0	12 27.30	-05 46.6	4.233	3.904	+0.56	-5.5	23.0	10.0/124	64.1	13.1	292/0.59	78					
	15	12 30.74	-06 28.3	12 32.86	-06 41.9	4.141	3.959	+0.43	-4.9	23.1	8.1/127	72.6	13.7	292/0.63	49					
	25	12 35.06	-07 16.8	12 37.19	-07 30.4	4.041	4.014	+0.29	-4.1	23.1	6.0/133	81.4	14.0	293/0.65	170					
1991	Jan.	4	12 38.01	-07 57.7	12 40.15	-08 11.3	3.936	4.068	+0.14	-3.2	23.1	3.9/147	90.7	14.0	293/0.67	45				
		14	12 39.46	-08 30.2	12 41.60	-08 43.9	3.831	4.122	-0.02	-2.3	23.1	2.3/186	100.3	13.6	294/0.67	79				
		24	12 39.30	-08 53.5	12 41.45	-09 07.1	3.729	4.175	-0.18	-1.3	23.1	3.0/243	110.3	12.8	295/0.64	154				
Feb.	3	12 37.50	-09 06.8	12 39.66	-09 20.5	3.637	4.227	-0.34	-0.3	23.1	5.0/267	120.8	11.6	296/0.60	10					
	13	12 34.11	-09 09.7	12 36.27	-09 23.5	3.560	4.279	-0.48	+0.7	23.1	7.2/276	131.6	9.9	298/0.52	112					

P/Schwassmann-Wachmann 1 Orbit by Kobayashi T. MPC 11510 (1987)

T/ET		q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch			
1989 Oct. 26.7255		5.771759	0.044663	14.9	49.8971	312.1229	9.3673	0.200	1989 Nov. 10.0			
Date/	Oh ET	R.A.(1950)	Decl.	Delta	r	Daily motion	Magnitude	Mot./PA	Elong.	P	PA/Tail	Moon Age
		h	m			m	m ₁ m ₂		°	°	°	
m1 = 6.0+5log(delta)+10.0log(r)												
m2 = 9.0+5log(delta)+ 8.0log(r)												
1989 Dec.	10	23 29.47	+05 09.8	23 31.51	5.558	+0.26	17.3 18.8	4.0/ 79	97.6	9.7	68/0.34	45
	20	23 32.08	+05 17.1	23 34.13	5.719	+0.36	17.4 18.9	5.5/ 75	88.2	9.8	66/0.33	175
	30	23 35.65	+05 31.1	23 37.69	5.879	+0.44	17.5 18.9	6.9/ 73	79.0	9.6	65/0.32	57
1990 Jan.	9	23 40.06	+05 51.5	23 42.11	6.034	+0.52	17.5 19.0	8.1/ 71	70.0	9.2	64/0.30	81
	19	23 45.22	+06 17.7	23 47.27	6.181	+0.58	17.6 19.0	9.2/ 70	61.3	8.6	62/0.27	149
	29	23 51.02	+06 49.2	23 53.07	6.316	+0.63	17.6 19.1	10.1/ 69	52.8	7.8	61/0.24	25
Feb.	8	23 57.36	+07 25.5	23 59.41	6.437	+0.68	17.7 19.1	10.9/ 68	44.4	6.9	59/0.21	114
	18	00 04.14	+08 05.8	00 06.19	6.541	+0.71	17.7 19.2	11.5/ 67	36.3	5.8	57/0.17	123
	28	00 11.27	+08 49.6	00 13.33	6.628	+0.74	17.7 19.2	11.9/ 67	28.3	4.7	53/0.14	9
Mar.	10	00 18.66	+09 36.3	00 20.72	6.694	+0.76	17.7 19.2	12.2/ 66	20.7	3.5	48/0.10	144
	20	00 26.23	+10 25.2	00 28.30	6.739	+0.77	17.8 19.2	12.4/ 66	13.5	2.3	36/0.07	97
	30	00 33.90	+11 15.8	00 35.98	6.764	+0.77	17.8 19.2	12.4/ 65	7.9	1.4	5/0.04	41
Apr.	9	00 41.60	+12 07.5	00 43.69	6.767	+0.77	17.8 19.2	12.4/ 65	8.1	1.4	307/0.04	171
	19	00 49.26	+12 59.8	00 51.36	6.749	+0.75	17.8 19.2	12.2/ 64	13.7	2.4	278/0.07	70
	29	00 56.79	+13 52.2	00 58.90	6.710	+0.73	17.8 19.2	11.9/ 64	20.7	3.5	267/0.10	73
May	9	01 04.13	+14 44.2	01 06.25	6.651	+0.71	17.7 19.2	11.4/ 63	28.0	4.7	261/0.14	161
	19	01 11.19	+15 35.4	01 13.33	6.573	+0.67	17.7 19.2	10.9/ 63	35.5	5.8	258/0.17	40
	29	01 17.91	+16 25.3	01 20.06	6.478	+0.63	17.7 19.2	10.2/ 62	43.2	6.9	256/0.21	105
June	8	01 24.18	+17 13.4	01 26.35	6.367	+0.57	17.6 19.1	9.4/ 61	51.0	7.8	254/0.24	134
	18	01 29.92	+17 59.4	01 32.11	6.242	+0.51	17.6 19.1	8.5/ 59	58.8	8.6	253/0.27	8
	28	01 35.03	+18 42.8	01 37.24	6.106	+0.44	17.6 19.0	7.4/ 57	66.9	9.3	252/0.29	135
July	8	01 39.42	+19 23.1	01 41.64	5.961	+0.36	17.5 19.0	6.2/ 54	75.1	9.8	251/0.32	105
	18	01 42.98	+19 59.8	01 45.21	5.811	+0.26	17.4 18.9	4.9/ 49	83.5	10.1	250/0.33	28
	28	01 45.61	+20 32.4	01 47.85	5.657	+0.16	17.4 18.9	3.6/ 39	92.2	10.1	249/0.34	165
Aug.	7	01 47.22	+21 00.1	01 49.48	5.505	+0.05	17.3 18.8	2.3/ 18	101.1	9.9	247/0.35	73
	17	01 47.75	+21 22.3	01 50.02	5.358	-0.06	17.3 18.7	1.8/333	110.3	9.4	245/0.34	65
	27	01 47.15	+21 38.3	01 49.42	5.221	-0.17	17.2 18.7	2.5/291	119.8	8.7	243/0.32	163
Sept.	6	01 45.45	+21 47.5	01 47.72	5.097	-0.27	17.2 18.6	3.8/273	129.5	7.7	240/0.29	37
	16	01 42.70	+21 49.4	01 44.98	4.991	-0.36	17.1 18.6	5.1/264	139.5	6.5	236/0.25	104
	26	01 39.07	+21 43.8	01 41.34	4.907	-0.43	17.1 18.6	6.1/258	149.5	5.0	230/0.20	130
Oct.	6	01 34.76	+21 30.8	01 37.02	4.849	-0.47	17.1 18.5	6.9/254	159.1	3.5	218/0.14	7
	16	01 30.06	+21 11.4	01 32.32	4.820	-0.48	17.0 18.5	7.1/250	167.1	2.2	190/0.09	143
	26	01 25.29	+20 46.6	01 27.54	4.820	-0.45	17.0 18.5	6.9/246	168.2	2.0	136/0.08	95
Nov.	5	01 20.79	+20 18.5	01 23.03	4.851	-0.39	17.1 18.5	6.3/242	161.2	3.2	102/0.13	46
	15	01 16.87	+19 49.1	01 19.10	4.911	-0.31	17.1 18.6	5.2/237	151.5	4.7	88/0.18	174
	25	01 13.78	+19 20.6	01 16.01	4.999	-0.21	17.1 18.6	3.9/229	141.2	6.1	81/0.24	59
Dec.	5	01 11.72	+18 55.1	01 13.94	5.110	-0.09	17.2 18.7	2.5/213	130.9	7.4	77/0.28	86
	15	01 10.78	+18 34.2	01 13.00	5.240	+0.02	17.2 18.7	1.5/167	120.7	8.4	73/0.31	144
	25	01 11.02	+18 19.0	01 13.23	5.385	+0.14	17.3 18.8	2.2/113	110.7	9.1	71/0.33	23
1991 Jan.	4	01 12.41	+18 10.4	01 14.63	5.540	+0.25	17.4 18.8	3.6/ 93	100.9	9.6	69/0.33	123
	14	01 14.91	+18 08.5	01 17.12	5.701	+0.35	17.4 18.9	5.0/ 84	91.4	9.7	68/0.33	113
	24	01 18.42	+18 13.3	01 20.64	5.863	+0.44	17.5 19.0	6.4/ 80	82.2	9.7	66/0.32	14
Feb.	3	01 22.86	+18 24.3	01 25.08	6.021	+0.53	17.5 19.0	7.7/ 77	73.2	9.3	65/0.30	156
	13	01 28.12	+18 41.2	01 30.35	6.172	+0.60	17.6 19.1	8.8/ 75	64.4	8.8	64/0.28	83

$$m2 = 13.0 + 5 \log(\text{delta}) + 10.0 \log(r)$$
$$m1 = 10.0 + 5 \log(\text{delta}) + 15.0 \log(r)$$

Date/	0h ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	Delta	r	Daily motion	Magnitude	Mot./PA	Elong.	P	PA/Tail	Moon Age
		$\text{h}^{\circ}\text{m}'$	$^{\circ}$	$\text{h}^{\circ}\text{m}'$	$^{\circ}$	'		m	m_1	m_2	'	'	'	'
1989 Dec.	10	02 12.24	+10 26.0	02 14.41	+10 37.3	1.546	2.363	+0.20	-	1.2	3.2/112	137.0	16.5	68/1.85
	20	02 14.28	+10 13.6	02 16.44	+10 24.9	1.644	2.372	+0.62	+ 0.5	16.5 17.7	6.8/ 85	127.2	19.3	68/2.05
	30	02 18.84	+10 18.9	02 21.00	+10 30.0	1.756	2.383	+0.69	+ 2.1	16.9 17.8	10.4/ 78	118.1	21.3	69/2.13
1990 Jan.	9	02 25.75	+10 39.6	02 27.92	+10 50.4	1.879	2.397	+0.90	+ 3.3	17.1 18.0	13.6/ 76	109.7	22.7	70/2.13
	19	02 34.72	+11 12.5	02 36.90	+11 23.0	2.010	2.412	+1.08	+ 4.2	17.3 18.3	16.4/ 75	101.8	23.5	71/2.08
	29	02 45.47	+11 54.6	02 47.67	+12 04.7	2.147	2.429	+1.23	+ 4.8	17.4 18.5	18.7/ 75	94.3	23.9	72/1.98
Feb.	8	02 57.76	+12 42.9	02 59.97	+12 52.5	2.287	2.448	+1.36	+ 5.2	17.6 18.7	20.5/ 75	87.3	23.7	74/1.86
	18	03 11.34	+13 34.6	03 13.57	+13 43.7	2.428	2.468	+1.47	+ 5.3	17.8 18.8	22.0/ 76	80.7	23.3	75/1.73
	28	03 26.00	+14 27.5	03 28.24	+14 35.8	2.569	2.490	+1.56	+ 5.2	18.0 19.0	23.2/ 77	74.3	22.5	77/1.59
Mar.	10	03 41.57	+15 19.2	03 43.83	+15 26.9	2.709	2.514	+1.63	+ 4.9	18.2 19.2	24.0/ 78	68.2	21.5	79/1.45
	20	03 57.87	+16 08.1	04 00.16	+16 15.0	2.846	2.540	+1.69	+ 4.5	18.3 19.3	24.7/ 79	62.2	20.3	81/1.31
Apr.	30	04 14.78	+16 52.7	04 17.09	+16 58.7	2.979	2.566	+1.74	+ 3.9	18.5 19.5	25.2/ 80	56.5	18.9	83/1.17
	9	04 32.17	+17 31.7	04 34.49	+17 36.7	3.107	2.594	+1.77	+ 3.2	18.7 19.6	25.5/ 82	50.9	17.4	85/1.04
	19	04 49.91	+18 04.0	04 52.25	+18 08.1	3.230	2.624	+1.80	+ 2.5	18.8 19.7	25.7/ 84	45.4	15.8	87/0.91
May	29	05 07.90	+18 29.1	05 10.25	+18 32.1	3.346	2.654	+1.81	+ 1.7	19.0 19.9	25.8/ 85	40.0	14.1	90/0.79
	9	05 26.03	+18 46.3	05 28.39	+18 48.3	3.454	2.685	+1.82	+ 0.9	19.1 20.0	25.8/ 87	34.6	12.3	93/0.67
	19	05 44.20	+18 55.3	05 46.57	+18 56.2	3.554	2.718	+1.81	+ 0.1	19.3 20.1	25.7/ 89	29.4	10.5	96/0.56
June	29	06 02.34	+18 55.9	06 04.71	+18 55.8	3.645	2.751	+1.80	- 0.8	19.4 20.2	25.6/ 91	24.1	8.7	100/0.45
	8	06 20.34	+18 48.3	06 22.71	+18 47.1	3.725	2.785	+1.78	- 1.6	19.5 20.3	25.3/ 93	19.0	6.8	105/0.35
	18	06 38.12	+18 32.6	06 40.48	+18 30.4	3.796	2.820	+1.75	- 2.3	19.6 20.4	25.0/ 95	13.9	5.0	113/0.25
July	28	06 55.63	+18 09.1	06 57.98	+18 05.9	3.855	2.855	+1.71	- 3.1	19.8 20.5	24.7/ 97	9.0	3.2	126/0.16
	8	07 12.78	+17 38.3	07 15.12	+17 34.1	3.902	2.891	+1.67	- 3.8	19.9 20.6	24.3/ 98	5.3	1.8	161/0.09
	18	07 29.51	+17 00.7	07 31.83	+16 55.6	3.937	2.928	+1.63	- 4.4	20.0 20.6	23.8/100	5.7	2.0	222/0.10
Aug.	28	07 45.77	+16 16.9	07 48.08	+16 10.9	3.960	2.965	+1.57	- 4.9	. 20.7	23.2/102	10.0	3.4	251/0.16
	7	08 01.50	+15 27.7	08 03.79	+15 20.9	3.969	3.002	+1.52	- 5.4	. 20.8	22.6/103	15.2	5.1	263/0.24
	17	08 16.66	+14 33.8	08 18.93	+14 26.2	3.965	3.040	+1.45	- 5.8	. 20.8	21.9/105	20.8	6.8	270/0.33
Sept.	27	08 31.18	+13 36.0	08 33.43	+13 27.7	3.947	3.078	+1.38	- 6.1	. 20.9	21.1/106	26.7	8.5	274/0.41
	6	08 45.00	+12 35.2	08 47.23	+12 26.3	3.916	3.116	+1.31	- 6.3	. 20.9	20.2/108	32.7	10.1	277/0.49
	16	08 58.07	+11 32.3	09 00.29	+11 22.8	3.872	3.155	+1.22	- 6.4	. 20.9	19.1/109	39.0	11.6	279/0.56
Oct.	26	09 10.32	+10 28.3	09 12.52	+10 18.3	3.815	3.193	+1.13	- 6.4	. 20.9	17.9/111	45.5	12.9	282/0.64
	6	09 21.66	+09 24.3	09 23.84	+09 13.9	3.745	3.232	+1.03	- 6.3	. 21.0	16.6/112	52.3	14.2	283/0.71
	16	09 32.00	+08 21.3	09 34.17	+08 10.5	3.664	3.271	+0.92	- 6.1	. 21.0	15.0/114	59.4	15.2	285/0.78
Nov.	26	09 41.22	+07 20.6	09 43.39	+07 09.4	3.573	3.310	+0.80	- 5.7	. 21.0	13.2/116	66.8	16.0	286/0.84
	5	09 49.21	+06 23.5	09 51.36	+06 12.0	3.474	3.349	+0.66	- 5.2	. 21.0	11.2/118	74.5	16.6	288/0.89
	15	09 55.82	+05 31.3	09 57.97	+05 19.6	3.368	3.387	+0.51	- 4.6	. 20.9	8.9/121	82.7	16.8	289/0.93
Dec.	25	10 00.90	+04 45.6	10 03.05	+04 33.7	3.259	3.426	+0.34	- 3.8	. 20.9	6.3/126	91.3	16.7	290/0.95
	5	10 04.30	+04 08.0	10 06.45	+03 56.0	3.150	3.465	+0.16	- 2.8	. 20.9	3.7/140	100.3	16.3	292/0.96
	15	10 05.90	+03 39.9	10 08.05	+03 27.8	3.045	3.503	-0.03	- 1.7	. 20.9	1.8/195	109.8	15.3	293/0.93
1991 Jan.	25	10 05.59	+03 22.9	10 07.74	+03 10.8	2.948	3.542	-0.22	- 0.5	. 20.8	3.3/262	119.8	13.9	295/0.87
	4	10 03.39	+03 18.0	10 05.55	+03 05.9	2.865	3.580	-0.40	+ 0.8	. 20.8	6.0/277	130.3	12.1	297/0.78
	14	09 59.42	+03 25.7	10 01.58	+03 13.7	2.799	3.618	-0.55	+ 2.0	. 20.8	8.4/284	141.2	9.8	301/0.64
Feb.	24	09 53.93	+03 45.6	09 56.10	+03 33.7	2.756	3.656	-0.65	+ 3.1	. 20.8	10.2/287	152.4	7.2	306/0.47
	3	09 47.40	+04 16.1	09 49.58	+04 04.5	2.740	3.694	-0.70	+ 3.9	. 20.9	11.2/290	163.2	4.4	320/0.29
	13	09 40.38	+04 54.7	09 42.57	+04 43.2	2.753	3.732	-0.69	+ 4.3	. 20.9	11.1/293	171.1	2.3	7/0.15

Okazaki-Levy-Rudenko 1989r Orbit by Marsden B.G. MPC 15215 (1989)

T/ET	1989 Nov. 11.9213		q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)						
			0.642418	1.0		150.5738	274.8182	90.1506	0.200						
$m_1 = 7.0+5\log(\delta)+10.0\log(r)$											$m_2 = 11.0+5\log(\delta)+5.0\log(r)+0.03(\text{phase})$				
Date/	Oh	ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	Delta	r	Daily motion	Magnitude	Mot./PA	Elong.	P	PA/Tail	Moon Age
			$^{\circ}$	$'$	$^{\circ}$	$'$	$''$		$''$	m_1	m_2	$^{\circ}$	$^{\circ}$	$^{\circ}$	$^{\circ}$
1989 Dec.	10	12	20.43	-61 32.0	12 22.61	-61 45.1	0.582	0.869	-9.98	-122.5	128.5/189	61.1	83.0	265/18.1	133 .90
	20	10	40.6	-81 56.5	10 40.5	-82 08.8	0.766	1.009	-43.38	-4.8	74.6/214	69.2	65.7	290/12.1	80 .50
	30	03	26.8	-82 44.3	03 23.5	-82 36.0	0.990	1.158	-7.20	+42.9	47.0/326	71.9	53.8	45/8.28	71 .04
1990 Jan.	9	02	14.7	-75 35.0	02 14.9	-75 24.1	1.222	1.310	-1.08	+32.2	32.5/350	72.0	45.6	71/5.99	107 .94
	19	02	03.9	-70 13.4	02 04.7	-70 02.2	1.447	1.461	+0.18	+24.3	24.3/ 3	71.0	39.6	82/4.55	94 .49
	29	02	05.75	-66 10.5	02 06.76	-65 59.3	1.662	1.611	+0.70	+18.9	19.4/ 14	69.7	35.0	91/3.60	69 .06
Feb.	8	02	12.78	-63 01.9	02 13.88	-62 50.9	1.863	1.758	+0.99	+14.9	16.4/ 26	68.4	31.4	99/2.94	108 .96
	18	02	22.65	-60 33.2	02 23.79	-60 22.5	2.049	1.903	+1.18	+11.8	14.8/ 39	67.4	28.7	106/2.47	92 .48
	28	02	34.42	-58 35.5	02 35.56	-58 25.2	2.222	2.045	+1.32	+9.1	13.9/ 50	66.8	26.4	114/2.12	72 .09
Mar.	10	02	47.58	-57 04.2	02 48.71	-56 54.4	2.379	2.185	+1.42	+6.8	13.6/ 61	66.6	24.7	121/1.87	110 .98
	20	03	01.81	-55 55.8	03 02.92	-55 46.5	2.523	2.322	+1.52	+4.8	13.7/ 71	66.9	23.2	128/1.67	88 .46
	30	03	16.97	-55 08.1	03 18.04	-54 59.4	2.655	2.456	+1.60	+2.8	14.1/ 80	67.7	22.1	134/1.52	79 .14
Apr.	9	03	32.93	-54 39.8	03 33.97	-54 31.9	2.775	2.588	+1.67	+1.0	14.5/ 88	68.9	21.2	141/1.40	107 .99
	19	03	49.62	-54 29.8	03 50.60	-54 22.7	2.885	2.718	+1.74	-0.7	15.1/ 95	70.4	20.4	147/1.30	84 .43
	29	04	07.00	-54 37.2	04 07.93	-54 30.9	2.986	2.846	+1.80	-2.4	15.8/101	72.3	19.7	153/1.22	85 .20
May	9	04	25.02	-55 01.2	04 25.89	-54 55.8	3.082	2.972	+1.86	-4.0	16.4/106	74.3	19.1	159/1.15	101 .99
	19	04	43.67	-55 40.9	04 44.46	-55 36.5	3.173	3.096	+1.93	-5.4	17.0/111	76.4	18.5	165/1.08	85 .37
	29	05	02.95	-56 35.2	05 03.67	-56 31.8	3.262	3.218	+1.99	-6.8	17.5/115	78.6	18.0	170/1.02	88 .26
June	8	05	22.84	-57 43.1	05 23.46	-57 40.9	3.351	3.339	+2.05	-8.0	18.0/119	80.6	17.5	175/0.97	95 1.00
	18	05	43.33	-59 03.0	05 43.87	-59 01.9	3.442	3.458	+2.11	-9.1	18.3/122	82.4	16.9	180/0.92	90 .30
	28	06	04.47	-60 33.5	06 04.91	-60 33.7	3.536	3.575	+2.18	-9.9	18.5/125	84.0	16.4	184/0.87	85 .31
July	8	06	26.25	-62 13.0	06 26.58	-62 14.4	3.635	3.691	+2.25	-10.6	18.6/127	85.2	15.9	189/0.82	93 1.00
	18	06	48.73	-63 59.4	06 48.94	-64 02.1	3.740	3.805	+2.32	-11.2	18.5/130	85.9	15.5	193/0.78	96 .22
	28	07	11.96	-65 51.2	07 12.06	-65 55.2	3.852	3.918	+2.41	-11.5	18.3/132	86.2	15.0	197/0.73	78 .35
Aug.	7	07	36.03	-67 46.5	07 36.03	-67 51.8	3.971	4.030	+2.51	-11.7	17.9/134	86.0	14.5	201/0.69	96 1.00
	17	08	01.11	-69 43.5	08 01.00	-69 50.1	4.098	4.140	+2.63	-11.7	17.5/135	85.3	14.1	205/0.65	97 .15
	27	08	27.4	-71 40.8	08 27.2	-71 48.7	4.231	4.250	+2.78	-11.6	17.0/136	84.2	13.7	208/0.61	71 .38
Sept.	6	08	55.2	-73 36.7	08 55.0	-73 45.9	4.371	4.358	+2.98	-11.3	16.4/137	82.6	13.3	210/0.58	104 .99
	16	09	25.0	-75 29.9	09 24.8	-75 40.3	4.515	4.465	+3.25	-10.9	15.8/137	80.7	12.8	212/0.54	91 .10
	26	09	57.6	-77 19.0	09 57.5	-77 30.6	4.664	4.571	+3.63	-10.3	15.2/137	78.5	12.4	213/0.51	68 .40
Oct.	6	10	33.9	-79 02.5	10 34.1	-79 15.0	4.814	4.676	+4.16	-9.6	14.6/136	76.1	12.0	213/0.47	114 .97
	16	11	15.5	-80 38.2	11 16.3	-80 51.5	4.966	4.780	+4.91	-8.6	13.9/134	73.5	11.5	212/0.44	80 .07
	26	12	04.5	-82 03.8	12 06.6	-82 17.3	5.116	4.883	+5.91	-7.1	13.3/129	71.0	11.1	210/0.42	71 .42
Nov.	5	13	03.7	-83 15.1	13 07.8	-83 28.2	5.263	4.985	+7.11	-5.2	12.8/123	68.5	10.7	204/0.39	120 .93
	15	14	14.8	-84 07.3	14 21.7	-84 18.5	5.405	5.086	+8.10	-2.8	12.2/113	66.1	10.2	196/0.36	69 .05
	25	15	35.7	-84 35.0	15 45.6	-84 42.8	5.542	5.187	+8.29	-0.1	11.6/101	64.1	9.9	186/0.34	80 .44
Dec.	5	16	58.6	-84 36.2	17 09.9	-84 39.6	5.670	5.286	+7.53	+2.1	11.1/ 88	62.4	9.5	176/0.32	117 .90
	15	18	13.8	-84 14.9	18 24.8	-84 13.9	5.790	5.385	+6.32	+3.6	10.6/ 78	61.2	9.2	167/0.31	61 .04
	25	19	17.0	-83 38.7	19 26.7	-83 34.1	5.900	5.483	+5.18	+4.4	10.1/ 71	60.5	9.0	162/0.29	93 .49
1991 Jan.	4	20	08.9	-82 55.0	20 17.0	-82 47.7	5.999	5.580	+4.31	+4.6	9.6/ 67	60.5	8.8	160/0.28	106 .86
	14	20	52.0	-82 09.1	20 58.7	-81 59.8	6.087	5.677	+3.68	+4.4	9.0/ 65	61.1	8.7	160/0.28	58 .04
	24	21	28.8	-81 24.7	21 34.5	-81 13.8	6.164	5.773	+3.24	+4.1	8.6/ 66	62.3	8.7	162/0.27	106 .54
Feb.	3	22	01.2	-80 44.0	22 05.9	-80 32.1	6.230	5.868	+2.93	+3.5	8.1/ 68	64.2	8.7	164/0.27	93 .83
	13	22	30.5	-80 08.8	22 34.5	-79 56.1	6.285	5.962	+2.71	+2.9	7.7/ 71	66.6	8.7	167/0.27	63 .03

Date/	Oh	ET	R.A. (1950)	Decl.	R.A. (App.)	Decl.	h	m	s	q (AU)	e	P	Peri.	Node	Inc.	Tail (AU)	Epoch	PA/Tail	Moon Age
1989	Dec.	10	17 51.23	-26 53.3	17 53.71	-26 53.9	17 53.71	-26 53.9	2.514	1.560	+3.46	-2.2	15.4	19.4	46.3/95	11.2	7.1	109/0.52	133 .90
		20	18 25.84	-27 15.5	18 28.33	-27 14.1	18 28.33	-27 14.1	2.534	1.570	+3.45	+0.8	15.5	19.5	46.0/91	9.1	5.7	113/0.42	97 .50
		30	19 00.30	-27 07.7	19 02.78	-27 04.3	19 02.78	-27 04.3	2.557	1.586	+3.38	+3.6	15.5	19.5	45.4/87	7.2	4.5	121/0.32	17 .04
1990	Jan.	9	19 34.11	-26 31.4	19 36.56	-26 26.1	19 36.56	-26 26.1	2.583	1.607	+3.28	+6.2	15.7	19.6	44.6/84	5.7	3.5	138/0.25	148 .94
		19	20 06.90	-25 29.5	20 09.30	-25 22.5	20 09.30	-25 22.5	2.612	1.634	+3.15	+8.4	15.8	19.7	43.7/81	5.1	3.1	164/0.22	88 .49
		29	20 38.37	-24 05.6	20 40.72	-23 57.2	20 40.72	-23 57.2	2.642	1.665	+3.00	+10.1	15.9	19.8	42.5/78	6.0	3.5	190/0.25	31 .06
	Feb.	8	21 08.35	-22 24.2	21 10.64	-22 14.4	21 10.64	-22 14.4	2.673	1.701	+2.84	+11.5	16.1	19.9	41.3/75	7.9	4.6	207/0.32	163 .96
		18	21 36.75	-20 29.4	21 38.99	-20 18.6	21 38.99	-20 18.6	2.703	1.741	+2.68	+12.4	16.3	20.1	39.9/73	10.5	6.0	217/0.41	78 .48
		28	22 03.59	-18 25.4	22 05.78	-18 13.7	22 05.78	-18 13.7	2.732	1.784	+2.53	+12.9	16.5	20.2	38.5/71	13.5	7.5	223/0.51	49 .09
	Mar.	10	22 28.91	-16 16.0	22 31.06	-16 03.6	22 31.06	-16 03.6	2.757	1.829	+2.39	+13.2	16.6	20.3	37.0/70	16.8	9.0	227/0.61	172 .98
		20	22 52.80	-14 04.3	22 54.92	-13 51.5	22 54.92	-13 51.5	2.778	1.877	+2.26	+13.1	16.8	20.5	35.5/69	20.4	10.7	230/0.71	65 .46
		30	23 15.36	-11 53.1	23 17.45	-11 39.9	23 17.45	-11 39.9	2.794	1.928	+2.13	+12.8	17.0	20.6	33.9/68	24.2	12.3	232/0.81	69 .14
	Apr.	9	23 36.66	-09 44.6	23 38.73	-09 31.3	23 38.73	-09 31.3	2.804	1.980	+2.01	+12.4	17.2	20.7	32.3/68	28.3	13.9	234/0.92	161 .99
		19	23 56.80	-07 40.8	23 58.86	-07 27.4	23 58.86	-07 27.4	2.806	2.037	+1.90	+11.8	17.4	20.8	30.7/68	32.5	15.4	236/1.02	50 .43
		29	00 15.82	-05 43.0	00 17.88	-05 29.6	00 17.88	-05 29.6	2.801	2.083	+1.79	+11.0	17.5	20.9	29.0/68	37.1	16.9	237/1.11	91 .20
	May	9	00 33.77	-03 52.6	00 35.82	-03 39.3	00 35.82	-03 39.3	2.786	2.143	+1.69	+10.2	17.7	21.0	27.3/68	41.8	18.3	239/1.21	145 .99
		19	00 50.65	-02 10.4	00 52.71	-01 57.3	00 52.71	-01 57.3	2.763	2.198	+1.58	+9.3	17.8	21.1	25.5/69	46.8	19.6	240/1.30	30 .37
		29	01 06.46	-00 37.3	01 08.53	-00 24.3	01 08.53	-00 24.3	2.730	2.254	+1.47	+8.3	18.0	21.2	23.5/69	52.1	20.8	242/1.39	114 .26
	June	8	01 21.14	+00 46.1	01 23.21	+00 58.8	01 23.21	+00 58.8	2.689	2.311	+1.35	+7.3	18.1	21.3	21.5/70	57.7	21.8	243/1.48	126 1.00
		18	01 34.62	+01 59.3	01 36.71	+02 11.8	01 36.71	+02 11.8	2.638	2.367	+1.22	+6.3	18.2	21.3	19.3/71	63.6	22.6	245/1.56	13 .30
		28	01 46.79	+03 01.9	01 48.89	+03 14.0	01 48.89	+03 14.0	2.579	2.424	+1.07	+5.1	18.3	21.4	16.9/72	69.8	23.2	246/1.63	137 .31
	July	8	01 57.51	+03 53.3	01 59.63	+04 05.2	01 59.63	+04 05.2	2.512	2.480	+0.91	+4.0	18.4	21.4	14.2/73	76.5	23.5	248/1.69	103 1.00
		18	02 06.61	+04 33.5	02 08.74	+04 45.2	02 08.74	+04 45.2	2.440	2.536	+0.73	+2.9	18.5	21.5	11.2/75	83.5	23.5	249/1.74	31 .22
		28	02 13.88	+05 02.1	02 16.01	+05 13.5	02 16.01	+05 13.5	2.364	2.591	+0.52	+1.7	18.6	21.5	8.0/78	91.1	23.1	251/1.76	159 .35
	Aug.	7	02 19.08	+05 18.8	02 21.23	+05 30.1	02 21.23	+05 30.1	2.286	2.646	+0.29	+0.5	18.6	21.5	4.4/83	99.3	22.2	252/1.75	76 1.00
		17	02 22.02	+05 23.9	02 24.17	+05 35.1	02 24.17	+05 35.1	2.210	2.701	+0.04	-0.6	18.7	21.5	0.9/134	108.1	20.9	254/1.70	64 .15
		27	02 22.46	+05 17.5	02 24.62	+05 28.7	02 24.62	+05 28.7	2.138	2.755	-0.21	-1.7	18.8	21.6	3.6/242	117.5	19.0	255/1.60	161 .38
	Sept.	6	02 20.33	+05 00.4	02 22.49	+05 11.8	02 22.49	+05 11.8	2.077	2.808	-0.47	-2.6	18.8	21.6	7.4/250	127.6	16.5	257/1.44	41 .99
		16	02 15.67	+04 34.3	02 17.82	+04 45.8	02 17.82	+04 45.8	2.031	2.861	-0.69	-3.3	18.9	21.6	10.9/253	138.4	13.5	260/1.20	102 .10
		26	02 08.73	+04 01.6	02 10.89	+04 13.3	02 10.89	+04 13.3	2.004	2.913	-0.86	-3.6	19.0	21.7	13.4/255	149.6	10.0	265/0.91	129 .40
	Oct.	6	02 00.09	+03 25.9	02 02.24	+03 38.0	02 02.24	+03 38.0	2.002	2.965	-0.96	-3.4	19.1	21.7	14.8/257	160.9	6.3	275/0.57	14 .97
		16	01 50.50	+02 51.6	01 52.65	+03 03.9	01 52.65	+03 03.9	2.027	3.016	-0.96	-2.9	19.2	21.8	14.7/259	170.7	3.1	308/0.28	143 .07
		26	01 40.89	+02 22.9	01 43.03	+02 35.5	01 43.03	+02 35.5	2.083	3.066	-0.87	-1.9	19.4	22.0	13.2/262	169.4	3.4	24/0.30	91 .42
	Nov.	5	01 32.15	+02 03.7	01 34.29	+02 16.4	01 34.29	+02 16.4	2.168	3.115	-0.72	-0.8	19.6	22.1	10.8/266	159.2	6.5	49/0.55	51 .93
		15	01 24.95	+01 56.0	01 27.08	+02 08.9	01 27.08	+02 08.9	2.281	3.163	-0.52	+0.5	19.8	22.3	7.8/274	148.0	9.5	58/0.77	167 .05
		25	01 19.73	+02 00.9	01 21.87	+02 13.9	01 21.87	+02 13.9	2.418	3.211	-0.30	+1.7	20.0	22.5	4.9/291	137.0	12.1	62/0.92	54 .44
	Dec.	5	01 16.69	+02 18.0	01 18.83	+02 31.0	01 18.83	+02 31.0	2.576	3.258	-0.09	+2.8	22.7	22.7	3.1/334	126.4	14.1	64/1.01	92 .90
		15	01 15.79	+02 46.0	01 17.93	+02 59.1	01 17.93	+02 59.1	2.749	3.304	+0.11	+3.8	22.9	22.9	4.1/24	116.3	15.5	65/1.04	138 .04
		25	01 16.90	+03 23.7	01 19.04	+03 36.7	01 19.04	+03 36.7	2.933	3.350	+0.29	+4.6	23.1	23.1	6.3/44	106.6	16.3	67/1.03	20 .49
	1991 Jan.	4	01 19.80	+04 09.3	01 21.94	+04 22.3	01 21.94	+04 22.3	3.124	3.394	+0.45	+5.2	23.3	23.3	8.4/52	97.4	16.7	67/0.99	127 .86
		14	01 24.25	+05 01.2	01 26.40	+05 14.1	01 26.40	+05 14.1	3.318	3.438	+0.58	+5.7	23.5	23.5	10.4/57	88.6	16.6	68/0.93	110 .04
		24	01 30.04	+05 58.1	01 32.20	+06 10.8	01 32.20	+06 10.8	3.512	3.481	+0.69	+6.0	23.6	23.6	12.0/60	80.1	16.2	69/0.86	18 .54
	Feb.	3	01 36.96	+06 58.6	01 39.12	+07 11.2	01 39.12	+07 11.2	3.701	3.523	+0.79	+6.3	23.8	23.8	13.3/62	72.0	15.4	70/0.78	156 .83
		13	01 44.82	+08 01.6	01 46.99	+08 13.9	01 46.99	+08 13.9	3.884	3.564	+0.86	+6.4	24.0	24.0	14.4/63	64.0	14.4	70/0.70	83 .03

T/ET	1990 Jan.	20.3328	q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch					
			1.585148	0.542986	6.46	162.8262	120.2885	4.7205	0.200	1990 Jan. 29.0					
m1 = 3.0+5log(delta)+26.0log(r)															
m2 = 13.5+5log(delta)+10.0log(r)															
Date/	Oh	ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	Delta	r	Daily motion	Magnitude	Mot./PA	Elong.	P	PA/Tail	Moon Age
			^h ^m	[°] [']	^h ^m	[°] [']			^m	^m 1 ^m 2	[°] [']	[°]		[°] [']	[°]
1989 Dec.	10	17	08.61	-20 56.4	17 10.98	-20 59.4	2.622	1.638	+3.19	- 4.2	10.7 17.7	44.8/ 97	2.1	1.2	23/0.09
	20	17	40.52	-21 38.2	17 42.91	-21 39.4	2.598	1.616	+3.26	- 1.8	10.5 17.7	45.5/ 94	2.7	1.6	312/0.12
30	18	13.14	-21 56.2	18 15.54	-21 55.5		2.577	1.600	+3.30	+ 0.7	10.4 17.6	45.9/ 91	4.9	3.0	286/0.22
1990 Jan.	9	18	46.11	-21 49.2	18 48.50	-21 46.6	2.560	1.589	+3.29	+ 3.2	10.3 17.6	46.0/ 88	7.3	4.5	275/0.33
	19	19	19.03	-21 17.2	19 21.40	-21 12.7	2.546	1.585	+3.25	+ 5.6	10.2 17.5	46.0/ 84	9.8	6.0	268/0.44
	29	19	51.57	-20 21.2	19 53.90	-20 15.0	2.536	1.588	+3.18	+ 7.8	10.2 17.5	45.6/ 82	12.3	7.6	262/0.55
Feb.	8	20	23.37	-19 03.6	20 25.66	-18 55.8	2.530	1.596	+3.08	+ 9.6	10.3 17.5	44.9/ 79	14.8	9.1	258/0.66
	18	20	54.18	-17 27.7	20 56.43	-17 18.5	2.527	1.611	+2.97	+11.1	10.4 17.6	44.1/ 77	17.4	10.6	254/0.77
	28	21	23.84	-15 37.0	21 26.05	-15 26.7	2.526	1.632	+2.84	+12.1	10.5 17.6	43.0/ 75	20.2	12.1	251/0.88
Mar.	10	21	52.24	-13 35.6	21 54.40	-13 24.3	2.526	1.658	+2.71	+12.8	10.7 17.7	41.7/ 73	23.0	13.5	249/0.99
	20	22	19.33	-11 27.3	22 21.46	-11 15.2	2.526	1.689	+2.58	+13.2	10.9 17.8	40.3/ 72	26.1	15.0	247/1.09
	30	22	45.13	-09 15.5	22 47.23	-09 02.8	2.526	1.726	+2.45	+13.2	11.2 17.9	38.7/ 71	29.3	16.4	246/1.19
Apr.	9	23	09.65	-07 03.7	23 11.73	-06 50.6	2.524	1.766	+2.33	+12.9	11.4 18.0	37.1/ 70	32.7	17.8	245/1.29
	19	23	32.94	-04 54.4	23 35.01	-04 41.0	2.518	1.810	+2.21	+12.4	11.7 18.1	35.3/ 70	36.3	19.2	244/1.39
	29	23	55.04	-02 49.9	23 57.10	-02 36.5	2.509	1.857	+2.09	+11.8	12.0 18.2	33.5/ 70	40.2	20.5	244/1.49
May	9	00	15.96	-00 52.3	00 18.02	-00 38.9	2.494	1.906	+1.98	+10.9	12.3 18.3	31.6/ 70	44.3	21.7	244/1.58
	19	00	35.72	+00 57.0	00 37.79	+01 10.3	2.473	1.958	+1.86	+10.0	12.6 18.4	29.6/ 70	48.7	22.8	244/1.67
	29	00	54.32	+02 36.8	00 56.40	+02 49.9	2.445	2.012	+1.74	+ 8.9	12.8 18.5	27.5/ 71	53.4	23.8	245/1.76
June	8	01	11.68	+04 06.0	01 13.77	+04 18.9	2.411	2.068	+1.61	+ 7.8	13.1 18.6	25.3/ 72	58.4	24.7	246/1.85
	18	01	27.76	+05 23.9	01 29.87	+05 36.5	2.370	2.125	+1.47	+ 6.6	13.4 18.6	22.9/ 73	63.7	25.4	247/1.93
	28	01	42.45	+06 29.9	01 44.57	+06 42.2	2.321	2.183	+1.31	+ 5.4	13.6 18.7	20.3/ 74	69.4	25.9	247/2.00
July	8	01	55.59	+07 23.5	01 57.73	+07 35.4	2.266	2.241	+1.14	+ 4.1	13.9 18.8	17.5/ 76	75.6	26.1	248/2.06
	18	02	07.02	+08 04.3	02 09.17	+08 15.9	2.206	2.300	+0.95	+ 2.8	14.1 18.8	14.4/ 79	82.2	26.0	250/2.10
	28	02	16.52	+08 31.8	02 18.69	+08 43.2	2.141	2.360	+0.73	+ 1.4	14.3 18.9	11.0/ 82	89.4	25.5	251/2.12
Aug.	7	02	23.86	+08 46.0	02 26.04	+08 57.1	2.075	2.419	+0.49	+ 0.1	14.6 18.9	7.3/ 89	97.1	24.6	252/2.11
	17	02	28.80	+08 46.5	02 30.99	+08 57.5	2.009	2.479	+0.23	- 1.3	14.8 19.0	3.7/111	105.5	23.2	253/2.06
	27	02	31.11	+08 33.6	02 33.30	+08 44.5	1.946	2.539	-0.04	- 2.6	15.0 19.0	2.7/194	114.6	21.2	254/1.94
Sept.	6	02	30.66	+08 07.8	02 32.85	+08 18.7	1.892	2.598	-0.32	- 3.7	15.2 19.0	6.0/232	124.4	18.7	256/1.76
	16	02	27.47	+07 30.4	02 29.65	+07 41.4	1.850	2.657	-0.57	- 4.7	15.4 19.1	9.7/241	134.9	15.5	258/1.50
	26	02	21.73	+06 43.7	02 23.92	+06 55.0	1.826	2.716	-0.77	- 5.2	15.6 19.1	12.6/246	146.1	11.9	261/1.17
Oct.	6	02	14.00	+05 51.8	02 16.18	+06 03.3	1.825	2.775	-0.89	- 5.2	15.8 19.2	14.4/249	157.5	7.9	268/0.78
	16	02	05.06	+04 59.3	02 07.22	+05 11.2	1.849	2.833	-0.92	- 4.8	16.1 19.4	14.6/251	168.4	4.0	288/0.39
	26	01	55.84	+04 11.8	01 57.99	+04 23.9	1.902	2.890	-0.85	- 3.8	16.4 19.5	13.3/254	172.1	2.7	5/0.26
Nov.	5	01	47.31	+03 34.0	01 49.46	+03 46.4	1.985	2.947	-0.71	- 2.5	16.7 19.7	10.9/257	163.0	5.7	45/0.52
	15	01	40.23	+03 09.1	01 42.38	+03 21.7	2.095	3.004	-0.51	- 1.0	17.0 19.9	7.7/262	151.8	8.9	56/0.78
	25	01	35.10	+02 58.8	01 37.25	+03 11.4	2.230	3.060	-0.29	+ 0.4	17.4 20.1	4.4/275	140.8	11.8	61/0.96
Dec.	5	01	32.16	+03 02.8	01 34.30	+03 15.5	2.387	3.115	-0.08	+ 1.7	17.7 20.3	2.1/326	130.2	14.0	63/1.07
	15	01	31.39	+03 19.8	01 33.53	+03 32.5	2.560	3.169	+0.13	+ 2.8	18.1 20.6	3.4/ 34	120.0	15.6	65/1.12
	25	01	32.66	+03 48.1	01 34.80	+04 00.8	2.746	3.223	+0.31	+ 3.8	18.4 20.8	6.0/ 51	110.4	16.6	66/1.12
1991 Jan.	4	01	35.76	+04 25.8	01 37.91	+04 38.4	2.940	3.276	+0.47	+ 4.5	18.7 21.0	8.3/ 57	101.2	17.1	68/1.08
	14	01	40.44	+05 10.8	01 42.60	+05 23.3	3.139	3.329	+0.61	+ 5.1	19.1 21.2	10.4/ 61	92.4	17.2	69/1.02
	24	01	46.49	+06 01.5	01 48.66	+06 13.8	3.339	3.380	+0.72	+ 5.5	19.4 21.4	12.0/ 63	84.0	16.8	70/0.94
Feb.	3	01	53.69	+06 56.2	01 55.86	+07 08.3	3.537	3.431	+0.81	+ 5.7	19.7 21.6	13.4/ 65	75.9	16.2	71/0.86
	13	02	01.83	+07 53.5	02 04.01	+08 05.3	3.730	3.482	+0.89	+ 5.9	19.9 21.8	14.5/ 66	68.0	15.2	72/0.77

T/ET	q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch							
1990 Feb. 8.2229	1.068021	0.655744	5.46	61.5849	140.8693	9.2290	0.200	1990 Jan. 29.0							
m1 = 10.0+5log(delta)+40.0log(r)															
m2 = 18.0+5log(delta)+ 5.0log(r)+0.03(phase)															
Date/ Oh ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	h	Delta	r	Variation for T=+1 day	Magnitude ml	m2	Mot./PA	Elong.	P	PA/Tail	Moon Age
1989 Dec. 10	12 27.23	-02 33.2	12 29.28	-02 46.4	1.285	1.326	1.326	-3.08	15.4	20.5	64.8/106	70.1	44.3	293/5.59	146
20 13 08.88	-05 29.9	13 10.96	-05 42.7	1.197	1.256	1.256	-3.33	12.7	14.4	20.3	69.1/105	69.6	47.2	293/6.28	20
30 13 53.86	-08 20.6	13 55.97	-08 32.4	1.132	1.194	1.194	-3.51	12.8	13.4	20.2	72.0/103	68.3	49.9	292/6.93	91
1990 Jan. 9	14 41.46	-10 52.4	14 43.63	-11 02.7	1.089	1.142	1.142	-3.56	12.1	20.0	72.9/101	66.6	52.2	290/7.43	141
19 15 30.48	-12 53.1	15 32.70	-13 01.3	1.070	1.102	1.102	-3.47	10.6	11.8	20.0	71.7/98	64.7	53.9	287/7.74	26
29 16 19.32	-14 14.1	16 21.58	-14 19.8	1.071	1.077	1.077	-3.23	8.8	11.4	19.9	68.4/95	63.0	54.6	283/7.83	91
Feb. 8	17 06.37	-14 53.5	17 08.66	-14 56.7	1.087	1.068	1.068	-2.91	7.3	11.3	63.9/92	61.8	54.5	280/7.70	139
18 17 50.44	-14 55.4	17 52.74	-14 56.1	1.115	1.076	1.076	-2.56	6.1	11.5	20.0	58.6/89	61.2	53.6	276/7.43	29
28 18 30.81	-14 27.2	18 33.10	-14 25.5	1.149	1.101	1.101	-2.24	5.3	12.0	20.1	53.1/86	61.4	52.2	272/7.09	96
Mar. 10	19 07.16	-13 37.5	19 09.43	-13 33.7	1.183	1.140	1.140	-1.95	4.9	12.6	47.7/83	62.4	50.6	268/6.73	134
20 19 39.50	-12 34.3	19 41.74	-12 28.7	1.215	1.191	1.191	-1.72	4.6	13.5	20.3	42.3/81	64.3	48.9	265/6.39	24
30 20 07.96	-11 24.3	20 10.18	-11 17.3	1.241	1.253	1.253	-1.54	4.5	14.4	20.4	37.2/80	67.1	47.2	261/6.09	111
Apr. 9	20 32.72	-10 13.6	20 34.91	-10 05.3	1.259	1.323	1.323	-1.40	4.3	15.4	32.1/78	70.6	45.6	259/5.83	122
19 20 53.95	-09 06.8	20 56.13	-08 57.6	1.268	1.398	1.398	-1.30	4.2	16.3	20.6	27.0/78	74.9	43.9	256/5.61	11
29 21 11.74	-08 08.1	21 13.90	-07 58.1	1.268	1.478	1.478	-1.24	4.0	17.3	20.6	21.8/78	80.1	42.2	254/5.41	133
May 9	21 26.10	-07 21.5	21 28.25	-07 10.9	1.260	1.560	1.560	-1.22	3.8	18.2	16.5/79	86.1	40.2	252/5.22	103
19 21 36.99	-06 50.2	21 39.14	-06 39.2	1.245	1.643	1.643	-1.24	3.3	19.1	20.7	10.9/84	92.9	37.9	251/5.01	18
29 21 44.25	-06 37.9	21 46.40	-06 26.7	1.224	1.728	1.728	-1.29	2.8	19.9	20.7	5.3/101	100.7	35.2	249/4.75	162
June 8	21 47.72	-06 47.7	21 49.87	-06 36.3	1.201	1.813	1.813	-1.38	2.0	20.6	3.5/191	109.5	31.9	248/4.40	76
18 21 47.29	-07 21.7	21 49.45	-07 10.3	1.181	1.897	1.897	-1.51	1.0	20.6	8.7/227	119.3	27.8	247/3.94	53	
28 21 42.97	-08 20.8	21 45.15	-08 09.5	1.167	1.981	1.981	-1.65	0.0	20.5	14.2/235	130.1	23.1	246/3.32	161	
July 8	21 35.13	-09 42.4	21 37.33	-09 31.3	1.167	2.065	2.065	-1.79	1.1	20.4	18.4/238	141.9	17.7	246/2.56	38
18 21 24.55	-11 20.4	21 26.78	-11 09.7	1.185	2.147	2.147	-1.90	2.1	20.4	20.6/239	154.4	11.8	244/1.70	99	
28 21 12.45	-13 05.6	21 14.70	-12 55.4	1.226	2.228	2.228	-1.95	2.7	20.4	20.4/240	167.2	5.8	240/0.81	120	
Aug. 7	21 00.31	-14 47.5	21 02.60	-14 37.8	1.294	2.308	2.308	-1.93	2.9	20.4	18.0/240	177.8	1.0	152/0.13	6
17 20 49.52	-16 17.7	20 51.84	-16 08.4	1.389	2.387	2.387	-1.86	2.8	20.8	14.2/238	167.0	5.5	81/0.69	148	
27 20 41.08	-17 31.2	20 43.42	-17 22.3	1.510	2.464	2.464	-1.73	2.6	21.2	9.7/235	155.1	9.9	77/1.16	79	
Sept. 6	20 35.54	-18 26.7	20 37.89	-18 18.1	1.654	2.540	2.540	-1.58	2.4	21.5	5.3/224	144.0	13.5	76/1.45	49
16 20 32.95	-19 05.1	20 35.32	-18 56.5	1.818	2.614	2.614	-1.43	2.1	21.9	2.3/173	133.5	16.2	75/1.59	170	
26 20 33.15	-19 28.1	20 35.52	-19 19.6	1.999	2.687	2.687	-1.28	1.9	22.2	3.9/105	123.7	18.1	75/1.63	45	
Oct. 6	20 35.82	-19 37.9	20 38.18	-19 29.3	2.191	2.759	2.759	-1.15	1.8	22.5	6.7/89	114.4	19.3	75/1.59	87
16 20 40.55	-19 36.4	20 42.91	-19 27.6	2.393	2.829	2.829	-1.03	1.7	22.7	9.2/83	105.6	19.8	75/1.51	135	
26 20 47.00	-19 25.0	20 49.35	-19 15.9	2.601	2.898	2.898	-0.92	1.7	23.0	11.3/80	97.2	19.9	74/1.40	16	
Nov. 5	20 54.84	-19 05.0	20 57.18	-18 55.5	2.811	2.966	2.966	-0.83	1.6	23.2	13.0/78	89.1	19.5	74/1.28	121
15 21 03.78	-18 37.4	21 06.10	-18 27.5	3.022	3.032	3.032	-0.75	1.6	23.4	14.4/77	81.2	18.8	74/1.15	107	
25 21 13.58	-18 03.1	21 15.88	-17 52.8	3.229	3.097	3.097	-0.67	1.5	23.5	15.5/75	73.5	17.8	73/1.02	11	
Dec. 5	21 24.03	-17 22.9	21 26.31	-17 12.3	3.431	3.160	3.160	-0.61	1.5	23.7	16.3/74	65.9	16.5	73/0.90	152
15 21 34.96	-16 37.6	21 37.22	-16 26.6	3.626	3.222	3.222	-0.56	1.5	23.8	17.0/73	58.5	15.1	73/0.78	81	
25 21 46.23	-15 47.8	21 48.48	-15 36.4	3.810	3.283	3.283	-0.51	1.4	23.9	17.5/73	51.2	13.5	72/0.67	38	
1991 Jan. 4	21 57.73	-14 54.4	21 59.95	-14 42.6	3.981	3.343	3.343	-0.47	1.4	24.0	17.8/72	43.9	11.8	72/0.56	175
14 22 09.33	-13 57.9	22 11.54	-13 45.8	4.139	3.401	3.401	-0.43	1.3	24.0	18.0/71	36.7	9.9	73/0.46	58	
24 22 20.98	-12 59.1	22 23.17	-12 46.7	4.281	3.459	3.459	-0.40	1.3	24.1	18.0/71	29.5	8.1	73/0.36	67	
Feb. 3	22 32.57	-11 58.7	22 34.75	-11 46.0	4.405	3.514	3.514	-0.37	1.2	24.1	18.0/70	22.4	6.1	75/0.27	152
13 22 44.06	-10 57.4	22 46.22	-10 44.4	4.512	3.569	3.569	-0.35	1.2	24.2	17.8/70	15.4	4.2	78/0.18	35	

9.

$$m2 = 16.0 + 5 \log(\text{delta}) + 10.0 \log(r)$$
1990 Comet Handbook

Date/	Oh	ET	R.A. (1950)	Decl.	R.A. (App.)	Decl.	h	m	s	q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch	PA/Tail	Moon Age
1989	Dec.	10	13 53.03	-20 56.6	13 55.24	-21 08.3	13	55	.24	2.517249	0.343269	7.50	353.2243	248.0158	14.0875	0.200	1990 May	29.0	
		20	14 09.85	-22 17.5	14 12.10	-22 28.7	14	12	.10										
1990	Jan.	30	14 26.55	-23 32.4	14 28.84	-23 43.2	14	28	.84										
		9	14 42.99	-24 40.6	14 45.31	-24 50.7	14	45	.31										
		19	14 59.02	-25 41.1	15 01.38	-25 50.6	15	01	.38										
		29	15 14.45	-26 33.0	15 16.85	-26 41.9	15	16	.85										
Feb.		8	15 29.03	-27 15.8	15 31.46	-27 24.1	15	31	.46										
		18	15 42.52	-27 48.8	15 44.98	-27 56.4	15	44	.98										
		28	15 54.60	-28 11.5	15 57.09	-28 18.5	15	57	.09										
Mar.		10	16 04.93	-28 23.2	16 07.44	-28 29.7	16	07	.44										
		20	16 13.19	-28 23.3	16 15.71	-28 29.4	16	15	.71										
		30	16 19.02	-28 11.0	16 21.55	-28 16.8	16	21	.55										
Apr.		9	16 22.17	-27 45.3	16 24.69	-27 51.0	16	24	.69										
		19	16 22.51	-27 05.4	16 25.03	-27 11.1	16	25	.03										
		29	16 20.14	-26 10.6	16 22.64	-26 16.4	16	22	.64										
May		9	16 15.47	-25 01.4	16 17.96	-25 07.5	16	17	.96										
		19	16 09.27	-23 40.3	16 11.73	-23 46.7	16	11	.73										
		29	16 02.49	-22 11.9	16 04.92	-22 18.7	16	04	.92										
June		8	15 56.24	-20 42.8	15 58.65	-20 49.9	15	58	.65										
		18	15 51.43	-19 19.6	15 53.81	-19 26.9	15	53	.81										
		28	15 48.69	-18 07.8	15 51.05	-18 15.2	15	51	.05										
July		8	15 48.38	-17 10.5	15 50.72	-17 18.0	15	50	.72										
		18	15 50.53	-16 28.6	15 52.86	-16 36.0	15	52	.86										
		28	15 55.04	-16 01.2	15 57.37	-16 08.3	15	57	.37										
Aug.		7	16 01.73	-15 46.0	16 04.05	-15 52.8	16	04	.05										
		17	16 10.31	-15 40.6	16 12.64	-15 46.9	16	12	.64										
		27	16 20.58	-15 42.2	16 22.91	-15 48.0	16	22	.91										
Sept.		6	16 32.29	-15 48.2	16 34.63	-15 53.3	16	34	.63										
		16	16 45.22	-15 56.2	16 47.57	-16 00.6	16	47	.57										
		26	16 59.21	-16 04.1	17 01.56	-16 07.7	17	01	.56										
Oct.		6	17 14.08	-16 10.0	17 16.43	-16 12.7	17	16	.43										
		16	17 29.65	-16 12.3	17 32.01	-16 14.1	17	32	.01										
		26	17 45.82	-16 09.8	17 48.18	-16 10.6	17	48	.18										
Nov.		5	18 02.43	-16 01.3	18 04.78	-16 01.2	18	04	.78										
		15	18 19.36	-15 46.3	18 21.71	-15 45.1	18	21	.71										
		25	18 36.50	-15 23.9	18 38.84	-15 21.7	18	38	.84										
Dec.		5	18 53.73	-14 54.0	18 56.06	-14 50.8	18	56	.06										
		15	19 10.95	-14 16.4	19 13.26	-14 12.2	19	13	.26										
		25	19 28.07	-13 31.1	19 30.37	-13 26.0	19	30	.37										
1991	Jan.	4	19 45.00	-12 38.4	19 47.28	-12 32.3	19	47	.28										
		14	20 01.65	-11 38.7	20 03.91	-11 31.8	20	03	.91										
		24	20 17.97	-10 32.4	20 20.21	-10 24.7	20	20	.21										
Feb.		3	20 33.87	-09 20.2	20 36.09	-09 11.7	20	36	.09										
		13	20 49.31	-08 02.8	20 51.50	-07 53.6	20	51	.50										

P/Helin-Roman-Crockett 1989b Orbit by Marsden B.G. MPC 14460 (1989)

T/ET	Date/	0h	ET	R.A. h	m	Decl. °	R.A. h	m	Decl. °	Delta	r	Peri. °	Daily m	motion	Node °	Inc. °	Magnitude m ₁ m ₂	Mot./PA	Elong. °	P	PA/Tail	Moon Age
1988 Sep.	10.2487			3.470510		0.141093				8.12	9.6218	91.4147	4.2376			0.200						
m ₁ = 7.0+5log(delta)+10.0log(r)																						
m ₂ = 11.0+5log(delta)+ 5.0log(r)+0.03(phase)																						
1989 Dec.	30	12	38.76	+00	31.9	12	40.82	+00	18.6	3.688	3.800	+0.46	-	1.6	15.6	17.2	7.0/103	89.0	15.0	293/0.76	112	.04
1990 Jan.	9	12	43.33	+00	15.5	12	45.40	+00	02.2	3.548	3.812	+0.31	-	0.6	15.6	17.1	4.7/ 98	98.0	14.8	292/0.78	110	.94
	19	12	46.43	+00	09.2	12	48.50	+00	04.1	3.412	3.824	+0.15	+	0.4	15.5	17.0	2.3/ 79	107.4	14.2	292/0.78	22	.49
	29	12	47.93	+00	13.3	12	50.00	+00	00.0	3.284	3.835	-0.02	+	1.5	15.4	16.9	1.5/348	117.2	13.2	290/0.75	145	.06
Feb.	8	12	47.73	+00	27.9	12	49.81	+00	14.6	3.167	3.847	-0.19	+	2.4	15.4	16.8	3.7/311	127.4	11.7	289/0.69	74	.96
	18	12	45.85	+00	52.1	12	47.93	+00	38.7	3.068	3.859	-0.35	+	3.2	15.3	16.7	6.1/302	138.0	9.9	287/0.60	52	.48
	28	12	42.40	+01	24.5	12	44.48	+01	11.1	2.989	3.871	-0.48	+	3.8	15.3	16.5	8.1/298	148.9	7.6	284/0.47	169	.09
Mar.	10	12	37.63	+02	02.7	12	39.72	+01	49.2	2.935	3.883	-0.57	+	4.1	15.2	16.4	9.4/296	160.0	5.0	278/0.32	36	.98
	20	12	31.95	+02	43.3	12	34.04	+02	29.8	2.910	3.896	-0.61	+	4.0	15.2	16.3	10.0/293	170.4	2.4	257/0.16	88	.46
	30	12	25.84	+03	23.0	12	27.93	+03	09.4	2.914	3.908	-0.60	+	3.5	15.2	16.3	9.6/291	173.1	1.8	169/0.11	130	.14
Apr.	9	12	19.85	+03	57.9	12	21.94	+03	44.3	2.949	3.920	-0.53	+	2.7	15.3	16.4	8.4/289	163.7	4.1	133/0.26	10	.99
	19	12	14.51	+04	25.3	12	16.60	+04	11.6	3.011	3.932	-0.43	+	1.8	15.3	16.6	6.7/285	152.9	6.7	124/0.42	125	.43
	29	12	10.22	+04	43.0	12	12.31	+04	29.4	3.099	3.944	-0.29	+	0.7	15.4	16.7	4.5/279	142.3	9.0	120/0.54	88	.20
May	9	12	07.28	+04	50.0	12	09.37	+04	36.4	3.209	3.956	-0.14	-	0.4	15.5	16.8	2.2/260	132.0	10.9	118/0.64	41	.99
	19	12	05.83	+04	46.2	12	07.92	+04	32.6	3.337	3.969	+0.01	-	1.4	15.6	17.0	1.4/175	122.1	12.5	117/0.70	161	.37
	29	12	05.91	+04	32.1	12	08.00	+04	18.5	3.479	3.981	+0.16	-	2.4	15.7	17.1	3.3/135	112.6	13.6	116/0.73	51	.26
June	8	12	07.48	+04	08.4	12	09.57	+03	54.8	3.630	3.993	+0.29	-	3.2	15.8	17.2	5.5/126	103.6	14.3	115/0.74	72	1.00
	18	12	10.43	+03	36.3	12	12.51	+03	22.7	3.787	4.005	+0.42	-	3.9	15.9	17.3	7.4/122	95.0	14.6	114/0.73	159	.30

$$m_2 = 11.0 + 5 \log(\delta) + 5.0 \log(r) + 0.03(\text{phase})$$

$$m_1 = 7.0 + 5 \log(\delta) + 10.0 \log(r)$$

P/Schwassmann-Wachmann 3 Orbit by Landgraf W. MPC 12122 (1987)

T/ET		q (AU)		e		P		Peri.		Node		Inc.		Tail(AU)		Epoch													
1990 May 19.3431		0.936273		0.694015		5.35		198.7706		69.2713		11.4110		0.200		1990 May 29.0													
		h m		h m						for T=+1 day		m1 m2																	
		Decl.		Decl.		Delta		r		Variation		Magnitude		Mot./PA		Elong.													
		h m		h m						for T=+1 day		m1 m2																	
		12 22.01		+09 58.7		12 24.04		+09 45.3		2.197		2.189		-1.16 + 9.0		18.8 20.1		26.8/105		76.6		25.9		297/2.11		137		.90	
1989 Dec. 20		12 39.49		+08 49.7		12 41.52		+08 36.5		1.996		2.101		-1.33 +10.4		18.3 19.7		27.6/103		82.2		27.6		295/2.45		17		.50	
30		12 57.58		+07 44.1		12 59.61		+07 31.0		1.797		2.012		-1.52 +12.2		17.8 19.3		28.7/102		87.6		29.2		294/2.84		110		.04	
1990 Jan. 9		13 16.43		+06 42.5		13 18.46		+06 29.7		1.603		1.921		-1.77 +14.3		17.3 18.9		30.2/101		92.8		30.8		292/3.30		114		.94	
19		13 36.31		+05 45.0		13 38.34		+05 32.6		1.415		1.828		-2.08 +17.0		16.7 18.4		32.2/ 99		97.7		32.2		290/3.85		22		.49	
29		13 57.56		+04 51.6		13 59.60		+04 39.7		1.235		1.735		-2.48 +20.3		16.0 17.9		35.0/ 98		102.2		33.7		288/4.53		128		.06	
Feb. 8		14 20.72		+04 01.2		14 22.76		+03 50.0		1.065		1.640		-3.01 +24.5		15.4 17.3		39.1/ 97		105.1		35.3		285/5.38		94		.96	
13		14 33.27		+03 36.4		14 35.31		+03 25.7		0.984		1.593		-3.36 +27.4		15.0 17.0		40.4/ 97		107.8		36.2		283/5.88		39		.90	
18		14 46.64		+03 11.4		14 48.68		+03 01.1		0.906		1.546		-3.73 +30.3		14.6 16.7		43.4/ 97		109.2		37.1		282/6.47		33		.48	
23		15 01.01		+02 45.4		15 03.06		+02 35.8		0.832		1.498		-4.16 +33.6		14.2 16.4		47.0/ 97		110.4		38.2		280/7.14		83		.07	
28		15 16.60		+02 17.8		15 18.65		+02 08.8		0.762		1.451		-4.65 +37.3		13.8 16.0		51.6/ 97		111.2		39.5		278/7.92		141		.09	
Mar. 5		15 33.69		+01 47.2		15 35.74		+01 38.9		0.695		1.404		-5.21 +41.6		13.4 15.7		57.2/ 97		111.5		41.1		276/8.83		138		.60	
10		15 52.62		+01 12.2		15 54.68		+01 04.9		0.633		1.358		-5.86 +46.3		13.0 15.3		64.1/ 97		111.4		42.9		274/9.92		84		.98	
15		16 13.82		+00 31.2		16 15.90		+00 24.9		0.575		1.312		-6.60 +51.7		12.6 15.0		72.5/ 98		110.7		45.1		273/11.2		38		.88	
20		16 37.78		-00 17.6		16 39.86		+00 22.5		0.522		1.268		-7.42 +57.5		12.1 14.6		82.4/ 98		109.2		47.9		271/12.7		36		.46	
25		17 04.97		-01 15.7		17 07.07		-01 19.1		0.476		1.224		-8.29 +63.5		11.7 14.3		93.6/ 99		107.0		51.2		269/14.5		84		.05	
30		17 35.85		-02 24.5		17 37.96		-02 26.1		0.436		1.182		-9.15 +69.3		11.3 13.9		105.4/ 99		103.9		55.1		267/16.6		141		.14	
Apr. 4		18 10.63		-03 43.5		18 12.76		-03 43.0		0.405		1.142		-9.88 +74.0		10.9 13.6		116.3/ 99		100.0		59.6		265/18.8		144		.67	

T/ET	q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch							
1990 June 21.6005	1.625775	0.597750	8.13	338.3133	259.3949	29.8326	0.200	1990 July 8.0							
m1 = 12.0+5log(delta)+15.0log(r)															
Date/	Oh ET	R.A.(1950)	Decl.	h	m	s	Delta	r	Variation for T=+1 day	Magnitude m1 m2	Mot./PA	Elong.	P	PA/Tail	Moon Age
m2 = 16.0+5log(delta)+10.0log(r)															
1989 Dec.															
10	10	58.06	-25 18.1	11	00.00	-25 30.8	2.412	2.474	-1.22 + 7.1	19.8 21.8	24.5/145	81.9	23.2	292/1.74	132 .90
20	11	08.80	-28 36.5	11	10.75	-28 49.4	2.250	2.411	-1.38 + 7.5	19.5 21.6	24.2/149	87.2	24.1	295/1.92	28 .50
30	11	18.69	-32 02.4	11	20.65	-32 15.4	2.092	2.348	-1.57 + 7.9	19.2 21.3	23.8/153	92.3	24.7	299/2.11	110 .04
1990 Jan.															
9	11	27.47	-35 33.5	11	29.45	-35 46.6	1.941	2.285	-1.81 + 8.5	18.8 21.0	23.1/158	97.3	25.3	304/2.30	108 .94
19	11	34.87	-39 07.0	11	36.86	-39 20.2	1.798	2.223	-2.09 + 9.1	18.5 20.7	22.1/164	102.1	25.6	310/2.50	36 .49
29	11	40.47	-42 38.8	11	42.48	-42 52.1	1.663	2.163	-2.42 + 10.0	18.1 20.5	20.7/170	106.7	25.9	316/2.71	127 .06
Feb.															
8	11	43.85	-46 02.8	11	45.88	-46 16.2	1.538	2.103	-2.80 + 11.3	17.8 20.2	18.9/178	110.9	26.0	324/2.92	86 .96
18	11	44.60	-49 11.7	11	46.63	-49 25.2	1.424	2.046	-3.22 + 13.1	17.4 19.9	16.5/187	114.8	26.0	332/3.13	53 .48
28	11	42.38	-51 55.8	11	44.39	-52 09.3	1.319	1.990	-3.65 + 15.6	17.1 19.6	13.6/199	118.3	26.0	343/3.35	136 .09
Mar.															
10	11	37.30	-54 03.6	11	39.27	-54 17.1	1.224	1.936	-4.03 + 18.7	16.7 19.3	10.2/217	121.3	26.0	354/3.57	66 .98
20															
11	30.15	-55 24.1	11	32.09	-55 37.6	1.140	1.885	1.885	-4.31 + 22.4	16.4 19.0	6.8/249	123.8	26.0	7/3.81	74 .46
30	11	22.58	-55 47.2	11	24.47	-56 00.7	1.065	1.837	-4.43 + 26.0	16.1 18.8	6.2/309	125.8	26.2	21/4.05	127 .14
Apr.															
9	11	16.97	-55 07.4	11	18.82	-55 20.8	1.000	1.793	-4.42 + 29.1	15.8 18.5	10.3/353	127.2	26.4	35/4.31	50 .99
19	11	15.54	-53 24.8	11	17.40	-53 38.3	0.945	1.753	-4.32 + 30.9	15.5 18.3	16.6/ 14	128.1	26.8	49/4.59	100 .43
29	11	19.75	-50 43.5	11	21.65	-50 57.1	0.902	1.718	-4.20 + 30.9	15.3 18.1	23.4/ 27	128.2	27.4	62/4.88	103 .20
May															
9	11	30.03	-47 12.2	11	32.00	-47 25.9	0.870	1.688	-4.10 + 28.9	15.1 18.0	30.1/ 35	127.6	28.3	73/5.18	44 .99
19	11	45.79	-43 01.8	11	47.83	-43 15.6	0.853	1.663	-4.01 + 25.0	15.0 17.9	35.8/ 41	126.0	29.5	83/5.47	131 .37
29	12	05.95	-38 26.0	12	08.06	-38 39.8	0.851	1.644	-3.94 + 19.5	14.9 17.8	40.1/ 47	123.6	30.9	92/5.74	73 .26
June															
8	12	29.28	-33 41.8	12	31.45	-33 55.5	0.866	1.632	-3.84 + 13.1	14.9 17.8	42.4/ 51	120.2	32.5	99/5.93	54 1.00
18	12	54.50	-29 06.1	12	56.71	-29 19.5	0.898	1.626	-3.71 + 6.7	14.9 17.9	43.1/ 56	116.2	34.1	103/6.02	163 .30
28															
13	20.66	-24 53.2	13	22.90	-25 06.1	0.948	1.627	1.627	-3.54 + 1.0	15.1 18.0	42.6/ 60	111.8	35.5	107/5.96	45 .31
July															
8	13	47.04	-21 12.6	13	49.29	-21 24.9	1.015	1.635	-3.34 - 3.7	15.2 18.2	41.3/ 65	107.2	36.5	108/5.77	72 1.00
18	14	13.16	-18 07.9	14	15.42	-18 19.3	1.096	1.649	-3.11 - 7.2	15.5 18.4	39.7/ 69	102.6	37.0	108/5.47	158 .22
28	14	38.79	-15 37.9	14	41.05	-15 48.5	1.190	1.669	-2.88 - 9.6	15.7 18.6	38.2/ 73	98.1	37.0	108/5.10	26 .35
Aug.															
7	15	03.83	-13 38.9	15	06.09	-13 48.4	1.295	1.695	-2.64 - 11.2	16.0 18.9	36.9/ 76	93.7	36.6	106/4.69	92 1.00
17	15	28.25	-12 05.2	15	30.51	-12 13.6	1.408	1.727	-2.41 - 12.0	16.3 19.1	35.8/ 79	89.5	35.9	104/4.27	134 .15
27	15	52.12	-10 51.5	15	54.37	-10 58.7	1.530	1.764	-2.20 - 12.4	16.6 19.4	35.0/ 81	85.4	34.8	102/3.86	17 .38
Sept.															
6	16	15.48	-09 52.3	16	17.72	-09 58.3	1.657	1.805	-2.00 - 12.5	16.9 19.7	34.2/ 82	81.3	33.5	99/3.46	110 .99
16	16	38.37	-09 03.0	16	40.61	-09 07.7	1.789	1.850	-1.82 - 12.3	17.3 19.9	33.6/ 83	77.3	32.0	95/3.10	113 .10
26	17	00.88	-08 19.6	17	03.10	-08 23.0	1.925	1.899	-1.66 - 12.0	17.6 20.2	33.1/ 83	73.4	30.4	92/2.76	19 .40
Oct.															
6	17	23.00	-07 38.7	17	25.22	-07 40.8	2.064	1.951	-1.51 - 11.7	17.9 20.5	32.6/ 83	69.4	28.7	88/2.45	129 .97
16	17	44.77	-06 57.7	17	46.98	-06 58.5	2.204	2.005	-1.38 - 11.2	18.2 20.7	32.2/ 83	65.4	26.9	84/2.17	95 .07
26	18	06.20	-06 14.4	18	08.39	-06 14.0	2.345	2.062	-1.26 - 10.8	18.6 21.0	31.8/ 82	61.3	25.0	80/1.92	28 .42
Nov.															
5	18	27.27	-05 27.2	18	29.44	-05 25.5	2.485	2.120	-1.16 - 10.3	18.9 21.2	31.4/ 81	57.3	23.2	75/1.69	147 .93
15	18	47.95	-04 34.9	18	50.12	-04 32.0	2.624	2.180	-1.06 - 9.8	19.2 21.5	30.9/ 79	53.1	21.3	71/1.48	79 .05
25	19	08.26	-03 36.7	19	10.40	-03 32.6	2.761	2.241	-0.98 - 9.3	19.5 21.7	30.5/ 78	49.0	19.4	66/1.29	41 .44
Dec.															
5	19	28.13	-02 32.1	19	30.26	-02 26.9	2.894	2.303	-0.90 - 8.8	19.7 21.9	30.0/ 76	44.8	17.6	60/1.12	160 .90
15	19	47.55	-01 21.0	19	49.66	-01 14.8	3.023	2.365	-0.83 - 8.3	20.0 22.1	29.5/ 75	40.7	15.7	55/0.97	63 .04
25	20	06.50	-00 03.4	20	08.60	+00 03.8	3.146	2.428	-0.77 - 7.9	22.3	28.9/ 73	36.6	14.0	48/0.83	58 .49
1991 Jan.															
4	20	24.95	+01 20.4	20	27.03	+01 28.5	3.262	2.492	-0.72 - 7.4	22.5	28.3/ 71	32.7	12.3	41/0.71	155 .86
14															
20	42.89	+02 50.0	20	44.95	+02 59.0	3.370	2.556	-0.67 - 7.0	22.7	27.7/ 70	29.1	10.8	32/0.60	47 .04	
24															
21	00.29	+04 25.1	21	02.33	+04 34.8	3.470	2.619	-0.63 - 6.5	22.9	27.1/ 68	25.8	9.4	22/0.51	79 .54	
Feb.															
3	21	17.13	+06 04.8	21	19.16	+06 15.2	3.560	2.683	-0.59 - 6.1	23.0	26.4/ 67	23.3	8.3	9/0.44	139 .83
13	21	33.40	+07 48.8	21	35.43	+07 59.8	3.640	2.747	-0.56 - 5.7	23.2	25.6/ 65	21.7	7.6	354/0.40	32 .03

T/ET 1990 July 7.5201 q (AU) 2.222545 e 0.366341 P 6.57 Peri. 92.9989 Node 70.3902 Inc. 6.1913 Tail(AU) 0.200 Epoch 1990 July 8.0

$$m_1 = 9.0 + 5 \log(\delta) + 15.0 \log(r) \quad m_2 = 16.0 + 5 \log(\delta) + 10.0 \log(r)$$

Date/	0h ET	R.A. (1950)	Decl.	R.A. (App.)	Decl.	Delta	r	Variation for T=+1 day	Magnitude m ₁	Magnitude m ₂	Mot./PA	Elong.	P	PA/Tail	Moon Age
1989 Dec.	10	07 30.51	+26 16.3	07 32.99	+26 11.1	1.747	2.627	-1.72 + 1.3	16.5 21.4	8.3/303	146.8	11.8	272/1.21	69	.90
	20	07 25.31	+27 00.5	07 27.82	+26 55.6	1.656	2.594	-1.82 + 1.0	16.3 21.2	11.1/295	158.0	8.2	266/0.87	70	.50
	30	07 17.76	+27 46.4	07 20.29	+27 41.9	1.591	2.563	-1.90 + 0.6	16.1 21.1	12.7/290	169.0	4.2	248/0.46	166	.04
	9	07 08.75	+28 28.8	07 11.31	+28 24.8	1.553	2.532	-1.94 0.0	16.0 21.0	12.6/286	173.5	2.5	161/0.29	26	.94
1990 Jan.	19	06 59.53	+29 03.3	07 02.10	+28 59.9	1.542	2.502	-1.93 - 0.6	15.9 20.9	10.9/283	163.7	6.3	118/0.73	107	.49
	29	06 51.43	+29 27.3	06 54.02	+29 24.3	1.559	2.473	-1.87 - 1.2	15.9 20.9	7.6/280	152.3	10.7	108/1.21	124	.06
	8	06 45.67	+29 40.4	06 48.26	+29 37.7	1.598	2.445	-1.79 - 1.5	15.8 20.9	3.5/276	141.1	14.7	103/1.62	17	.96
	18	06 43.00	+29 44.0	06 45.59	+29 41.5	1.657	2.419	-1.70 - 1.6	15.9 20.9	1.0/114	130.5	18.1	100/1.93	142	.48
Mar.	28	06 43.73	+29 39.8	06 46.31	+29 37.3	1.731	2.394	-1.60 - 1.5	15.9 21.0	5.5/101	120.7	20.8	98/2.13	85	.09
	10	06 47.85	+29 29.2	06 50.43	+29 26.4	1.815	2.370	-1.52 - 1.3	15.9 21.0	9.6/ 99	111.7	22.9	97/2.23	52	.98
Apr.	20	06 55.09	+29 12.7	06 57.66	+29 09.5	1.907	2.347	-1.44 - 0.9	16.0 21.1	13.3/ 99	103.4	24.4	97/2.26	171	.46
	30	07 05.07	+28 50.0	07 07.62	+28 46.3	2.003	2.327	-1.38 - 0.4	16.0 21.2	16.5/100	95.8	25.3	97/2.24	51	.14
	9	07 17.40	+28 20.7	07 19.94	+28 16.3	2.101	2.307	-1.32 + 0.1	16.1 21.2	19.2/100	88.7	25.7	97/2.18	80	.99
	19	07 31.67	+27 43.8	07 34.18	+27 38.6	2.199	2.290	-1.28 + 0.7	16.1 21.3	21.6/101	82.2	25.8	98/2.09	163	.43
May	29	07 47.51	+26 58.5	07 50.00	+26 52.4	2.296	2.274	-1.24 + 1.3	16.2 21.4	23.6/102	76.1	25.5	99/1.99	22	.20
	9	08 04.61	+26 04.0	08 07.06	+25 57.1	2.390	2.261	-1.20 + 1.8	16.2 21.4	25.2/104	70.4	24.9	100/1.87	102	.99
	19	08 22.64	+25 00.1	08 25.06	+24 52.2	2.482	2.249	-1.17 + 2.4	16.3 21.5	26.7/105	65.0	24.1	101/1.75	139	.37
	29	08 41.39	+23 46.3	08 43.77	+23 37.6	2.570	2.240	-1.13 + 3.0	16.3 21.6	27.8/106	59.8	23.0	102/1.63	6	.26
June	8	09 00.63	+22 22.9	09 02.97	+22 13.4	2.655	2.232	-1.10 + 3.5	16.4 21.6	28.8/108	54.9	21.8	103/1.50	121	1.00
	18	09 20.19	+20 50.3	09 22.48	+20 39.9	2.735	2.227	-1.07 + 4.0	16.4 21.7	29.6/109	50.2	20.5	104/1.37	115	.30
July	28	09 39.94	+19 08.8	09 42.19	+18 57.8	2.812	2.224	-1.04 + 4.5	16.5 21.7	30.3/110	45.7	19.1	104/1.25	24	.31
	8	09 59.77	+17 19.5	10 01.99	+17 07.8	2.884	2.223	-1.01 + 4.9	16.5 21.8	30.8/111	41.2	17.5	105/1.12	139	1.00
	18	10 19.60	+15 23.1	10 21.78	+15 10.9	2.952	2.224	-0.98 + 5.2	16.6 21.8	31.2/112	36.8	15.9	105/1.00	92	.22
	28	10 39.39	+13 20.8	10 41.54	+13 08.1	3.015	2.227	-0.95 + 5.5	16.6 21.9	31.5/113	32.5	14.2	105/0.88	42	.35
Aug.	7	10 59.09	+11 13.7	11 01.22	+11 00.6	3.073	2.233	-0.93 + 5.7	16.7 21.9	31.8/114	28.3	12.4	104/0.76	157	1.00
	17	11 18.70	+09 03.0	11 20.80	+08 49.7	3.127	2.240	-0.90 + 5.9	16.7 22.0	31.9/114	24.0	10.6	104/0.63	69	.15
	27	11 38.21	+06 49.9	11 40.29	+06 36.5	3.175	2.250	-0.88 + 6.0	16.8 22.0	31.9/115	19.8	8.7	102/0.52	57	.38
	Sept. 6	11 57.61	+04 35.8	11 59.69	+04 22.3	3.217	2.262	-0.86 + 6.1	16.9 22.1	31.9/115	15.5	6.9	99/0.40	172	.99
Sept.	16	12 16.92	+02 21.8	12 19.00	+02 08.3	3.253	2.276	-0.84 + 6.1	16.9 22.1	31.7/115	11.3	5.0	94/0.29	47	.10
	26	12 36.15	+00 09.1	12 38.23	-00 04.3	3.283	2.291	-0.83 + 6.0	17.0 22.2	31.5/114	7.2	3.1	82/0.18	73	.40
Oct.	6	12 55.30	-02 01.0	12 57.39	-02 14.2	3.305	2.309	-0.82 + 5.9	17.0 22.2	31.2/114	3.9	1.7	47/0.10	159	.97
	16	13 14.37	-04 07.5	13 16.47	-04 20.4	3.321	2.328	-0.80 + 5.8	17.1 22.3	30.9/113	4.6	2.0	341/0.11	28	.07
	26	13 33.37	-06 09.4	13 35.49	-06 21.9	3.328	2.349	-0.79 + 5.7	17.2 22.3	30.4/113	8.5	3.6	314/0.20	89	.42
	Nov. 5	13 52.26	-08 05.5	13 54.41	-08 17.5	3.326	2.372	-0.79 + 5.5	17.2 22.4	29.9/112	13.2	5.5	304/0.31	137	.93
Nov.	15	14 11.03	-09 55.1	14 13.20	-10 06.5	3.316	2.396	-0.78 + 5.2	17.3 22.4	29.3/111	18.1	7.4	299/0.42	11	.05
	25	14 29.64	-11 37.3	14 31.84	-11 48.2	3.297	2.421	-0.77 + 5.0	17.4 22.4	28.5/110	23.2	9.3	295/0.53	107	.44
	Dec. 5	14 48.01	-13 11.6	14 50.24	-13 21.8	3.268	2.448	-0.77 + 4.8	17.4 22.5	27.7/109	28.6	11.1	292/0.64	113	.90
	15	15 06.08	-14 37.5	15 08.35	-14 46.9	3.229	2.476	-0.77 + 4.5	17.5 22.5	26.7/107	34.1	12.9	290/0.75	13	.04
1991 Jan.	25	15 23.75	-15 54.7	15 26.05	-16 03.3	3.180	2.505	-0.77 + 4.3	17.5 22.5	25.6/106	39.8	14.5	288/0.85	128	.49
	4	15 40.89	-17 03.0	15 43.23	-17 10.8	3.122	2.535	-0.77 + 4.0	17.5 22.5	24.3/105	45.7	16.1	286/0.96	90	.86
Feb.	14	15 57.39	-18 02.7	15 59.76	-18 09.7	3.055	2.565	-0.77 + 3.8	17.6 22.5	22.9/104	51.8	17.5	284/1.06	31	.04
	24	16 13.07	-18 53.9	16 15.46	-19 00.1	2.978	2.597	-0.78 + 3.6	17.6 22.5	21.2/102	58.1	18.8	282/1.17	153	.54
	3	16 27.76	-19 37.4	16 30.18	-19 42.8	2.894	2.629	-0.79 + 3.4	17.6 22.5	19.4/101	64.8	19.8	280/1.26	66	.83
	13	16 41.27	-20 13.8	16 43.71	-20 18.4	2.803	2.663	-0.80 + 3.2	17.6 22.5	17.3/101	71.6	20.6	278/1.35	52	.03

Epoch
1990 July 8.0

$$m2 = 16.5 + 5 \log(\text{delta}) + 10.0 \log(r)$$
1990 Comet Handbook

Epoch

$$m2 = 18.0 + 5 \log(\text{delta}) + 15.0 \log(r)$$

1990 Comet Handbook

T/ET	Date/	Oh	ET	R.A. h m s	(1950)	Decl.	R.A.(App.) h m s	e	P	Peri.	Node	Inc.	Tail(AU)	Elong.	P	PA/Tail	Moon Age
1990 Sep.	12.7771			0.541253	0.821884	5.30	325.7354	88.6612	4.2246	1990 Sep.	26.0						
m1 = 13.5+5log(delta)+20.0log(r) m2 = 18.0+5log(delta)+15.0log(r)																	
1990 Oct.	11	11	12.13	+06° 38.9'		1.462	0.786	-1.21 + 3.9	12.2 17.3	51.5/109	30.5	40.1	295/4.56	61	.52		
	16	11	28.40	+05° 13.3'		1.535	0.855	-1.09 + 4.0	13.1 17.9	48.0/110	31.2	37.1	296/4.07	5	.07		
	21	11	43.48	+03° 51.7'		1.602	0.926	-0.98 + 3.9	13.9 18.5	44.7/110	32.1	34.9	296/3.71	59	.05		
	26	11	57.48	+02° 34.5'		1.663	0.997	-0.87 + 3.7	14.6 19.1	41.6/110	33.4	32.3	297/3.44	114	.42		
	31	12	10.50	+01° 22.1'		1.718	1.068	-0.77 + 3.4	15.2 19.6	38.9/110	34.9	33.2	297/3.23	172	.88		
Nov.	5	12	22.65	+00° 14.4'		1.767	1.138	-0.69 + 3.2	15.9 20.1	36.3/110	36.7	31.4	297/3.08	113	.93		
	10	12	34.00	-00° 48.6'		1.810	1.208	-0.61 + 2.9	16.4 20.5	34.0/110	38.7	30.8	296/2.96	45	.45		
	15	12	44.64	-01° 47.0'		1.848	1.277	-0.54 + 2.7	17.0 20.9	31.7/110	40.9	30.5	296/2.88	17	.05		
	20	12	54.59	-02° 40.9'		1.881	1.345	-0.48 + 2.4	17.4 21.3	29.6/110	43.3	30.3	296/2.81	72	.06		
	25	13	03.90	-03° 30.3'		1.908	1.412	-0.43 + 2.2	17.9 21.6	27.6/109	45.9	30.1	295/2.77	130	.44		
Dec.	5	13	20.72	-04° 56.2'		1.947	1.542	-0.35 + 1.9	18.7 22.3	22.8/108	51.6	30.1	295/2.71	90	.90		
	15	13	35.24	-06° 05.6'		1.966	1.668	-0.28 + 1.7	19.4 22.8	19.0/106	58.0	30.0	294/2.68	36	.04		
	25	13	47.45	-06° 58.6'		1.967	1.789	-0.24 + 1.6	20.0 23.3	15.1/104	65.0	29.9	293/2.67	152	.49		
1991 Jan.	4	13	57.26	-07° 35.4'		1.953	1.906	-0.22 + 1.6	23.7	11.0/101	72.6	29.5	292/2.66	63	.86		
	14	14	04.52	-07° 55.9'		1.924	2.020	-0.21 + 1.8	24.0	6.6/ 93	81.0	28.8	291/2.63	60	.04		
	24	14	08.98	-07° 59.6'		1.886	2.129	-0.23 + 2.0	24.3	2.5/ 57	90.1	27.5	290/2.57	168	.54		
Feb.	3	14	10.39	-07° 46.1'		1.843	2.235	-0.26 + 2.3	24.6	4.1/318	100.0	25.7	289/2.46	32	.83		
	13	14	08.55	-07° 15.2'		1.800	2.338	-0.31 + 2.8	24.8	9.1/302	110.6	23.3	288/2.29	91	.03		

P/Encke

Orbit by Nakano S.

NK 519 (1987)

[illegible]

T/ET	q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch					
1990 Oct. 28.5664	0.330886	0.850219	3.28	186.2443	334.0410	11.9391	0.200	1990 Nov. 5.0					
m1 = 9.8 + 5log(delta) + 2.5(r ^{1.5} - 1)													
m2 = 14.5+5log(delta)+ 5.0log(r)+0.03(phase)													
Date/ Oh ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	Delta	r	Daily motion	Magnitude	Mot./PA	Elong.	P	PA/Tail	Moon Age
	^h ^m	[°] ['] ^{''}	^h ^m	[°] ['] ^{''}			^m	^m ₁ ^m ₂		[°]		[°]	[°]
1990 June 8	01 42.70	+16 47.1	01 44.88	+16 59.3	2.828	2.258	+1.61	+11.1	19.1	25.6/ 64	46.8	19.1	254/1.24
18	01 58.83	+18 38.5	02 01.05	+18 50.3	2.630	2.160	+1.73	+11.6	19.4	27.1/ 64	52.1	21.8	254/1.51
28	02 16.11	+20 34.9	02 18.38	+20 46.1	2.424	2.057	+1.88	+12.2	18.4	28.9/ 64	57.1	24.5	255/1.82
July 8	02 34.92	+22 37.1	02 37.23	+22 47.7	2.211	1.949	+2.09	+12.9	17.3	31.5/ 65	61.8	27.4	256/2.20
18	02 55.83	+24 46.3	02 58.21	+24 56.0	1.996	1.836	+2.30	+13.5	16.3	34.0/ 66	66.1	30.4	257/2.67
23	03 07.34	+25 53.7	03 09.75	+26 03.0	1.887	1.777	+2.48	+13.9	15.7	36.1/ 67	68.0	32.0	257/2.95
28	03 19.73	+27 03.2	03 22.17	+27 11.9	1.779	1.717	+2.69	+14.3	15.2	38.5/ 67	69.8	33.7	258/3.27
Aug. 2	03 33.21	+28 14.7	03 35.69	+28 22.8	1.672	1.655	+2.96	+14.7	14.6	41.6/ 68	71.3	35.5	259/3.62
7	03 48.01	+29 28.0	03 50.53	+29 35.4	1.565	1.591	+3.29	+14.9	14.0	45.2/ 70	72.6	37.5	260/4.04
12	04 04.46	+30 42.5	04 07.02	+30 49.1	1.461	1.526	+3.70	+14.9	13.5	49.7/ 71	73.6	39.6	262/4.51
17	04 22.95	+31 57.2	04 25.56	+32 02.8	1.359	1.458	+4.21	+14.6	12.9	55.1/ 73	74.3	41.9	263/5.07
22	04 43.98	+33 10.1	04 46.64	+33 14.5	1.260	1.389	+4.83	+13.5	12.3	61.8/ 76	74.5	44.6	265/5.71
27	05 08.15	+34 17.6	05 10.85	+34 20.6	1.166	1.317	+5.60	+11.2	11.7	69.9/ 79	74.1	47.5	268/6.47
Sept. 1	05 36.14	+35 13.8	05 38.87	+35 15.1	1.077	1.244	+6.50	+7.1	11.2	79.6/ 83	73.1	50.9	271/7.36
6	06 08.64	+35 49.3	06 11.38	+35 48.8	0.996	1.167	+7.49	+0.3	10.6	91.0/ 87	71.3	54.9	275/8.37
11	06 46.08	+35 50.6	06 48.81	+35 47.9	0.925	1.089	+8.44	-10.1	10.0	103.7/ 93	68.5	59.3	280/9.51
16	07 28.30	+35 00.2	07 30.98	+34 55.0	0.866	1.007	+9.17	-24.0	9.5	116.5/ 99	64.6	64.4	285/10.7
21	08 14.17	+33 00.2	08 16.75	+32 52.6	0.823	0.923	+9.48	-40.1	9.0	127.8/105	59.7	69.9	291/11.9
26	09 01.55	+29 39.7	09 04.00	+29 30.0	0.800	0.835	+9.28	-55.5	8.6	15.9/135.4/111	53.8	75.6	296/12.8
Oct. 1	09 47.94	+25 02.2	09 50.26	+24 50.7	0.800	0.745	+8.70	-67.2	8.3	15.8/138.1/117	47.3	80.7	300/13.3
6	10 31.43	+19 26.3	10 33.64	+19 13.6	0.824	0.653	+7.98	-73.7	8.0	15.7/136.4/121	40.5	84.4	303/13.3
11	11 11.31	+13 17.8	11 13.44	+13 04.5	0.874	0.560	+7.37	-75.9	7.9	15.5/132.6/124	34.0	85.3	304/12.6
16	11 48.16	+06 58.0	11 50.25	+06 44.5	0.949	0.469	+7.08	-76.0	7.8	15.2/130.4/125	27.7	81.8	304/11.5
21	12 23.57	+00 37.9	12 25.66	+00 24.4	1.047	0.389	+7.24	-75.1	7.9	14.7/131.9/125	21.8	71.7	301/9.71
26	12 59.79	-05 37.5	13 01.90	-05 50.7	1.159	0.338	+7.66	-70.8	8.0	14.1/133.8/123	15.8	53.3	295/7.15
31	13 38.09	-11 31.7	13 40.25	-11 44.0	1.269	0.338	+7.81	-60.6	8.2	13.6/128.7/119	9.9	30.4	284/4.01
Nov. 5	14 17.12	-16 34.4	14 19.35	-16 45.7	1.365	0.387	+7.54	-47.3	8.4	13.5/117.1/115	5.0	12.8	257/1.63
10	14 54.79	-20 31.1	14 57.11	-20 40.9	1.450	0.466	+7.07	-35.1	8.7	13.9/104.4/111	3.7	7.9	189/0.96
15	15 30.14	-23 26.4	15 32.54	-23 34.7	1.531	0.557	+6.55	-25.0	9.1	14.5/92.9/107	6.0	10.7	150/1.23
20	16 02.90	-25 31.3	16 05.37	-25 38.0	1.612	0.650	+6.04	-17.0	9.5	15.0/83.0/103	8.3	12.7	136/1.40
25	16 33.08	-26 56.2	16 35.60	-27 01.3	1.694	0.743	+5.54	-10.8	9.9	15.4/74.6/100	10.1	13.4	128/1.41
30	17 00.79	-27 50.0	17 03.34	-27 53.5	1.778	0.833	+5.08	-5.9	10.3	15.8/67.5/97	11.2	13.2	123/1.33
Dec. 5	17 26.18	-28 19.7	17 28.76	-28 21.7	1.863	0.920	+4.66	-2.3	10.8	16.0/61.5/94	11.7	12.5	119/1.21
10	17 49.46	-28 31.1	17 52.05	-28 31.7	1.949	1.005	+4.27	+0.5	11.3	16.3/56.3/91	11.7	11.5	117/1.06
15	18 10.83	-28 28.5	18 13.42	-28 27.8	2.034	1.086	+3.93	+2.6	11.7	16.5/52.0/88	11.4	10.3	115/0.92
20	18 30.49	-28 15.3	18 33.07	-28 13.5	2.117	1.165	+3.63	+4.2	12.2	16.7/48.2/86	10.7	9.0	115/0.78
25	18 48.63	-27 54.1	18 51.19	-27 51.2	2.200	1.241	+3.36	+5.4	12.7	16.9/44.9/84	9.7	7.7	115/0.64
30	19 05.41	-27 26.8	19 07.96	-27 23.0	2.279	1.315	+3.12	+6.3	13.2	17.1/42.1/82	8.6	6.4	118/0.51
1991 Jan. 4	19 21.00	-26 55.1	19 23.53	-26 50.4	2.357	1.387	+2.91	+7.0	13.7	17.2/39.6/81	7.3	5.1	123/0.40
9	19 35.53	-26 20.0	19 38.04	-26 14.5	2.431	1.456	+2.72	+7.5	14.1	17.4/37.4/79	5.9	4.0	132/0.30
14	19 49.12	-25 42.4	19 51.61	-25 36.2	2.501	1.524	+2.47	+8.0	14.6	17.5/34.6/78	4.9	3.1	149/0.23
24	20 13.87	-24 22.6	20 16.31	-24 15.0	2.631	1.653	+2.20	+8.3	15.6	17.8/31.3/76	5.1	3.1	199/0.22
Feb. 3	20 35.87	-22 59.5	20 38.28	-22 50.9	2.743	1.775	+1.98	+8.4	16.5	18.1/28.7/74	8.7	4.8	226/0.33
13	20 55.63	-21 35.7	20 57.99	-21 26.2	2.837	1.891	+1.78	+8.3	17.4	18.4/26.3/72	13.5	7.0	237/0.46
													8 .03

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1990 Comet Handbook

P/Kearns-Kwee 1989u Orbit by Kobayashi T. MPC 15215 (1989)

T/ET 1990 Nov. 22.6078 q (AU) 2.215383 e 0.486628 P 8.96 Peri. 131.8347 Node 315.0276 Inc. 9.0071 Tail(AU) 0.200 Epoch 1990 Nov. 5.0

m1 = 7.5+5log(delta)+15.0log(r) m2 = 11.5+5log(delta)+10.0log(r)

Date/	Oh	ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	h	m	s	Delta	r	Daily motion	Magnitude	Mot./PA	Elong.	P	PA/Tail	Moon Age	
1989 Dec.	10	22	27.21	-03 37.5	22 29.29	-03 25.2				3.394	3.364	+0.75	+ 4.1	18.1 19.4	11.9/ 70	79.9	16.7	67/0.92	63
	20	22	34.68	-02 56.3	22 36.74	-02 43.8				3.492	3.318	+0.87	+ 5.0	18.0 19.4	14.0/ 69	71.8	16.4	66/0.88	161
	30	22	43.39	-02 06.1	22 45.45	-01 53.5				3.582	3.272	+0.98	+ 5.9	18.0 19.4	15.8/ 68	63.9	15.7	65/0.82	42
1990 Jan.	9	22	53.21	-01 07.5	22 55.27	-00 54.7				3.664	3.226	+1.08	+ 6.6	17.9 19.4	17.5/ 68	56.5	14.7	64/0.76	95
	19	23	03.98	-00 01.1	23 06.03	+00 11.8				3.734	3.180	+1.16	+ 7.4	17.9 19.4	18.9/ 67	49.2	13.6	62/0.68	137
	29	23	15.59	+01 12.4	23 17.64	+01 25.5				3.792	3.134	+1.24	+ 8.0	17.8 19.4	20.2/ 67	42.3	12.2	61/0.61	14
Feb.	8	23	27.95	+02 32.5	23 29.99	+02 45.7				3.836	3.088	+1.30	+ 8.6	17.8 19.3	21.3/ 66	35.6	10.7	59/0.53	123
	18	23	40.95	+03 58.3	23 42.99	+04 11.7				3.867	3.043	+1.36	+ 9.1	17.7 19.3	22.3/ 66	29.2	9.1	57/0.45	116
	28	23	54.55	+05 29.3	23 56.60	+05 42.7				3.884	2.997	+1.41	+ 9.5	17.6 19.2	23.1/ 65	23.0	7.4	53/0.36	13
Mar.	10	00	08.69	+07 04.7	00 10.74	+07 18.0				3.887	2.952	+1.46	+ 9.9	17.5 19.1	23.9/ 65	17.1	5.7	48/0.28	147
	20	00	23.33	+08 43.6	00 25.40	+08 56.9				3.876	2.908	+1.51	+10.2	17.4 19.1	24.6/ 65	11.7	4.0	38/0.20	96
	30	00	38.47	+10 25.3	00 40.55	+10 38.5				3.851	2.864	+1.56	+10.4	17.3 19.0	25.2/ 65	7.3	2.5	15/0.13	40
Apr.	9	00	54.07	+12 09.1	00 56.17	+12 22.1				3.814	2.820	+1.61	+10.5	17.2 18.9	25.7/ 65	6.0	2.1	326/0.11	169
	19	01	10.14	+13 54.0	01 12.26	+14 06.8				3.765	2.777	+1.65	+10.5	17.0 18.8	26.2/ 66	8.9	3.2	289/0.16	75
	29	01	26.68	+15 39.3	01 28.83	+15 51.8				3.704	2.735	+1.70	+10.5	16.9 18.7	26.6/ 66	13.5	4.9	275/0.25	66
May	9	01	43.69	+17 24.0	01 45.87	+17 36.1				3.633	2.693	+1.75	+10.3	16.8 18.6	27.0/ 67	18.3	6.8	268/0.35	171
	19	02	01.18	+19 07.3	02 03.40	+19 18.9				3.552	2.653	+1.80	+10.1	16.6 18.5	27.3/ 68	23.2	8.6	265/0.46	52
	29	02	19.15	+20 48.2	02 21.41	+20 59.2				3.463	2.613	+1.85	+ 9.7	16.5 18.4	27.5/ 68	28.1	10.5	263/0.57	89
June	8	02	37.60	+22 25.7	02 39.91	+22 36.1				3.366	2.575	+1.89	+ 9.3	16.3 18.2	27.7/ 69	33.0	12.4	262/0.69	152
	18	02	56.53	+23 58.8	02 58.88	+24 08.5				3.263	2.538	+1.94	+ 8.8	16.1 18.1	27.8/ 71	37.8	14.2	262/0.81	29
	28	03	15.90	+25 26.6	03 18.30	+25 35.5				3.153	2.502	+1.98	+ 8.2	16.0 18.0	27.8/ 72	42.7	16.0	262/0.94	111
July	8	03	35.67	+26 48.2	03 38.12	+26 56.1				3.039	2.468	+2.01	+ 7.4	15.8 17.8	27.8/ 73	47.5	17.7	263/1.08	133
	18	03	55.79	+28 02.5	03 58.29	+28 09.5				2.920	2.435	+2.04	+ 6.6	15.6 17.7	27.6/ 75	52.3	19.3	264/1.22	4
	28	04	16.16	+29 08.9	04 18.70	+29 14.9				2.799	2.404	+2.05	+ 5.8	15.4 17.5	27.3/ 77	57.2	20.8	265/1.36	130
Aug.	7	04	36.65	+30 06.7	04 39.23	+30 11.5				2.675	2.375	+2.05	+ 4.9	15.3 17.4	26.9/ 78	62.1	22.2	266/1.51	112
	17	04	57.12	+30 55.5	04 59.73	+30 59.2				2.549	2.348	+2.02	+ 4.0	15.1 17.2	26.2/ 80	67.1	23.4	267/1.67	22
	27	05	17.35	+31 35.2	05 19.99	+31 37.7				2.422	2.323	+1.98	+ 3.1	14.9 17.1	25.4/ 82	72.3	24.5	268/1.82	148
Sept.	6	05	37.11	+32 05.8	05 39.77	+32 07.1				2.295	2.301	+1.90	+ 2.2	14.7 16.9	24.2/ 83	77.6	25.3	270/1.98	89
	16	05	56.14	+32 28.0	05 58.81	+32 28.2				2.169	2.281	+1.80	+ 1.5	14.6 16.8	22.7/ 85	83.2	26.0	271/2.13	48
	26	06	14.09	+32 42.6	06 16.78	+32 41.7				2.045	2.263	+1.65	+ 0.8	14.4 16.6	20.9/ 87	89.1	26.3	272/2.28	167

T/ET	1990 Dec. 16.9168	q (AU)	1.578058	e	0.540979	P	6.37	Peri.	41.5738	Node	135.5750	Inc.	3.2494	Tail(AU)	0.200	Epoch	1990 Dec. 15.0
Date/	Oh	ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	Delta	r	Daily motion	Magnitude	Mot./PA	Elong.	P	PA/Tail	Moon	Age	
			h^m	$^{\circ}$	h^m	$^{\circ}$			m	m_1	m_2	$^{\circ}$	$^{\circ}$	$^{\circ}$	$^{\circ}$		
1989 Dec.	10	03	04.50	+12 51.2	03 06.72	+13 00.6	2.503	3.390	-0.65	1.9	16.4	20.3	9.7/259	149.7	8.4	66/0.61	12
	20	02	57.98	+12 32.7	03 00.19	+12 42.4	2.541	3.338	-0.46	0.9	16.4	20.3	6.8/263	138.0	11.4	69/0.82	132
	30	02	53.38	+12 23.9	02 55.59	+12 33.7	2.602	3.286	-0.24	0.2	16.3	20.2	3.5/273	126.8	13.9	70/0.97	104
1990 Jan.	9	02	50.99	+12 25.8	02 53.20	+12 35.7	2.678	3.234	-0.01	1.2	16.3	20.2	1.3/352	116.1	15.8	71/1.08	36
	19	02	50.87	+12 38.2	02 53.08	+12 48.1	2.766	3.180	+0.21	2.2	16.2	20.2	3.8/54	106.0	17.3	72/1.15	163
	29	02	52.99	+13 00.4	02 55.20	+13 10.3	2.859	3.126	+0.42	3.1	16.2	20.2	6.9/63	96.4	18.2	73/1.17	68
Feb.	8	02	57.22	+13 31.2	02 59.43	+13 40.9	2.953	3.071	+0.62	3.8	16.2	20.2	9.7/67	87.4	18.7	74/1.17	71
	18	03	03.38	+14 09.0	03 05.60	+14 18.4	3.045	3.016	+0.79	4.3	16.1	20.2	12.3/69	78.9	18.8	74/1.14	164
	28	03	11.31	+14 52.3	03 13.55	+15 01.4	3.132	2.960	+0.96	4.7	16.0	20.2	14.6/71	70.9	18.4	75/1.09	36
Mar.	10	03	20.86	+15 39.5	03 23.12	+15 48.2	3.210	2.903	+1.10	5.0	16.0	20.2	16.6/72	63.4	17.8	77/1.03	100
	20	03	31.88	+16 29.1	03 34.15	+16 37.2	3.278	2.846	+1.24	5.1	15.9	20.1	18.5/74	56.2	16.9	78/0.96	141
Apr.	30	03	44.25	+17 19.6	03 46.54	+17 27.2	3.334	2.788	+1.36	5.0	15.8	20.1	20.1/75	49.3	15.8	79/0.88	9
	9	03	57.86	+18 09.6	04 00.18	+18 16.4	3.378	2.730	+1.48	4.8	15.7	20.0	21.5/77	42.8	14.4	81/0.80	125
	19	04	12.64	+18 57.7	04 14.97	+19 03.7	3.409	2.671	+1.59	4.5	15.6	19.9	22.9/78	36.6	13.0	83/0.71	118
May	29	04	28.51	+19 42.5	04 30.87	+19 47.8	3.427	2.612	+1.69	4.0	15.4	19.8	24.2/80	30.7	11.4	85/0.62	24
	9	04	45.42	+20 22.8	04 47.79	+20 27.2	3.431	2.553	+1.79	3.5	15.3	19.7	25.3/81	25.1	9.6	87/0.53	146
	19	05	03.30	+20 57.4	05 05.70	+21 00.7	3.423	2.493	+1.88	2.8	15.1	19.6	26.5/83	19.6	7.8	90/0.43	95
June	29	05	22.13	+21 24.9	05 24.54	+21 27.1	3.402	2.434	+1.97	1.9	15.0	19.5	27.6/85	14.5	6.0	93/0.33	48
	8	05	41.85	+21 44.2	05 44.27	+21 45.2	3.369	2.374	+2.06	1.0	14.8	19.4	28.7/87	9.5	4.1	98/0.23	165
	18	06	02.42	+21 54.0	06 04.84	+21 53.9	3.325	2.314	+2.14	0.1	14.6	19.3	29.7/89	4.9	2.1	109/0.12	71
July	28	06	23.79	+21 53.3	06 26.21	+21 51.9	3.271	2.255	+2.21	1.2	14.4	19.1	30.8/91	1.4	0.6	182/0.04	68
	8	06	45.90	+21 41.0	06 48.31	+21 38.3	3.208	2.196	+2.28	2.5	14.2	18.9	31.9/93	4.6	2.1	258/0.12	175
	18	07	08.69	+21 16.1	07 11.10	+21 12.1	3.137	2.138	+2.34	3.8	13.9	18.8	33.1/96	8.7	4.1	269/0.25	47
Aug.	28	07	32.13	+20 37.8	07 34.52	+20 32.5	3.060	2.081	+2.40	5.2	13.7	18.6	34.2/98	12.7	6.2	274/0.38	85
	7	07	56.13	+19 45.4	07 58.49	+19 38.8	2.976	2.025	+2.45	6.7	13.5	18.4	35.4/100	16.5	8.2	278/0.51	158
	17	08	20.65	+18 38.4	08 22.97	+18 30.7	2.889	1.970	+2.50	8.2	13.2	18.2	36.6/102	20.2	10.2	281/0.66	25
Sept.	27	08	45.63	+17 16.7	08 47.92	+17 07.8	2.798	1.917	+2.54	9.6	13.0	18.1	37.8/104	23.8	12.3	284/0.81	100
	6	09	11.01	+15 40.4	09 13.26	+15 30.3	2.706	1.867	+2.58	11.1	12.7	17.9	39.0/106	27.1	14.3	286/0.97	140
	16	09	36.78	+13 49.7	09 38.99	+13 38.7	2.614	1.819	+2.61	12.4	12.5	17.7	40.2/107	30.4	16.2	288/1.14	6
Oct.	26	10	02.88	+11 45.5	10 05.06	+11 33.7	2.522	1.773	+2.64	13.6	12.2	17.5	41.3/109	33.4	18.2	290/1.32	112
	6	10	29.31	+09 29.3	10 31.45	+09 16.7	2.432	1.732	+2.67	14.7	12.0	17.3	42.3/110	36.4	20.0	292/1.50	122
Nov.	16	10	56.05	+07 02.5	10 58.17	+06 49.4	2.345	1.694	+2.70	15.5	11.8	17.1	43.2/111	39.2	21.9	293/1.68	10
	26	11	23.09	+04 27.4	11 25.19	+04 14.0	2.261	1.661	+2.73	16.0	11.6	17.0	44.0/111	42.0	23.6	294/1.87	123
	5	11	50.43	+01 46.9	11 52.52	+01 33.3	2.182	1.633	+2.76	16.3	11.4	16.8	44.5/111	44.6	25.3	294/2.07	105
Dec.	15	12	18.04	-00 56.0	12 20.14	-01 09.6	2.108	1.610	+2.79	16.2	11.2	16.7	44.8/111	47.3	26.8	294/2.26	22
	25	12	45.90	-03 37.7	12 48.01	-03 51.1	2.039	1.593	+2.80	15.7	11.1	16.6	44.7/111	49.9	28.3	294/2.45	134
	5	13	13.92	-06 14.6	13 16.06	-06 27.6	1.974	1.583	+2.81	14.8	11.0	16.5	44.4/110	52.6	29.7	293/2.63	89
1991 Jan.	15	13	42.04	-08 43.0	13 44.20	-08 55.4	1.914	1.578	+2.80	13.6	10.9	16.4	43.6/109	55.4	30.9	292/2.81	33
	25	14	10.07	-10 59.4	14 12.27	-11 11.0	1.857	1.580	+2.78	12.2	10.8	16.3	42.5/107	58.3	32.0	291/2.99	146
	4	14	37.82	-13 00.9	14 40.07	-13 11.5	1.804	1.588	+2.72	10.4	10.8	16.3	41.0/106	61.4	32.9	289/3.15	74
Feb.	14	15	05.07	-14 45.4	15 07.36	-14 54.9	1.753	1.603	+2.64	8.6	10.8	16.3	39.2/104	64.8	33.7	287/3.30	44
	24	15	31.50	-16 11.4	15 33.82	-16 19.7	1.703	1.624	+2.53	6.7	10.8	16.3	36.9/101	68.4	34.3	285/3.44	162
	3	15	56.77	-17 18.6	15 59.13	-17 25.7	1.654	1.650	+2.38	4.9	10.9	16.3	34.3/99	72.4	34.7	283/3.57	59
	13	16	20.55	-18 07.7	16 22.94	-18 13.5	1.604	1.681	+2.19	3.2	10.9	16.3	31.3/97	76.8	34.9	280/3.69	58

T/ET	Date	h	R.A. (1950)	Decl.	h	R.A. (App.)	Decl.	Delta	r	Variation for T=+1 day	Magnitude m ₁	Mot./PA	Elong.	P	PA/Tail	Moon Age
1991 Feb.	22.6774	17 40.56	-28 48.4	-28 48.4	17 43.08	-28 49.6	-28 49.6	5.181	4.215	-0.30	24.8	15.7/ 90	10.0	2.3	125/0.09	135 .90
		20 17 52.47	-28 45.8	-28 45.8	17 55.00	-28 46.3	-28 46.3	5.134	4.155	-0.31	24.7	16.0/ 89	5.4	1.3	173/0.05	90 .50
1990 Jan.	30 18 04.67	-28 41.0	-28 41.0	-28 41.0	18 07.19	-28 40.7	-28 40.7	5.055	4.095	-0.33	24.6	16.3/ 88	8.5	2.0	232/0.08	29 .04
	9 18 17.49	-28 33.7	-28 33.7	-28 33.7	18 19.56	-28 32.7	-28 32.7	4.976	4.034	-0.35	24.5	16.4/ 87	15.0	3.6	249/0.14	166 .94
	19 18 29.04	-28 23.8	-28 23.8	-28 23.8	18 32.01	-28 22.1	-28 22.1	4.866	3.972	-0.37	24.4	16.5/ 86	22.1	5.4	254/0.21	66 .49
	29 18 41.93	-28 11.3	-28 11.3	-28 11.3	18 44.45	-28 08.9	-28 08.9	4.738	3.910	-0.39	24.3	16.4/ 85	29.4	7.1	257/0.29	58 .06
Feb.	8 18 54.24	-27 56.3	-27 56.3	-27 56.3	18 56.75	-27 53.2	-27 53.2	4.592	3.846	-0.42	24.2	16.1/ 85	36.7	8.8	258/0.37	165 .96
	18 19 06.33	-27 38.9	-27 38.9	-27 38.9	19 08.83	-27 35.1	-27 35.1	4.430	3.782	-0.44	24.0	15.8/ 84	44.0	10.5	258/0.45	43 .48
	28 19 18.09	-27 19.6	-27 19.6	-27 19.6	19 20.58	-27 15.2	-27 15.2	4.253	3.717	-0.47	23.8	15.2/ 83	51.4	12.0	258/0.54	87 .09
Mar.	10 19 29.38	-26 58.9	-26 58.9	-26 58.9	19 31.87	-26 53.8	-26 53.8	4.065	3.651	-0.51	23.7	14.5/ 82	58.8	13.5	258/0.63	137 .98
	20 19 40.11	-26 37.2	-26 37.2	-26 37.2	19 42.58	-26 31.5	-26 31.5	3.866	3.584	-0.55	23.5	13.6/ 81	66.3	14.7	258/0.72	19 .46
	30 19 50.12	-26 15.4	-26 15.4	-26 15.4	19 52.58	-26 09.1	-26 09.1	3.660	3.517	-0.59	23.3	12.5/ 81	73.9	15.8	258/0.81	119 .14
Apr.	9 19 59.27	-25 54.1	-25 54.1	-25 54.1	20 01.72	-25 47.4	-25 47.4	3.448	3.449	-0.63	23.1	11.1/ 80	81.7	16.7	258/0.90	110 .99
	19 20 07.38	-25 34.4	-25 34.4	-25 34.4	20 09.82	-25 27.3	-25 27.3	3.234	3.379	-0.69	22.8	9.5/ 80	89.6	17.3	258/0.99	10 .43
	29 20 14.25	-25 17.3	-25 17.3	-25 17.3	20 16.69	-25 09.8	-25 09.8	3.020	3.309	-0.75	22.6	7.5/ 80	97.7	17.6	258/1.08	152 .20
May	9 20 19.66	-25 03.6	-25 03.6	-25 03.6	20 22.09	-24 55.8	-24 55.8	2.810	3.239	-0.81	22.3	5.1/ 80	106.1	17.4	258/1.14	82 .99
	19 20 23.35	-24 54.3	-24 54.3	-24 54.3	20 25.78	-24 46.4	-24 46.4	2.606	3.167	-0.89	22.1	2.3/ 80	114.9	16.8	259/1.19	41 .37
	29 20 25.03	-24 50.3	-24 50.3	-24 50.3	20 27.46	-24 42.2	-24 42.2	2.411	3.094	-0.97	21.8	0.8/261	124.0	15.8	260/1.19	172 .26
June	8 20 24.43	-24 51.6	-24 51.6	-24 51.6	20 26.86	-24 43.5	-24 43.5	2.230	3.021	-1.05	21.5	4.3/261	133.7	14.1	262/1.15	50 1.00
	18 20 21.32	-24 57.9	-24 57.9	-24 57.9	20 23.77	-24 49.9	-24 49.9	2.065	2.947	-1.13	21.3	7.9/263	143.8	11.7	264/1.03	79 .30
	28 20 15.57	-25 07.7	-25 07.7	-25 07.7	20 18.03	-25 00.0	-25 00.0	1.921	2.872	-1.21	21.0	11.3/264	154.5	8.8	268/0.82	136 .31
July	8 20 07.31	-25 18.3	-25 18.3	-25 18.3	20 09.78	-25 11.1	-25 11.1	1.801	2.797	-1.27	20.7	14.0/266	165.6	5.2	278/0.52	14 1.00
	18 19 56.99	-25 26.1	-25 26.1	-25 26.1	19 59.48	-25 19.4	-25 19.4	1.707	2.721	-1.31	20.5	15.6/269	175.1	1.8	328/0.19	123 .22
	28 19 45.44	-25 27.4	-25 27.4	-25 27.4	19 47.95	-25 21.3	-25 21.3	1.640	2.644	-1.31	20.3	15.7/272	168.8	4.3	58/0.47	96 .35
Aug.	7 19 33.87	-25 19.3	-25 19.3	-25 19.3	19 36.38	-25 13.9	-25 13.9	1.601	2.566	-1.28	20.1	14.2/277	157.2	8.8	72/0.98	28 1.00
	17 19 23.53	-25 01.0	-25 01.0	-25 01.0	19 26.05	-24 56.1	-24 56.1	1.587	2.488	-1.22	20.0	11.2/284	145.5	13.3	78/1.48	169 .15
	27 19 15.56	-24 33.4	-24 33.4	-24 33.4	19 18.07	-24 29.0	-24 29.0	1.594	2.410	-1.14	19.8	7.4/298	134.2	17.5	80/1.93	58 .38
Sept.	6 19 10.76	-23 58.5	-23 58.5	-23 58.5	19 13.26	-23 54.4	-23 54.4	1.618	2.332	-1.07	19.7	4.4/336	123.5	21.1	82/2.29	69 .99
	16 19 09.49	-23 18.2	-23 18.2	-23 18.2	19 11.97	-23 14.1	-23 14.1	1.653	2.253	-1.00	19.6	5.5/ 36	113.6	24.1	83/2.55	150 .10
	26 19 11.83	-22 33.4	-22 33.4	-22 33.4	19 14.30	-22 29.2	-22 29.2	1.696	2.175	-0.95	19.5	9.5/ 59	104.5	26.5	83/2.73	26 .40
Oct.	6 19 17.65	-21 44.1	-21 44.1	-21 44.1	19 20.10	-21 39.6	-21 39.6	1.740	2.097	-0.92	19.3	13.7/ 67	96.1	28.3	82/2.83	105 .97
	16 19 26.66	-20 49.5	-20 49.5	-20 49.5	19 29.09	-20 44.4	-20 44.4	1.784	2.019	-0.91	18.9	17.9/ 70	88.4	29.6	82/2.89	118 .07
	26 19 38.61	-19 47.6	-19 47.6	-19 47.6	19 41.01	-19 41.9	-19 41.9	1.825	1.943	-0.91	18.5	21.8/ 72	81.4	30.4	80/2.90	3 .42
Nov.	5 19 53.19	-18 36.6	-18 36.6	-18 36.6	19 55.56	-18 30.2	-18 30.2	1.860	1.867	-0.93	18.0	25.5/ 72	75.0	30.9	79/2.89	135 .93
	15 20 10.12	-17 14.3	-17 14.3	-17 14.3	20 12.46	-17 07.0	-17 07.0	1.889	1.794	-0.96	17.5	29.1/ 71	69.2	31.0	77/2.86	95 .05
	25 20 29.19	-15 38.5	-15 38.5	-15 38.5	20 31.49	-15 30.2	-15 30.2	1.912	1.724	-1.00	17.0	32.4/ 71	63.9	31.0	74/2.83	20 .44
Dec.	5 20 50.16	-13 47.2	-13 47.2	-13 47.2	20 52.43	-13 37.9	-13 37.9	1.928	1.656	-1.05	16.5	35.6/ 70	59.2	30.7	72/2.79	159 .90
	15 21 12.88	-11 39.1	-11 39.1	-11 39.1	21 15.10	-11 28.9	-11 28.9	1.938	1.593	-1.11	16.0	38.7/ 68	55.0	30.4	70/2.75	78 .04
	25 21 37.20	-09 13.1	-09 13.1	-09 13.1	21 39.39	-09 02.0	-09 02.0	1.944	1.535	-1.18	15.5	41.7/ 67	51.3	30.0	67/2.71	38 .49
1991 Jan.	4 22 03.00	-06 29.3	-06 29.3	-06 29.3	22 05.16	-06 17.3	-06 17.3	1.946	1.483	-1.26	15.1	44.5/ 66	48.2	29.6	65/2.67	176 .86
	14 22 30.22	-03 28.5	-03 28.5	-03 28.5	22 32.34	-03 15.8	-03 15.8	1.946	1.439	-1.35	14.7	47.1/ 66	45.5	29.2	63/2.63	67 .04
	24 22 58.79	-00 12.8	-00 12.8	-00 12.8	23 00.90	+00 00.5	+00 00.5	1.948	1.403	-1.44	14.4	49.4/ 65	43.2	28.7	61/2.60	53 .54
Feb.	3 23 28.69	+03 14.1	+03 14.1	+03 14.1	23 30.79	+03 27.7	+03 27.7	1.952	1.376	-1.54	14.1	51.3/ 65	41.4	28.3	60/2.55	172 .83
	13 23 59.89	+06 47.4	+06 47.4	+06 47.4	00 02.00	+07 01.1	+07 01.1	1.961	1.360	-1.64	14.0	52.7/ 66	39.9	27.7	59/2.50	59 .03

$$m_1 = 8.5 + 5 \log(\delta) + 30.0 \log(r) \quad m_2 = 15.0 + 5 \log(\delta) + 10.0 \log(r)$$

T/ET	q (AU)	P	Peri.	Node	Inc.	Tail(AU)	Epoch								
1991 Apr. 4.8292	1.607836	6.51	186.9747	254.1712	18.4730	0.200	1991 Apr. 14.0								
m1 = 8.0+5log(delta)+15.0log(r)															
Date/ Oh ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	Delta	r	Variation for T=+1 day	Magnitude m1 m2	Mot./PA	Elong.	P	PA/Tail	Moon Age		
	h m	°	h m	°											
1989 Dec. 10	19 47.25	-08 19.4	19 49.40	-08 13.4	4.589	3.907	-0.28	22.7	15.1/ 82	41.5	9.6	65/0.40	102 .90		
20 19 57.29	-07 56.9	19 59.44	-07 50.3	4.635	3.863	-0.29	-1.9	22.7	16.0/ 80	34.4	8.3	60/0.34	122 .50		
30 20 07.88	-07 27.4	20 10.02	-07 20.3	4.663	3.819	-0.29	-1.9	22.7	16.8/ 78	27.6	6.8	53/0.28	14 .04		
1990 Jan. 9	20 18.90	-06 50.9	20 21.03	-06 43.3	4.673	3.774	-0.30	20.0	17.5/ 76	21.3	5.4	42/0.22	131 .94		
19 20 30.26	-06 07.5	20 32.37	-05 59.4	4.663	3.728	-0.31	-2.0	19.9	18.0/ 74	16.1	4.2	26/0.17	99 .49		
29 20 41.85	-05 17.3	20 43.96	-05 08.7	4.635	3.682	-0.33	-2.1	19.8	18.5/ 72	12.9	3.4	359/0.14	27 .06		
Feb. 8	20 53.60	-04 20.4	20 55.69	-04 11.3	4.588	3.634	-0.34	2.2	19.7	18.8/ 70	3.5	327/0.15	157 .96		
18 21 05.41	-03 17.2	21 07.50	-03 07.6	4.522	3.587	-0.36	-2.3	19.6	19.0/ 69	16.6	4.5	303/0.19	78 .48		
28 21 17.24	-02 07.7	21 19.31	-01 57.6	4.439	3.538	-0.38	-2.4	19.5	19.2/ 67	21.7	5.9	288/0.26	53 .09		
Mar. 10	21 28.98	-00 52.4	21 31.04	-00 41.9	4.340	3.489	-0.40	2.5	19.3	19.2/ 65	7.5	278/0.33	166 .98		
20 21 40.60	+00 28.4	21 42.65	+00 39.3	4.224	3.439	-0.42	-2.7	19.2	19.2/ 63	33.5	9.2	272/0.41	56 .46		
30 21 52.02	+01 54.4	21 54.06	+02 05.7	4.095	3.388	-0.45	-2.8	19.0	19.0/ 61	39.8	10.9	267/0.50	82 .14		
Apr. 9	22 03.16	+03 25.2	22 05.20	+03 36.8	3.953	3.337	-0.48	3.0	18.8	21.7	18.8/ 59	46.0	263/0.60	147 .99	
19 22 13.98	+05 00.3	22 16.01	+05 12.3	3.800	3.284	-0.51	-3.2	18.6	21.6	18.4/ 57	52.4	14.0	260/0.69	34 .43	
29 22 24.39	+06 39.5	22 26.41	+06 51.7	3.637	3.232	-0.55	-3.4	18.4	21.4	18.0/ 55	58.8	15.5	257/0.80	110 .20	
May 9	22 34.29	+08 22.2	22 36.31	+08 34.6	3.467	3.178	-0.59	3.6	18.2	21.2	17.4/ 52	65.2	16.8	255/0.90	124 .99
19 22 43.60	+10 07.8	22 45.62	+10 20.5	3.291	3.124	-0.64	-3.9	18.0	21.0	16.6/ 49	71.7	17.9	253/1.01	15 .37	
29 22 52.19	+11 55.9	22 54.22	+12 08.8	3.111	3.070	-0.70	-4.1	17.8	20.8	15.7/ 46	78.3	18.9	250/1.12	137 .26	
June 8	22 59.91	+13 45.6	23 01.94	+13 58.6	2.929	3.014	-0.76	4.4	17.5	20.6	14.7/ 41	84.9	19.6	248/1.23	101 1.00
18 23 06.59	+15 36.1	23 08.62	+15 49.2	2.747	2.958	-0.83	-4.8	17.3	20.4	13.5/ 35	91.8	20.1	245/1.34	29 .30	
28 23 12.02	+17 25.9	23 14.05	+17 39.1	2.568	2.902	-0.92	-5.2	17.0	20.2	12.1/ 27	98.7	20.3	242/1.44	159 .31	
July 8	23 15.95	+19 13.2	23 17.99	+19 26.5	2.393	2.845	-1.01	5.7	16.7	19.9	10.7/ 17	105.9	20.1	239/1.53	75 1.00
18 23 18.12	+20 55.8	23 20.16	+21 09.2	2.226	2.787	-1.11	-6.3	16.4	19.7	9.4/ 1	113.2	19.6	234/1.59	60 .22	
28 23 18.26	+22 30.1	23 20.30	+22 43.5	2.068	2.730	-1.21	-7.0	16.1	19.4	8.7/340	120.7	18.7	229/1.62	154 .35	
Aug. 7	23 16.13	+23 51.6	23 18.17	+24 05.0	1.922	2.671	-1.32	7.9	15.8	19.2	8.8/316	128.3	17.3	221/1.62	47 1.00
17 23 11.65	+24 54.8	23 13.68	+25 08.2	1.791	2.613	-1.42	-8.9	15.5	18.9	9.9/293	135.6	15.7	212/1.56	96 .15	
27 23 04.92	+25 33.2	23 06.93	+25 46.5	1.678	2.554	-1.50	-10.0	15.2	18.7	11.5/274	142.3	14.0	198/1.48	127 .38	
Sept. 6	22 56.43	+25 41.0	22 58.43	+25 54.2	1.586	2.495	-1.54	11.1	15.0	18.5	13.0/259	147.5	12.5	180/1.40	26 .99
16 22 47.04	+25 14.4	22 49.03	+25 27.5	1.515	2.436	-1.55	-12.1	14.7	18.3	13.9/244	149.7	12.0	157/1.39	133 .10	
26 22 37.90	+24 13.6	22 39.88	+24 26.6	1.466	2.377	-1.52	-12.7	14.5	18.1	13.8/230	148.1	12.9	134/1.54	92 .40	
Oct. 6	22 30.28	+22 44.4	22 32.25	+22 57.2	1.440	2.319	-1.46	14.3	17.9	12.9/213	143.1	15.0	114/1.82	48 .97	
16 22 25.20	+20 56.1	22 27.18	+21 08.8	1.435	2.260	-1.39	-12.5	14.1	17.8	11.8/192	136.0	17.9	100/2.16	155 .07	
26 22 23.39	+19 00.4	22 25.38	+19 13.1	1.447	2.203	-1.32	-11.7	13.9	17.7	11.5/167	128.0	20.8	89/2.50	58 .42	
Nov. 5	22 25.16	+17 08.4	22 27.16	+17 21.1	1.474	2.146	-1.26	13.8	17.7	12.6/142	119.7	23.7	82/2.77	86 .93	
15 22 30.47	+15 28.4	22 32.48	+15 41.2	1.511	2.090	-1.22	-9.6	13.7	17.6	15.0/123	111.7	26.1	76/2.98	137 .05	
25 22 39.12	+14 06.0	22 41.15	+14 19.1	1.556	2.035	-1.20	-8.4	13.6	17.5	18.1/110	104.1	28.1	72/3.11	28 .44	
Dec. 5	22 50.81	+13 04.3	22 52.86	+13 17.5	1.605	1.982	-1.19	13.5	17.5	21.4/101	96.9	29.6	69/3.18	119 .90	
15 23 05.19	+12 23.7	23 07.25	+12 37.2	1.657	1.931	-1.21	-6.4	13.4	17.5	24.7/ 94	90.2	30.7	66/3.19	114 .04	
25 23 21.96	+12 03.8	23 24.03	+12 17.5	1.710	1.882	-1.23	-5.5	13.3	17.4	27.7/ 90	84.0	31.3	64/3.17	11 .49	
1991 Jan. 4	23 40.83	+12 02.8	23 42.92	+12 16.6	1.763	1.835	-1.27	13.2	17.4	30.4/ 87	78.2	31.6	63/3.11	145 .86	
14 00 01.55	+12 18.3	00 03.66	+12 32.1	1.814	1.792	-1.32	-4.0	13.1	17.3	32.9/ 84	72.9	31.7	63/3.03	94 .04	
24 00 23.94	+12 47.4	00 26.07	+13 01.1	1.864	1.752	-1.37	-3.3	13.0	17.3	35.1/ 83	68.0	31.4	63/2.93	28 .54	
Feb. 3	00 47.81	+13 26.8	00 49.97	+13 40.4	1.913	1.716	-1.42	12.9	17.3	37.0/ 82	63.4	30.9	63/2.82	166 .83	
13 01 13.02	+14 13.1	01 15.21	+14 26.2	1.961	1.685	-1.48	-1.8	12.9	17.2	38.7/ 82	59.2	30.2	64/2.70	78 .03	

T/ET	q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch								
1991 Apr. 24.7126	2.400910	0.552661	12.4	134.1475	148.4399	6.6195	0.200	1991 Apr. 14.0								
m1 = 8.0+5log(delta)+15.0log(r)																
m2 = 13.5+5log(delta)+ 5.0log(r)+0.03(phase)																
Date/	Oh ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	Delta	r	Variation for T=+1 day	Magnitude m1	Magnitude m2	Mot./PA	Elong.	P	PA/Tail	Moon Age	
1989 Dec.																
10	12 42.42	-01 12.9	12 44.47	-01 26.1	4.605	4.319	-0.40	+ 2.0	20.4	10.8/107	67.2	12.1	294/0.50	149	.90	
20	12 49.31	-01 43.7	12 51.37	-01 56.8	4.409	4.271	-0.42	+ 2.1	20.3	9.4/105	75.5	12.9	294/0.56	15	.50	
30	12 55.41	-02 07.7	12 57.48	-02 20.8	4.209	4.223	-0.45	+ 2.3	20.2	7.9/102	84.1	13.4	293/0.60	107	.04	
1990 Jan.																
9	13 00.54	-02 23.9	13 02.61	-02 37.0	4.006	4.175	-0.48	+ 2.4	20.0	6.0/ 97	93.0	13.6	292/0.64	115	.94	
19	13 04.54	-02 31.5	13 06.62	-02 44.5	3.805	4.127	-0.51	+ 2.5	19.9	4.1/ 87	102.2	13.5	292/0.67	17	.49	
29	13 07.24	-02 29.5	13 09.33	-02 42.4	3.609	4.078	-0.54	+ 2.7	19.7	2.2/ 57	111.7	13.0	291/0.68	140	.06	
Feb.																
8	13 08.50	-02 17.3	13 10.59	-02 30.3	3.424	4.029	-0.57	+ 2.8	19.6	2.3/349	121.6	12.0	290/0.66	80	.96	
18	13 08.21	-01 54.8	13 10.30	-02 07.8	3.252	3.980	-0.60	+ 2.9	19.4	4.3/319	131.9	10.7	288/0.61	46	.48	
28	13 06.32	-01 22.3	13 08.42	-01 35.4	3.100	3.932	-0.63	+ 3.1	19.2	6.6/309	142.5	8.8	286/0.53	170	.09	
Mar.																
10	13 02.92	-00 41.1	13 05.01	-00 54.3	2.970	3.882	-0.66	+ 3.2	19.0	8.5/304	153.3	6.6	281/0.42	43	.98	
Apr.																
20	12 58.21	+00 06.6	13 00.30	-00 06.6	2.866	3.833	-0.67	+ 3.2	18.8	9.9/301	164.1	4.1	272/0.27	81	.46	
30	12 52.53	+00 57.7	12 54.62	+00 44.4	2.791	3.784	-0.68	+ 3.2	18.7	10.5/299	173.1	1.8	231/0.12	137	.14	
May																
9	12 46.37	+01 48.2	12 48.46	+01 34.9	2.746	3.735	-0.68	+ 3.1	18.6	10.2/297	169.6	2.8	150/0.19	11	.99	
19	12 40.30	+02 34.2	12 42.39	+02 20.7	2.730	3.686	-0.67	+ 3.0	18.7	9.0/295	159.2	5.6	130/0.38	119	.43	
29	12 34.85	+03 11.9	12 36.94	+02 58.4	2.741	3.637	-0.66	+ 2.9	18.6	7.0/292	148.3	8.4	124/0.57	94	.20	
June																
9	12 30.53	+03 38.5	12 32.62	+03 24.9	2.777	3.587	-0.64	+ 2.8	18.5	4.5/288	137.6	10.9	120/0.73	35	.99	
19	12 27.68	+03 52.5	12 29.76	+03 38.9	2.832	3.538	-0.62	+ 2.6	18.5	1.8/273	127.3	13.1	118/0.86	156	.37	
29	12 26.51	+03 53.3	12 28.59	+03 39.8	2.903	3.489	-0.59	+ 2.5	18.5	1.5/143	117.5	14.9	117/0.95	56	.26	
July																
8	12 27.11	+03 41.2	12 29.19	+03 27.7	2.985	3.441	-0.57	+ 2.5	18.4	4.3/124	108.3	16.3	115/1.01	68	1.00	
18	12 29.46	+03 17.0	12 31.55	+03 03.6	3.074	3.392	-0.56	+ 2.4	18.4	7.0/120	99.5	17.2	114/1.04	162	.30	
Aug.																
28	12 33.49	+02 41.9	12 35.58	+02 28.5	3.166	3.344	-0.55	+ 2.4	18.4	9.5/118	91.1	17.7	113/1.04	25	.31	
8	12 39.09	+01 57.1	12 41.17	+01 43.7	3.258	3.296	-0.54	+ 2.4	18.3	11.8/117	83.2	17.8	113/1.02	97	1.00	
18	12 46.11	+01 03.7	12 48.20	+00 50.4	3.347	3.248	-0.53	+ 2.5	18.3	13.9/116	75.7	17.6	112/0.98	130	.22	
28	12 54.45	+00 03.1	12 56.54	-00 10.1	3.431	3.201	-0.53	+ 2.5	18.3	15.8/115	68.5	17.2	111/0.93	11	.35	
Sept.																
7	13 03.99	-01 03.7	13 06.08	-01 16.8	3.508	3.154	-0.54	+ 2.6	18.2	19.2	17.5/114	61.6	16.4	110/0.88	124	1.00
17	13 14.61	-02 15.6	13 16.70	-02 28.4	3.577	3.108	-0.55	+ 2.6	18.2	19.0/114	55.0	15.5	109/0.81	100	.15	
27	13 26.24	-03 31.4	13 28.34	-03 44.1	3.636	3.062	-0.56	+ 2.7	18.1	20.4/113	48.5	14.3	107/0.74	30	.38	
6	13 38.80	-04 50.2	13 40.92	-05 02.6	3.686	3.018	-0.57	+ 2.8	18.0	21.6/112	42.3	13.0	106/0.66	149	.99	
16	13 52.24	-06 11.0	13 54.37	-06 22.9	3.724	2.973	-0.58	+ 2.8	18.0	22.8/111	36.3	11.5	104/0.58	73	.10	
26	14 06.51	-07 32.6	14 08.66	-07 44.2	3.751	2.930	-0.60	+ 2.9	17.9	23.8/110	30.4	10.0	101/0.50	49	.40	
Oct.																
6	14 21.57	-08 54.0	14 23.74	-09 05.1	3.767	2.888	-0.63	+ 2.9	17.8	24.7/109	24.6	8.3	98/0.42	170	.97	
16	14 37.38	-10 14.2	14 39.57	-10 24.7	3.770	2.846	-0.65	+ 2.9	17.7	25.6/108	19.0	6.6	94/0.33	49	.07	
26	14 53.92	-11 32.0	14 56.14	-11 41.9	3.763	2.806	-0.68	+ 2.9	17.6	26.3/107	13.6	4.8	86/0.24	68	.42	
Nov.																
5	15 11.15	-12 46.2	15 13.39	-12 55.4	3.744	2.767	-0.71	+ 2.8	17.5	27.0/105	8.6	3.1	71/0.16	155	.93	
15	15 29.03	-13 55.9	15 31.30	-14 04.2	3.714	2.730	-0.74	+ 2.7	17.4	27.6/104	5.1	1.8	32/0.09	29	.05	
25	15 47.53	-14 59.7	15 49.82	-15 07.2	3.673	2.693	-0.77	+ 2.6	17.3	28.1/102	6.2	2.3	334/0.12	88	.44	
Dec.																
5	16 06.57	-15 56.7	16 08.89	-16 03.2	3.622	2.659	-0.81	+ 2.5	17.2	28.6/101	10.5	3.9	308/0.20	132	.90	
15	16 26.12	-16 45.8	16 28.46	-16 51.2	3.562	2.626	-0.84	+ 2.3	17.0	28.9/ 99	15.4	5.7	297/0.31	13	.04	
25	16 46.08	-17 26.1	16 48.44	-17 30.4	3.492	2.595	-0.88	+ 2.1	16.9	29.1/ 97	20.6	7.7	290/0.42	108	.49	
1991 Jan.																
4	17 06.35	-17 56.8	17 08.73	-18 00.0	3.415	2.566	-0.92	+ 1.8	16.8	29.3/ 95	25.8	9.6	286/0.53	110	.86	
Feb.																
14	17 26.84	-18 17.4	17 29.24	-18 19.4	3.331	2.538	-0.96	+ 1.5	16.7	29.3/ 93	31.0	11.5	282/0.65	12	.04	
24	17 47.42	-18 27.5	17 49.83	-18 28.3	3.240	2.513	-0.99	+ 1.2	16.6	29.2/ 91	36.2	13.4	278/0.77	131	.54	
3	18 07.96	-18 27.1	18 10.37	-18 26.6	3.143	2.491	-1.03	+ 0.8	16.4	29.0/ 89	41.4	15.2	275/0.90	90	.83	
13	18 28.33	-18 16.3	18 30.74	-18 14.7	3.041	2.470	-1.07	+ 0.4	16.3	28.7/ 87	46.7	16.9	272/1.03	28	.03	

T/ET		q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch
1991 Apr. 28.7521		1.795450	0.451536	5.92	179.4713	38.3006	25.5651	0.200	1991 Apr. 14.0
$m_2 = 17.0+5\log(\delta)+10.0\log(r)$									
Date/	Oh ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	h	m	Delta	r
$m_1 = 13.0+5\log(\delta)+15.0\log(r)$									
1990 Aug.	27	09 33.94	+34 28.4	09 36.38	+34 17.5	3.494	2.625	3.494	2.625
Sept.	6	09 54.48	+33 03.5	09 56.86	+32 51.9	3.402	2.577	3.402	2.577
	16	10 14.91	+31 32.7	10 17.23	+31 20.5	3.303	2.529	3.303	2.529
	26	10 35.21	+29 56.7	10 37.48	+29 44.0	3.195	2.481	3.195	2.481
Oct.	6	10 55.34	+28 16.4	10 57.56	+28 03.3	3.082	2.433	3.082	2.433
	16	11 15.30	+26 32.4	11 17.47	+26 19.0	2.962	2.386	2.962	2.386
	26	11 35.06	+24 45.7	11 37.20	+24 32.1	2.837	2.339	2.837	2.339
Nov.	5	11 54.60	+22 57.3	11 56.70	+22 43.6	2.709	2.293	2.709	2.293
	15	12 13.89	+21 08.1	12 15.96	+20 54.4	2.577	2.248	2.577	2.248
	25	12 32.88	+19 19.2	12 34.93	+19 05.5	2.443	2.203	2.443	2.203
Dec.	5	12 51.52	+17 31.3	12 53.56	+17 17.8	2.307	2.160	2.307	2.160
	15	13 09.74	+15 45.3	13 11.76	+15 32.1	2.171	2.118	2.171	2.118
	25	13 27.41	+14 01.9	13 29.43	+13 49.0	2.034	2.077	2.034	2.077
1991 Jan.	4	13 44.40	+12 21.2	13 46.42	+12 08.7	1.898	2.038	1.898	2.038
	14	14 00.52	+10 43.4	14 02.55	+10 31.3	1.763	2.001	1.763	2.001
	24	14 15.54	+09 07.8	14 17.57	+08 56.2	1.631	1.967	1.631	1.967
Feb.	3	14 29.14	+07 33.1	14 31.19	+07 22.0	1.502	1.935	1.502	1.935
	13	14 40.97	+05 57.2	14 43.04	+05 46.5	1.377	1.905	1.377	1.905
Mot./PA									
Elong.									
P									
PA/Tail									
Moon Age									

P/Harrington-Abell

Orbit by Nakano S.

NK 516

(1987)

T/ET		q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch
1991 July 6.9277		1.774389	0.540439	7.59	138.6754	336.6354	10.1766	0.200	1991 July 3.0
$m_2 = 16.0+5\log(\delta)+5.0\log(r)+0.03(\text{phase})$									
Date/	Oh ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	h	m	Delta	r
$m_1 = 13.0+5\log(\delta)+15.0\log(r)$									
1990 July	18	01 15.33	+13 31.2	01 17.49	+13 44.1	3.163	3.357	3.163	3.357
	28	01 20.11	+14 31.9	01 22.29	+14 44.8	2.971	3.304	2.971	3.304
Aug.	7	01 23.44	+15 27.4	01 25.63	+15 40.2	2.783	3.250	2.783	3.250
	17	01 25.07	+16 16.4	01 27.27	+16 29.1	2.602	3.197	2.602	3.197
	27	01 24.73	+16 57.3	01 26.95	+17 10.1	2.433	3.142	2.433	3.142
Sept.	6	01 22.26	+17 28.3	01 24.47	+17 41.2	2.278	3.087	2.278	3.087
	16	01 17.57	+17 47.5	01 19.79	+18 00.5	2.142	3.032	2.142	3.032
	26	01 10.80	+17 52.8	01 13.01	+18 06.0	2.028	2.977	2.028	2.977
Oct.	6	01 02.38	+17 43.5	01 04.58	+17 56.8	1.940	2.921	1.940	2.921
	16	00 53.03	+17 20.2	00 55.23	+17 33.7	1.880	2.865	1.880	2.865
	26	00 43.71	+16 46.1	00 45.89	+16 59.8	1.849	2.809	1.849	2.809
Nov.	5	00 35.44	+16 06.5	00 37.60	+16 20.2	1.845	2.753	1.845	2.753
	15	00 29.06	+15 27.4	00 31.21	+15 41.2	1.865	2.697	1.865	2.697
	25	00 25.20	+14 55.0	00 27.35	+15 08.8	1.906	2.641	1.906	2.641
Dec.	5	00 24.16	+14 34.0	00 26.30	+14 47.8	1.962	2.585	1.962	2.585
	15	00 25.96	+14 27.0	00 28.11	+14 40.8	2.028	2.529	2.028	2.529
	25	00 30.53	+14 35.5	00 32.68	+14 49.3	2.101	2.473	2.101	2.473
1991 Jan.	4	00 37.64	+14 59.3	00 39.80	+15 13.0	2.176	2.419	2.176	2.419
Mot./PA									
Elong.									
P									
PA/Tail									
Moon Age									

T/ET	q (AU)	P	Peri.	Node	Inc.	Tail(AU)	Epoch								
1991 May	1.850061	7.99	47.0686	355.4954	19.9289	0.200	1991 May								
m2 = 15.0+5log(delta)+10.0log(r)															
Date/	Oh ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	Delta	r	Variation for T=+1 day	Magnitude m1	Magnitude m2	Mot./PA	Elong.	P	PA/Tail	Moon Age
1989 Dec.	10	18 09.90	-39 31.2	18 12.67	-39 30.7	5.130	4.230	-0.38 - 0.4	24.8	24.8	16.0/ 86	21.6	4.9	136/0.18	128
	20	18 23.67	-39 16.2	18 26.43	-39 14.9	5.114	4.186	-0.39 - 0.6	24.8	24.8	16.4/ 86	17.5	4.0	153/0.15	95
	30	18 37.72	-39 00.4	18 40.47	-38 58.2	5.080	4.142	-0.40 - 0.8	24.7	24.7	16.7/ 85	15.8	3.7	177/0.14	26
1990 Jan.	9	18 51.94	-38 43.3	18 54.67	-38 40.4	5.025	4.097	-0.41 - 1.0	24.6	24.6	16.8/ 85	17.4	4.1	200/0.16	156
	19	19 06.22	-38 25.2	19 08.94	-38 21.4	4.952	4.052	-0.42 - 1.3	24.6	24.6	16.9/ 85	21.4	5.1	217/0.20	73
	29	19 20.46	-38 06.0	19 23.16	-38 01.4	4.861	4.006	-0.44 - 1.5	24.5	24.5	16.8/ 84	26.8	6.4	228/0.25	53
Feb.	8	19 34.56	-37 46.0	19 37.24	-37 40.6	4.752	3.960	-0.45 - 1.8	24.4	24.4	16.6/ 84	32.9	7.8	234/0.31	164
	18	19 48.41	-37 25.7	19 51.07	-37 19.6	4.627	3.913	-0.47 - 2.0	24.3	24.3	16.3/ 84	39.3	9.2	239/0.38	51
Mar.	28	20 01.92	-37 05.7	20 04.56	-36 58.8	4.487	3.865	-0.49 - 2.3	24.1	24.1	15.8/ 84	46.0	10.6	241/0.45	81
	10	20 14.98	-36 46.6	20 17.60	-36 39.1	4.334	3.817	-0.51 - 2.7	24.0	24.0	15.2/ 84	52.8	12.0	244/0.52	141
Apr.	20	20 27.49	-36 29.2	20 30.08	-36 21.1	4.170	3.769	-0.53 - 3.0	23.9	23.9	14.4/ 85	59.8	13.2	245/0.60	29
	30	20 39.33	-36 14.6	20 41.90	-36 06.0	3.997	3.720	-0.55 - 3.3	23.7	23.7	13.4/ 86	66.9	14.3	247/0.68	111
	9	20 50.37	-36 03.9	20 52.92	-35 54.7	3.816	3.670	-0.58 - 3.7	23.6	23.6	12.3/ 88	74.1	15.2	248/0.75	116
May	19	21 00.47	-35 57.9	21 03.01	-35 48.3	3.631	3.620	-0.61 - 4.1	23.4	23.4	10.9/ 91	81.4	15.9	250/0.82	18
	29	21 09.47	-35 58.1	21 11.99	-35 48.1	3.443	3.570	-0.65 - 4.6	23.2	23.2	9.4/ 95	89.0	16.4	252/0.89	141
	9	21 17.16	-36 05.4	21 19.66	-35 55.1	3.255	3.519	-0.69 - 5.0	23.0	23.0	7.6/102	96.7	16.6	254/0.95	90
June	19	21 23.32	-36 20.8	21 25.83	-36 10.2	3.071	3.467	-0.74 - 5.4	20.0	22.8	5.8/115	104.6	16.4	256/0.99	38
	29	21 27.70	-36 44.8	21 30.21	-36 34.0	2.893	3.415	-0.80 - 5.9	19.8	22.6	4.3/140	112.8	15.9	260/1.02	159
	8	21 30.02	-37 17.4	21 32.53	-37 06.5	2.724	3.363	-0.86 - 6.2	19.6	22.4	4.0/180	121.2	15.0	264/1.01	61
18	21 29.99	-37 57.4	21 32.52	-37 46.5	2.567	3.310	-0.93 - 6.5	19.3	22.2	5.5/214	129.7	13.7	270/0.98	71	
July	28	21 27.36	-38 42.5	21 29.92	-38 31.6	2.427	3.257	-1.00 - 6.7	19.1	22.1	7.7/233	138.3	12.0	278/0.91	140
	8	21 22.03	-39 28.2	21 24.62	-39 17.6	2.307	3.204	-1.07 - 6.8	18.9	21.9	10.0/245	146.5	10.1	290/0.80	32
	18	21 14.11	-40 08.9	21 16.73	-39 58.5	2.209	3.150	-1.12 - 6.7	18.7	21.7	11.9/255	153.4	8.3	309/0.69	111
Aug.	28	21 04.02	-40 37.6	21 06.68	-40 27.7	2.135	3.096	-1.16 - 6.4	18.5	21.6	13.0/265	157.1	7.3	336/0.63	106
	7	20 52.63	-40 47.9	20 55.32	-40 38.5	2.088	3.042	-1.18 - 6.0	18.3	21.4	13.2/274	155.8	7.9	7/0.69	28
	17	20 41.07	-40 35.5	20 43.79	-40 26.6	2.067	2.987	-1.16 - 5.6	18.2	21.3	12.5/286	150.0	9.8	31/0.86	150
Sept.	27	20 30.57	-39 59.3	20 33.30	-39 51.0	2.071	2.933	-1.12 - 5.2	18.1	21.3	11.3/300	141.9	12.3	47/1.08	70
	6	20 22.22	-39 01.5	20 24.94	-38 53.6	2.096	2.878	-1.06 - 5.0	18.0	21.2	9.9/319	132.8	14.9	57/1.29	60
	16	20 16.71	-37 46.3	20 19.41	-37 38.7	2.140	2.823	-1.00 - 4.9	17.9	21.2	9.2/342	123.6	17.3	64/1.46	154
26	20 14.35	-36 18.2	20 17.02	-36 10.7	2.198	2.768	-0.93 - 5.0	17.8	21.1	9.7/ 6	114.5	19.2	69/1.58	38	
Oct.	6	20 15.14	-34 41.3	20 17.77	-34 33.7	2.266	2.714	-0.87 - 5.2	17.8	21.1	11.3/ 24	105.7	20.8	73/1.66	96
	16	20 18.85	-32 58.2	20 21.44	-32 50.5	2.341	2.659	-0.82 - 5.4	17.7	21.1	13.5/ 37	97.4	21.8	75/1.69	125
	26	20 25.18	-31 10.4	20 27.73	-31 02.4	2.418	2.605	-0.78 - 5.8	17.7	21.1	15.8/ 45	89.4	22.4	76/1.68	14
Nov.	5	20 33.78	-29 18.5	20 36.28	-29 10.0	2.496	2.551	-0.75 - 6.1	17.6	21.1	18.1/ 51	81.8	22.6	77/1.64	128
	15	20 44.30	-27 22.3	20 46.76	-27 13.3	2.571	2.498	-0.73 - 6.5	17.5	21.0	20.3/ 54	74.6	22.4	77/1.59	99
	25	20 56.45	-25 21.1	20 58.86	-25 11.6	2.642	2.445	-0.71 - 6.9	17.4	21.0	22.4/ 56	67.7	21.9	77/1.51	19
Dec.	5	21 09.95	-23 14.5	21 12.32	-23 04.5	2.707	2.394	-0.69 - 7.3	17.3	21.0	24.3/ 58	61.2	21.1	76/1.43	157
	15	21 24.57	-21 01.8	21 26.89	-20 51.1	2.766	2.343	-0.69 - 7.8	17.3	20.9	26.0/ 58	54.9	20.1	76/1.34	77
	25	21 40.15	-18 42.3	21 42.42	-18 31.1	2.816	2.293	-0.68 - 8.2	17.2	20.9	27.6/ 59	48.9	18.9	75/1.23	41
1991 Jan.	4	21 56.50	-16 15.7	21 58.74	-16 03.9	2.858	2.245	-0.68 - 8.7	17.0	20.8	29.1/ 59	43.2	17.5	74/1.13	174
Feb.	14	22 13.53	-13 41.7	22 15.73	-13 29.4	2.892	2.198	-0.69 - 9.1	16.9	20.7	30.4/ 58	37.7	15.9	72/1.02	59
	24	22 31.14	-11 00.2	22 33.31	-10 47.6	2.917	2.153	-0.70 - 9.6	16.8	20.7	31.7/ 58	32.5	14.2	71/0.91	64
	3	22 49.28	-08 11.6	22 51.43	-07 58.6	2.935	2.110	-0.71 - 10.0	16.7	20.6	32.8/ 58	27.5	12.5	69/0.79	158
13	23 07.92	-05 16.1	23 10.05	-05 02.8	2.944	2.070	-0.73 - 10.5	16.6	20.5	33.9/ 58	22.8	10.6	67/0.68	42	

T/ET	q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch
1991 July 22.0127	0.125548	0.958369	5.24	14.5291	93.8227	60.1470	0.200	1991 July 3.0

$m_2 = 14.5+5\log(\delta)+5.0\log(r)+0.03(\text{phase})$

Date/	0h	ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	h	m	s	Delta	r	Daily motion	Magnitude	Mot./PA	Elong.	P	PA/Tail	Moon Age		
1989 Dec.	10		18 48.46	-37 51.1	18 51.17	-37 48.3				6.201	5.340	+0.80	+1.0	22.2	9.5/85	26.7	4.8	117/0.15	121	.90
	20		18 56.46	-37 41.4	18 59.16	-37 38.2				6.220	5.308	+0.83	+0.8	22.2	9.9/86	20.3	3.7	130/0.11	102	.50
	30		19 04.79	-37 33.3	19 07.48	-37 29.7				6.214	5.274	+0.85	+0.6	22.2	10.2/87	15.8	2.9	153/0.09	21	.04
1990 Jan.	9		19 13.32	-37 27.1	19 16.00	-37 22.9				6.182	5.240	+0.86	+0.4	22.1	10.3/88	15.2	2.8	184/0.09	153	.94
	19		19 21.92	-37 22.9	19 24.60	-37 18.2				6.126	5.205	+0.86	+0.2	22.1	10.2/90	18.8	3.5	209/0.11	76	.49
	29		19 30.48	-37 21.1	19 33.16	-37 15.9				6.045	5.168	+0.84	-0.1	22.1	10.0/91	24.8	4.6	224/0.15	50	.06
Feb.	8		19 38.88	-37 22.1	19 41.54	-37 16.5				5.941	5.131	+0.81	-0.5	22.1	9.7/93	31.9	5.8	233/0.19	165	.96
	18		19 46.98	-37 26.7	19 49.64	-37 20.6				5.815	5.092	+0.77	-0.9	22.1	9.2/96	39.6	7.1	239/0.24	51	.48
	28		19 54.67	-37 35.4	19 57.32	-37 28.9				5.668	5.052	+0.71	-1.4	22.0	8.6/100	47.5	8.3	243/0.28	83	.09
Mar.	10		20 01.79	-37 49.1	20 04.45	-37 42.2				5.504	5.011	+0.64	-2.0	22.0	7.8/105	55.7	9.4	246/0.33	139	.98

P/Tsuchinshan I

Orbit by Szutowicz S.

AA 36, 323 (1986)

T/ET	q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch									
1991 Aug.	1.497517	0.576321	6.65	22.7558	96.1846	10.5032	0.200	1991 Aug. 12.0									
m2 = 16.0+5log(delta)+10.0log(r)																	
Date/	0h ET	R.A.(1950)	Decl.	R.A.(App.)	h	m	Decl.	Delta	r	Variation for T=+1 day	Magnitude ml	m2	Mot./PA	Elong.	P	PA/Tail	Moon Age
1990 June	28	00 32.62	-07 52.5	00 34.69	-07 39.0			3.601	3.761	-0.47	-3.0	24.5	7.2/ 92	91.1	15.7	247/0.82	155 .31
July	8	00 37.44	-07 55.2	00 39.51	-07 41.7			3.407	3.711	-0.51	-3.2	24.4	5.5/105	99.4	15.7	248/0.86	80 1.00
	18	00 41.00	-08 09.0	00 43.07	-07 55.5			3.216	3.661	-0.54	-3.4	24.2	4.0/130	108.0	15.3	250/0.89	55 .22
Aug.	28	00 43.08	-08 34.6	00 45.16	-08 21.0			3.034	3.609	-0.58	-3.6	24.0	3.8/171	117.0	14.5	253/0.89	160 .35
	7	00 43.50	-09 12.2	00 45.58	-08 58.6			2.862	3.557	-0.62	-3.8	23.8	5.3/203	126.3	13.3	256/0.86	49 1.00
	17	00 42.09	-10 01.3	00 44.17	-09 47.7			2.705	3.505	-0.66	-4.0	23.6	7.7/220	136.0	11.6	261/0.79	93 .15
	27	00 38.75	-11 00.3	00 40.84	-10 46.7			2.568	3.451	-0.70	-4.1	23.4	10.1/229	145.8	9.5	268/0.68	132 .38
Sept.	6	00 33.54	-12 06.0	00 35.63	-11 52.3			2.455	3.397	-0.73	-4.1	23.3	12.1/236	155.3	7.1	280/0.53	20 .99
	16	00 26.67	-13 13.7	00 28.77	-13 00.0			2.367	3.342	-0.75	-4.0	23.1	13.4/241	163.0	5.0	306/0.39	133 .10
	26	00 18.62	-14 17.8	00 20.72	-14 04.0			2.308	3.286	-0.75	-3.8	23.0	13.6/246	164.6	4.6	350/0.37	96 .40
Oct.	6	00 10.04	-15 11.9	00 12.15	-14 58.1			2.278	3.229	-0.74	-3.6	22.9	12.7/252	158.4	6.5	237/0.53	42 .97
	16	00 01.71	-15 51.1	00 03.83	-15 37.3			2.277	3.172	-0.72	-3.3	22.8	10.7/259	148.8	9.4	40/0.76	161 .07
	26	23 54.42	-16 11.7	23 56.55	-15 58.0			2.300	3.113	-0.69	-3.1	22.7	8.1/269	138.3	12.3	49/0.98	60 .42
Nov.	5	23 48.81	-16 12.6	23 50.95	-15 58.9			2.344	3.054	-0.66	-2.9	22.7	5.4/290	127.8	14.9	55/1.16	82 .93
	15	23 45.31	-15 54.3	23 47.44	-15 40.6			2.405	2.995	-0.62	-2.8	22.7	4.0/335	117.6	17.0	59/1.29	140 .05
	25	23 44.13	-15 18.4	23 46.26	-15 04.7			2.477	2.934	-0.59	-2.8	22.6	5.4/ 18	107.9	18.7	62/1.38	28 .44
Dec.	5	23 45.29	-14 27.1	23 47.42	-14 13.4			2.556	2.873	-0.56	-2.8	22.6	8.1/ 38	98.6	19.8	64/1.42	119 .90
	15	23 48.69	-13 22.5	23 50.81	-13 08.8			2.636	2.812	-0.55	-2.9	22.6	11.0/ 47	89.9	20.5	66/1.42	111 .04

P/Skiff-Kosai

Orbit by Nakano S.

NK 501 (1987)

T/ET	q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch										
1991 Sep.	2.846426	0.259714	7.54	26.5299	80.1455	3.1992	0.200	1991 Sep. 21.0										
m1 = 8.5+5log(delta)+15.0log(r)																		
m2 = 12.0+5log(delta)+10.0log(r)																		
Date/	Oh ET	R.A.(1950)	Decl.	R.A.(App.)	h	m	Decl.	Delta	r	Variation for T=+1 day	Magnitude ml	m2	Mot./PA	Elong.	P	PA/Tail	Moon Age	
1990 Aug.	7	02 45.01	+13 05.4	02 47.25	+13 15.7			3.278	3.445	-0.65	-3.5	19.1	8.8/ 75	90.8	17.1	253/0.97	84 1.00	
	17	02 50.82	+13 27.5	02 53.06	+13 37.6			3.115	3.422	-0.69	-3.7	19.0	6.5/ 77	99.0	17.0	253/1.01	54 .15	
	27	02 55.14	+13 42.4	02 57.40	+13 52.3			2.955	3.399	-0.74	-3.8	18.8	3.9/ 79	107.5	16.5	254/1.03	171 .38	
Sept.	6	02 57.78	+13 49.7	03 00.05	+13 59.6			2.803	3.376	-0.78	-4.0	18.7	1.1/ 92	116.5	15.5	255/1.02	51 .99	
	16	02 58.55	+13 49.4	03 00.82	+13 59.2			2.661	3.353	-0.83	-4.3	18.5	19.4	2.0/246	126.0	14.0	256/0.97	90 .10
	26	02 57.32	+13 41.2	02 59.59	+13 51.1			2.534	3.330	-0.88	-4.5	18.4	19.2	4.9/252	136.1	12.0	257/0.88	145 .40
Oct.	6	02 54.11	+13 25.7	02 56.38	+13 35.8			2.426	3.308	-0.92	-4.8	18.2	19.1	7.6/253	146.7	9.5	258/0.72	15 .97
	16	02 49.09	+13 03.8	02 51.36	+13 14.1			2.341	3.286	-0.95	-5.0	18.1	19.0	9.8/254	157.8	6.6	260/0.52	128 .07
	26	02 42.66	+12 37.3	02 44.92	+12 47.8			2.282	3.264	-0.96	-5.2	18.0	18.9	11.0/255	169.2	3.3	268/0.26	109 .42
Nov.	5	02 35.45	+12 08.8	02 37.70	+12 19.6			2.252	3.242	-0.97	-5.3	17.9	18.9	11.0/256	176.8	1.0	8/0.08	32 .93
	15	02 28.17	+11 41.7	02 30.42	+11 52.8			2.251	3.221	-0.95	-5.4	17.9	18.8	9.9/257	166.4	4.1	60/0.34	165 .05
	25	02 21.61	+11 19.5	02 23.85	+11 30.9			2.278	3.200	-0.92	-5.3	17.9	18.8	7.7/260	154.9	7.5	65/0.61	71 .44
Dec.	5	02 16.44	+11 05.4	02 18.67	+11 16.9			2.332	3.179	-0.89	-5.2	17.9	18.9	4.9/265	143.5	10.6	67/0.84	75 .90
	15	02 13.12	+11 01.3	02 15.34	+11 12.9			2.408	3.159	-0.85	-5.0	17.9	18.9	1.9/292	132.6	13.3	69/1.01	155 .04
	25	02 11.91	+11 08.4	02 14.13	+11 20.0			2.503	3.139	-0.81	-4.8	17.9	19.0	2.3/ 38	122.2	15.4	69/1.13	34 .49
1991 Jan.	4	02 12.89	+11 26.7	02 15.12	+11 38.2			2.610	3.119	-0.77	-4.6	18.0	19.0	5.4/ 58	112.3	17.0	70/1.19	112 .86
	14	02 16.00	+11 55.2	02 18.23	+12 06.7			2.727	3.100	-0.74	-4.4	18.0	19.1	8.4/ 63	103.0	18.0	70/1.21	124 .04
	24	02 21.09	+12 32.8	02 23.33	+12 44.1			2.849	3.082	-0.71	-4.2	18.1	19.2	11.1/ 66	94.2	18.6	71/1.20	7 .54

T/ET	q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch								
1991 Oct.	2.7180	0.600052	6.82	329.0588	121.4520	17.8877	0.200	1991 Sep. 21.0								
m1 = 10.0+5log(delta)+15.0log(r)																
m2 = 15.5+5log(delta)+ 5.0log(r)+0.03(phase)																
Date/	Oh ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	h	Delta	r	Variation for T=+1 day	Magnitude m1	Magnitude m2	Mot./PA	Elong.	P	PA/Tail	Moon Age
1989 Dec.																
10	19 40.52	-21 05.9	19 42.87	-21 00.3	5.568	4.807	-0.22	+ 0.5	22.8	12.1/ 85	36.0	6.9	80/0.24	107	.90	
20	19 49.14	-20 55.0	19 51.48	-20 49.0	5.620	4.773	-0.22	+ 0.5	22.8	12.8/ 84	27.8	5.5	79/0.19	117	.50	
30	19 58.22	-20 41.0	20 00.55	-20 34.5	5.652	4.738	-0.22	+ 0.4	22.8	13.3/ 83	19.8	4.0	79/0.14	3	.04	
1990 Jan.																
9	20 07.63	-20 24.1	20 09.95	-20 17.1	5.661	4.702	-0.23	+ 0.4	22.7	13.7/ 82	11.8	2.5	79/0.08	139	.94	
19	20 17.27	-20 04.4	20 19.58	-19 56.9	5.647	4.666	-0.24	+ 0.3	22.6	14.0/ 81	3.9	0.8	82/0.03	92	.49	
29	20 27.05	-19 42.4	20 29.35	-19 34.5	5.612	4.629	-0.24	+ 0.2	22.6	14.1/ 81	4.0	0.8	248/0.03	32	.06	
8	20 36.85	-19 18.5	20 39.14	-19 10.1	5.553	4.592	-0.25	+ 0.2	22.6	14.0/ 80	11.8	2.5	252/0.09	170	.96	
18	20 46.60	-18 53.3	20 48.88	-18 44.4	5.473	4.554	-0.26	+ 0.1	22.6	13.9/ 80	19.6	4.2	252/0.15	68	.48	
28	20 56.20	-18 27.2	20 58.46	-18 17.9	5.372	4.515	-0.27	0.0	22.6	13.6/ 79	27.3	5.8	252/0.21	63	.09	
1991 Mar.																
10	21 05.55	-18 01.0	21 07.81	-17 51.3	5.251	4.475	-0.29	0.0	22.6	13.1/ 79	35.1	7.3	251/0.27	161	.98	
1991 Apr.																
20	21 14.57	-17 35.4	21 16.82	-17 25.4	5.113	4.435	-0.30	- 0.1	22.5	12.5/ 79	42.9	8.8	251/0.33	42	.46	
30	21 23.17	-17 11.4	21 25.41	-17 01.0	4.958	4.394	-0.31	- 0.2	22.5	11.8/ 80	50.7	10.1	251/0.39	96	.14	
1991 Apr.																
9	21 31.24	-16 49.8	21 33.47	-16 39.1	4.789	4.352	-0.33	- 0.2	22.4	10.8/ 81	58.6	11.3	250/0.45	133	.99	
19	21 38.69	-16 31.7	21 40.91	-16 20.7	4.608	4.310	-0.35	- 0.3	22.4	9.7/ 82	66.6	12.4	250/0.51	15	.43	
29	21 45.39	-16 18.1	21 47.60	-16 06.9	4.419	4.266	-0.37	- 0.4	22.3	8.4/ 85	74.8	13.2	250/0.57	129	.20	
1991 May																
9	21 51.21	-16 10.4	21 53.42	-15 59.0	4.223	4.222	-0.39	- 0.5	22.2	6.9/ 90	83.1	13.7	250/0.62	105	.99	
19	21 56.02	-16 09.7	21 58.23	-15 58.0	4.024	4.177	-0.42	- 0.5	22.0	5.3/ 98	91.6	14.0	250/0.66	18	.37	
29	21 59.66	-16 17.2	22 01.88	-16 05.4	3.826	4.132	-0.44	- 0.6	21.9	3.7/117	100.5	14.0	251/0.69	162	.26	
1991 June																
8	22 01.97	-16 34.2	22 04.20	-16 22.3	3.632	4.086	-0.47	- 0.6	21.8	3.0/156	109.6	13.5	251/0.70	75	1.00	
18	22 02.81	-17 01.5	22 05.04	-16 49.6	3.446	4.039	-0.50	- 0.7	21.6	4.0/197	119.0	12.7	252/0.69	54	.30	
1991 July																
28	22 02.01	-17 39.7	22 04.25	-17 27.8	3.273	3.991	-0.53	- 0.7	21.4	6.1/216	128.9	11.4	254/0.65	161	.31	
8	21 59.49	-18 28.6	22 01.75	-18 16.7	3.117	3.942	-0.56	- 0.6	21.2	8.4/226	139.1	9.7	257/0.58	41	1.00	
18	21 55.25	-19 26.9	21 57.52	-19 15.1	2.981	3.893	-0.59	- 0.5	21.1	10.5/231	149.7	7.6	261/0.47	95	.22	
28	21 49.38	-20 32.3	21 51.68	-20 20.7	2.871	3.842	-0.60	- 0.4	20.9	12.2/235	160.3	5.1	270/0.33	124	.35	
1991 Aug.																
7	21 42.18	-21 41.2	21 44.50	-21 29.9	2.789	3.791	-0.62	- 0.2	20.7	13.1/238	169.8	2.7	298/0.18	9	1.00	
17	21 34.11	-22 49.3	21 36.46	-22 38.2	2.737	3.740	-0.62	+ 0.1	20.6	13.1/241	170.7	2.5	13/0.17	140	.15	
27	21 25.77	-23 52.0	21 28.14	-23 41.3	2.715	3.687	-0.61	+ 0.3	20.7	12.1/243	161.5	5.0	46/0.34	86	.38	
1991 Sept.																
6	21 17.87	-24 45.5	21 20.26	-24 35.1	2.722	3.633	-0.59	+ 0.6	20.7	10.2/245	150.5	7.9	57/0.54	43	.99	
16	21 11.05	-25 27.4	21 13.47	-25 17.2	2.755	3.579	-0.57	+ 0.8	20.8	7.6/247	139.5	10.5	62/0.71	170	.10	
26	21 05.88	-25 56.4	21 08.30	-25 46.4	2.810	3.524	-0.54	+ 0.9	20.9	4.6/249	128.6	12.8	66/0.85	50	.40	
1991 Oct.																
6	21 02.72	-26 12.7	21 05.15	-26 02.9	2.881	3.468	-0.52	+ 1.0	20.9	1.4/251	118.2	14.7	68/0.95	83	.97	
16	21 01.74	-26 17.2	21 04.17	-26 07.5	2.965	3.411	-0.50	+ 1.0	21.0	1.8/ 70	108.3	16.1	70/1.01	137	.07	
26	21 02.99	-26 11.0	21 05.41	-26 01.2	3.056	3.354	-0.48	+ 1.0	21.1	4.8/ 71	98.7	17.0	72/1.03	19	.42	
1991 Nov.																
5	21 06.37	-25 55.2	21 08.79	-25 45.3	3.148	3.295	-0.47	+ 0.9	21.1	7.6/ 72	89.7	17.5	73/1.03	121	.93	
15	21 11.73	-25 30.8	21 14.13	-25 20.7	3.240	3.236	-0.46	+ 0.8	21.1	10.2/ 72	81.0	17.6	74/1.01	105	.05	
25	21 18.88	-24 58.4	21 21.26	-24 48.0	3.326	3.176	-0.46	+ 0.6	21.1	12.6/ 72	72.8	17.3	75/0.97	16	.44	
1991 Dec.																
5	21 27.63	-24 18.7	21 29.98	-24 07.9	3.403	3.115	-0.46	+ 0.4	21.1	14.7/ 72	64.9	16.6	76/0.91	153	.90	
15	21 37.77	-23 31.9	21 40.10	-23 20.8	3.471	3.054	-0.47	+ 0.2	20.0	21.1	16.6/ 72	57.3	15.7	77/0.85	79	.04
25	21 49.13	-22 38.4	21 51.44	-22 26.9	3.526	2.991	-0.48	0.0	19.9	21.1	18.3/ 71	50.0	14.6	78/0.78	42	.49
1991 Jan.																
4	22 01.56	-21 38.6	22 03.84	-21 26.7	3.568	2.928	-0.49	- 0.3	19.8	21.0	19.8/ 71	43.1	13.3	79/0.70	168	.86
1991 Feb.																
14	22 14.93	-20 32.5	22 17.18	-20 20.3	3.594	2.864	-0.51	- 0.5	19.6	20.9	21.3/ 71	36.5	11.8	81/0.62	57	.04
24	22 29.11	-19 20.6	22 31.34	-19 07.9	3.606	2.799	-0.53	- 0.8	19.5	20.8	22.6/ 71	30.2	10.2	84/0.54	68	.54
3	22 44.03	-18 03.0	22 46.23	-17 50.1	3.602	2.734	-0.55	- 1.2	19.3	20.7	23.8/ 70	24.3	8.5	89/0.45	150	.83
13	22 59.61	-16 40.3	23 01.79	-16 27.0	3.583	2.668	-0.58	- 1.5	19.2	20.6	25.0/ 70	18.9	6.9	96/0.37	37	.03

T/ET	q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch							
1991 Nov. 16.1937	1.593386	0.578185	7.34	203.9538	198.8801	9.0909	0.200	1991 Oct. 31.0							
m1 = 9.0+5log(delta)+15.0log(r)															
m2 = 14.0+5log(delta)+ 5.0log(r)+0.03(phase)															
Date/	Oh ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	Delta	r	Variation for T=+1 day	Magnitude ml	Mot./PA	Elong.	P	PA/Tail	Moon	Age
1989 Dec.	10	16 56.16	-16 21.1	16 58.45	-16 24.8	5.935	4.958	-0.22 + 0.1	21.4	13.3/ 95	6.8	1.4	341/0.04	144	.90
	20	17 05.40	-16 31.0	17 07.69	-16 34.2	5.882	4.925	-0.23 + 0.1	21.4	13.3/ 93	12.4	2.5	305/0.08	79	.50
	30	17 14.64	-16 37.3	17 16.94	-16 40.0	5.806	4.891	-0.24 + 0.1	21.4	13.1/ 91	19.7	3.9	293/0.13	42	.04
1990 Jan.	9	17 23.77	-16 40.0	17 26.08	-16 42.1	5.709	4.857	-0.25 0.0	21.4	12.8/ 90	27.4	5.3	286/0.18	169	.94
	19	17 32.68	-16 38.8	17 34.99	-16 40.5	5.592	4.824	-0.26 0.0	21.4	12.3/ 88	35.2	6.8	282/0.23	55	.49
	29	17 41.26	-16 33.9	17 43.57	-16 35.0	5.457	4.787	-0.27 - 0.1	21.3	11.7/ 86	43.2	8.1	279/0.29	71	.06
Feb.	8	17 49.36	-16 25.2	17 51.68	-16 25.9	5.304	4.750	-0.28 - 0.1	21.3	10.9/ 84	51.3	9.3	277/0.34	150	.96
	18	17 56.88	-16 13.1	17 59.20	-16 13.4	5.137	4.714	-0.29 - 0.2	21.2	9.9/ 81	59.5	10.4	275/0.39	30	.48
Mar.	28	18 03.66	-15 57.8	18 05.98	-15 57.6	4.958	4.676	-0.31 - 0.2	21.2	8.7/ 78	67.9	11.3	273/0.44	103	.09
	10	18 09.57	-15 39.6	18 11.89	-15 39.1	4.770	4.638	-0.32 - 0.3	21.1	7.4/ 74	76.4	12.0	271/0.48	120	.98

1989 Dec.	10	16 58.16	-16 21.1	16 58.45	-16 24.8	5.935	4.958	-0.22 + 0.1	21.4	13.3/ 95	6.8	1.4	341/0.04	144	.90
	20	17 05.40	-16 31.0	17 07.69	-16 34.2	5.882	4.925	-0.23 + 0.1	21.4	13.3/ 93	12.4	2.5	305/0.08	79	.50
	30	17 14.64	-16 37.3	17 16.94	-16 40.0	5.806	4.891	-0.24 + 0.1	21.4	13.1/ 91	19.7	3.9	293/0.13	42	.04
1990 Jan.	9	17 23.77	-16 40.0	17 26.08	-16 42.1	5.709	4.857	-0.25	21.4	12.8/ 90	27.4	5.3	286/0.18	169	.94
	19	17 32.68	-16 38.8	17 34.99	-16 40.5	5.592	4.822	-0.26	21.4	12.3/ 88	35.2	6.8	282/0.23	55	.49
	29	17 41.26	-16 33.9	17 43.57	-16 35.0	5.457	4.787	-0.27	21.3	11.7/ 86	43.2	8.1	279/0.29	71	.06
Feb.	8	17 49.36	-16 25.2	17 51.68	-16 25.9	5.304	4.750	-0.28	21.3	10.9/ 84	51.3	9.3	277/0.34	150	.96
	18	17 56.88	-16 13.1	17 59.20	-16 13.4	5.137	4.714	-0.29	21.2	9.9/ 81	59.5	10.4	275/0.39	30	.48
	28	18 03.66	-15 57.8	18 05.98	-15 57.6	4.958	4.676	-0.31	21.2	8.7/ 78	67.9	11.3	273/0.44	103	.09
Mar.	10	18 09.57	-15 39.6	18 11.89	-15 39.1	4.770	4.638	-0.32	21.1	7.4/ 74	76.4	12.0	271/0.48	120	.98
	20	18 14.46	-15 19.0	18 16.77	-15 18.3	4.576	4.599	-0.34	21.0	5.8/ 67	85.1	12.5	269/0.52	12	.46
	30	18 18.17	-14 56.6	18 20.49	-14 55.6	4.380	4.560	-0.36	20.9	4.2/ 56	94.0	12.6	268/0.55	137	.14
Apr.	9	18 20.56	-14 32.9	18 22.87	-14 31.8	4.186	4.520	-0.38	20.8	2.8/ 30	103.1	12.5	266/0.56	89	.99
	19	18 21.50	-14 08.7	18 23.82	-14 07.5	3.998	4.480	-0.40	20.6	2.6/340	112.5	12.0	264/0.57	33	.43
	29	18 20.89	-13 44.6	18 23.20	-13 43.4	3.819	4.438	-0.42	20.5	4.0/305	122.2	11.1	262/0.55	167	.20
May	9	18 18.66	-13 21.5	18 20.97	-13 20.5	3.655	4.366	-0.43	20.3	6.0/291	132.1	9.8	259/0.51	57	.99
	19	18 14.86	-13 00.2	18 17.17	-12 59.4	3.509	4.354	-0.45	20.2	7.9/283	142.3	8.2	255/0.44	68	.37
	29	18 09.59	-12 41.6	18 11.90	-12 41.1	3.387	4.311	-0.46	20.0	9.6/279	152.4	6.2	248/0.35	142	.26
June	8	18 03.12	-12 26.4	18 05.43	-12 26.3	3.290	4.267	-0.47	19.9	10.8/276	162.0	4.2	233/0.24	24	1.00
	18	17 55.82	-12 15.4	17 58.13	-12 15.7	3.222	4.222	-0.47	19.8	11.2/273	168.4	2.8	196/0.16	109	.30
	28	17 48.17	-12 09.1	17 50.47	-12 09.8	3.184	4.177	-0.46	19.7	10.9/270	165.0	3.4	144/0.20	104	.31
July	8	17 40.71	-12 08.0	17 43.01	-12 09.1	3.175	4.131	-0.45	19.8	9.9/267	157.3	5.4	120/0.32	24	1.00
	18	17 33.95	-12 12.0	17 36.26	-12 13.6	3.193	4.085	-0.44	19.8	8.3/264	147.2	7.7	110/0.46	151	.22
	28	17 28.35	-12 21.1	17 30.66	-12 23.0	3.236	4.037	-0.42	19.9	6.2/257	136.9	9.9	105/0.57	67	.35
Aug.	7	17 24.26	-12 34.8	17 26.57	-12 36.9	3.300	3.990	-0.40	19.9	3.9/243	126.7	11.8	102/0.67	58	1.00
	17	17 21.87	-12 52.4	17 24.18	-12 54.6	3.379	3.941	-0.39	20.0	2.2/202	116.8	13.3	99/0.74	158	.15
	27	17 21.28	-13 13.1	17 23.60	-13 15.3	3.470	3.892	-0.37	20.1	2.9/142	107.2	14.4	97/0.78	35	.38
Sept.	6	17 22.51	-13 35.8	17 24.83	-13 38.0	3.568	3.842	-0.36	20.1	4.9/119	98.1	15.1	95/0.79	94	.99
	16	17 25.48	-13 59.5	17 27.80	-14 01.6	3.659	3.791	-0.35	20.2	7.1/110	89.2	15.4	93/0.79	125	.10
	26	17 30.10	-14 23.4	17 32.43	-14 25.1	3.768	3.740	-0.35	20.2	9.2/105	80.7	15.3	92/0.77	13	.40
Oct.	6	17 36.25	-14 46.2	17 38.58	-14 47.6	3.853	3.688	-0.35	20.2	11.1/101	72.5	15.0	90/0.73	127	.97
	16	17 43.79	-15 07.1	17 46.13	-15 08.0	3.950	3.635	-0.35	20.2	12.9/ 98	64.5	14.3	88/0.68	95	.07
	26	17 52.60	-15 25.1	17 54.94	-15 25.5	4.027	3.581	-0.36	20.2	14.4/ 96	56.8	13.4	85/0.63	26	.42
Nov.	5	18 02.54	-15 39.4	18 04.89	-15 39.3	4.092	3.527	-0.37	20.2	15.8/ 94	49.3	12.3	83/0.57	158	.93
	15	18 13.49	-15 49.3	18 15.84	-15 48.5	4.143	3.472	-0.38	20.2	17.1/ 92	42.0	11.0	80/0.50	68	.05
	25	18 25.34	-15 53.9	18 27.69	-15 52.4	4.179	3.417	-0.39	20.1	18.2/ 90	35.0	9.5	77/0.43	50	.44
Dec.	5	18 37.98	-15 52.8	18 40.32	-15 50.5	4.198	3.361	-0.41	20.0	19.2/ 88	28.1	7.9	72/0.36	166	.90
	15	18 51.29	-15 45.3	18 53.63	-15 42.2	4.201	3.304	-0.43	19.9	20.1/ 86	21.4	6.2	66/0.28	45	.04
	25	19 05.19	-15 31.0	19 07.52	-15 27.2	4.186	3.247	-0.45	19.8	20.9/ 85	15.2	4.5	56/0.21	75	.49
1991 Jan.	4	19 19.57	-15 09.6	19 21.89	-15 05.0	4.153	3.189	-0.47	19.6	21.6/ 83	9.7	3.0	36/0.14	142	.86
	14	19 34.35	-14 40.9	19 36.67	-14 35.5	4.104	3.130	-0.49	19.5	22.2/ 81	6.9	2.2	352/0.10	23	.04
	24	19 49.46	-14 04.8	19 51.76	-13 58.5	4.038	3.070	-0.52	19.3	22.8/ 79	9.3	3.0	307/0.14	101	.54
Feb.	3	20 04.81	-13 21.1	20 07.10	-13 14.1	3.956	3.011	-0.55	19.2	23.3/ 78	14.3	4.6	286/0.22	119	.83
	13	20 20.35	-12 30.1	20 22.62	-12 22.2	3.859	2.950	-0.58	19.0	23.7/ 76	19.9	6.6	276/0.32	6	.03

T/ET	q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch						
1991 Dec. 18.8453	1.985847	0.470403	7.26	18.7868	339.2482	26.2366	0.200	1991 Dec. 10.0						
m1 = 8.0+5log(delta)+15.0log(r)														
m2 = 12.0+5log(delta)+10.0log(r)														
Date/	Oh ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	Delta	r	Variation for T=+1 day	Magnitude m1 m2	Mot./PA	Elong.	P	PA/Tail	Moon Age
1989 Dec.	10	14 00.00	-31 53.1	14 02.31	-32 04.5	5.397	4.708	-0.27 + 2.2	. 22.4	12.9/126	41.7	8.0	269/0.29	167 .90
	20	14 08.26	-33 08.1	14 10.62	-33 19.4	5.266	4.680	-0.29 + 2.3	. 22.3	12.3/129	49.0	9.1	274/0.33	45 .50
	30	14 16.00	-34 24.4	14 18.39	-34 35.4	5.120	4.651	-0.31 + 2.3	. 22.2	11.6/132	56.6	10.2	277/0.38	77 .04
1990 Jan.	9	14 23.04	-35 41.4	14 25.47	-35 52.2	4.962	4.622	-0.33 + 2.3	. 22.1	10.7/137	64.4	11.1	280/0.43	143 .94
	19	14 29.19	-36 58.9	14 31.66	-37 09.5	4.795	4.593	-0.36 + 2.4	. 22.0	9.8/143	72.3	11.8	283/0.47	23 .49
	29	14 34.26	-38 16.4	14 36.77	-38 26.8	4.621	4.562	-0.38 + 2.4	. 21.9	8.8/151	80.4	12.3	286/0.51	107 .06
Feb.	8	14 38.00	-39 33.1	14 40.55	-39 43.4	4.445	4.532	-0.41 + 2.5	. 21.8	7.9/162	88.7	12.6	289/0.54	112 .96
	18	14 40.20	-40 47.9	14 42.78	-40 58.1	4.269	4.500	-0.44 + 2.6	. 21.7	7.2/176	97.2	12.6	293/0.56	22 .48
	28	14 40.61	-41 59.4	14 43.22	-42 09.6	4.097	4.469	-0.47 + 2.8	. 21.6	6.8/195	105.7	12.3	297/0.57	139 .09
Mar.	10	14 39.04	-43 05.5	14 41.67	-43 15.8	3.934	4.436	-0.50 + 3.0	. 21.4	7.0/214	114.3	11.8	303/0.57	80 .98
Apr.	20	14 35.37	-44 03.6	14 38.01	-44 14.1	3.783	4.404	-0.52 + 3.2	. 21.3	7.8/232	122.8	11.0	310/0.55	47 .46
	30	14 29.61	-44 50.5	14 32.25	-45 01.2	3.649	4.370	-0.54 + 3.4	. 21.2	8.7/247	131.0	9.9	319/0.51	156 .14
	9	14 21.97	-45 22.9	14 24.60	-45 34.0	3.535	4.336	-0.55 + 3.7	. 21.1	9.7/260	138.5	8.8	331/0.47	48 .99
May	19	14 12.88	-45 38.1	14 15.50	-45 49.5	3.444	4.302	-0.55 + 4.0	. 21.0	10.4/271	144.6	7.8	348/0.43	81 .43
	29	14 03.00	-45 34.2	14 05.58	-45 46.0	3.377	4.267	-0.54 + 4.3	. 20.9	10.7/281	148.3	7.1	9/0.40	128 .20
	9	13 53.11	-45 11.7	13 55.64	-45 23.8	3.338	4.232	-0.52 + 4.5	20.0 20.9	10.4/291	148.6	7.1	32/0.40	27 .99
June	19	13 44.00	-44 32.7	13 46.50	-44 45.1	3.324	4.196	-0.49 + 4.6	20.0 20.8	9.7/301	145.3	7.9	53/0.45	118 .37
	29	13 36.35	-43 41.4	13 38.80	-43 54.0	3.336	4.160	-0.46 + 4.7	19.9 20.8	8.6/313	139.6	9.1	70/0.51	91 .26
	8	13 30.63	-42 42.9	13 33.05	-42 55.7	3.370	4.123	-0.43 + 4.7	19.9 20.8	7.2/327	132.4	10.5	83/0.58	41 .00
18	13 27.08	-41 42.5	13 29.48	-41 55.3	3.423	4.085	-0.41 + 4.5	19.8 20.8	6.0/346	124.5	11.8	92/0.65	150 .30	
July	28	13 25.77	-40 44.6	13 28.15	-40 57.5	3.492	4.047	-0.39 + 4.4	19.8 20.8	5.3/ 11	116.3	13.0	99/0.70	56 .31
	8	13 26.64	-39 53.0	13 29.01	-40 05.9	3.573	4.009	-0.37 + 4.2	19.8 20.8	5.4/ 38	108.2	13.9	105/0.73	71 .00
	18	13 29.52	-39 10.0	13 31.89	-39 22.8	3.662	3.970	-0.36 + 4.0	19.8 20.8	6.5/ 59	100.2	14.6	109/0.75	149 .22
Aug.	28	13 34.26	-38 36.8	13 36.64	-38 49.5	3.756	3.931	-0.36 + 3.8	19.8 20.8	7.9/ 74	92.4	15.0	113/0.75	29 .35
	7	13 40.67	-38 14.1	13 43.07	-38 26.6	3.850	3.891	-0.36 + 3.6	19.8 20.8	9.4/ 83	84.8	15.0	116/0.74	101 .00
	17	13 48.59	-38 01.6	13 51.00	-38 13.8	3.942	3.850	-0.37 + 3.3	19.8 20.8	11.0/ 89	77.4	14.9	119/0.71	119 .15
Sept.	27	13 57.88	-37 58.7	14 00.31	-38 10.7	4.030	3.810	-0.37 + 3.1	19.7 20.8	12.4/ 94	70.3	14.5	122/0.68	21 .38
	6	14 08.40	-38 04.6	14 10.86	-38 16.2	4.111	3.768	-0.39 + 2.9	19.7 20.8	13.8/ 97	63.4	13.8	124/0.64	129 .99
	16	14 20.06	-38 18.1	14 22.55	-38 29.4	4.182	3.726	-0.40 + 2.7	19.7 20.8	15.1/ 99	56.7	13.0	127/0.59	90 .10
26	14 32.77	-38 38.2	14 35.30	-38 49.0	4.243	3.684	-0.42 + 2.5	19.6 20.8	16.2/100	50.3	12.1	130/0.54	37 .40	
Oct.	6	14 46.45	-39 03.7	14 49.03	-39 13.9	4.291	3.641	-0.44 + 2.3	19.6 20.8	17.2/101	44.2	11.0	133/0.49	156 .97
	16	15 01.06	-39 33.2	15 03.68	-39 42.9	4.327	3.598	-0.47 + 2.1	19.5 20.7	18.1/102	38.3	9.9	137/0.43	63 .07
	26	15 16.54	-40 05.7	15 19.20	-40 14.6	4.348	3.555	-0.49 + 1.9	19.5 20.7	18.9/102	32.9	8.7	143/0.38	58 .42
Nov.	5	15 32.83	-40 39.8	15 35.54	-40 47.9	4.355	3.511	-0.52 + 1.7	19.4 20.6	19.6/102	28.0	7.6	151/0.33	160 .93
	15	15 49.90	-41 14.4	15 52.65	-41 21.7	4.346	3.466	-0.55 + 1.4	19.3 20.6	20.3/101	24.1	6.7	161/0.29	40 .05
	25	16 07.68	-41 48.4	16 10.48	-41 54.8	4.322	3.421	-0.59 + 1.1	19.2 20.5	20.8/101	21.3	6.0	175/0.27	80 .44
Dec.	5	16 26.11	-42 20.8	16 28.96	-42 26.2	4.282	3.376	-0.62 + 0.8	19.1 20.4	21.2/100	20.4	5.8	191/0.26	138 .90
	15	16 45.13	-42 50.6	16 48.02	-42 54.9	4.228	3.331	-0.66 + 0.4	19.0 20.4	21.6/ 99	21.4	6.2	207/0.28	22 .04
	25	17 04.65	-43 17.0	17 07.57	-43 20.2	4.159	3.285	-0.69 + 0.0	18.8 20.3	21.8/ 98	24.0	7.0	220/0.32	103 .49
1991 Jan.	4	17 24.57	-43 39.3	17 27.52	-43 41.3	4.075	3.239	-0.73 - 0.5	18.7 20.2	22.0/ 96	27.9	8.2	229/0.38	113 .86
Feb.	14	17 44.79	-43 57.0	17 47.76	-43 57.8	3.979	3.192	-0.77 - 1.0	18.6 20.0	22.0/ 95	32.4	9.5	235/0.45	19 .04
	24	18 05.19	-44 09.8	18 08.18	-44 09.4	3.869	3.145	-0.81 - 1.6	18.4 19.9	22.0/ 94	37.5	11.0	240/0.54	127 .54
	3	18 25.63	-44 17.7	18 28.62	-44 16.0	3.749	3.099	-0.85 - 2.2	18.2 19.8	21.8/ 93	42.8	12.5	243/0.63	91 .83
13	18 45.99	-44 20.6	18 48.97	-44 17.7	3.619	3.051	-0.88 - 2.9	18.1 19.6	21.6/ 91	48.2	14.0	245/0.73	33 .03	

T/ET	q (AU)	e	P	Peri.	Node	Inc.	Tail(AU)	Epoch							
1992 Aug.	5.9350	0.147314	8.57	88.9384	76.8382	6.6282	0.200	1992 Aug.							
m1 = 5.0+5log(delta)+15.0log(r)															
m2 = 10.0+5log(delta)+10.0log(r)															
Date/	Oh ET	R.A.(1950)	Decl.	R.A.(App.)	Decl.	Delta	r	Daily motion	Magnitude	Mot./PA	Elong.	P	PA/Tail	Moon Age	
		h	m	h	m	'		m	m1	'	°	°	°	°	
1989 Dec.	10	02 01.26	+07 14.2	02 03.39	+07 25.8	3.743	4.475	-0.22	+0.5	17.6 19.4	3.3/278	133.2	9.2	65/0.46	14 .90
	20	01 59.06	+07 18.8	02 01.19	+07 30.5	3.858	4.466	-0.07	+1.3	17.7 19.4	1.7/320	122.6	10.7	67/0.52	147 .50
	30	01 58.34	+07 31.6	02 00.47	+07 43.4	3.987	4.456	+0.08	+2.1	17.7 19.5	2.4/29	112.4	11.8	68/0.56	90 .04
1990 Jan.	9	01 59.13	+07 52.4	02 01.26	+08 04.1	4.127	4.446	+0.22	+2.8	17.8 19.6	4.3/50	102.5	12.5	69/0.57	49 .94
	19	02 01.35	+08 20.3	02 03.48	+08 32.0	4.273	4.435	+0.36	+3.4	17.9 19.6	6.3/57	93.1	12.8	70/0.57	171 .49
	29	02 04.91	+08 54.5	02 07.04	+09 06.0	4.419	4.425	+0.48	+3.9	17.9 19.7	8.1/61	83.9	12.8	70/0.55	56 .06
Feb.	8	02 09.69	+09 33.8	02 11.83	+09 45.2	4.563	4.415	+0.59	+4.3	18.0 19.7	9.7/63	75.1	12.5	71/0.52	83 .96
	18	02 15.56	+10 17.3	02 17.71	+10 28.4	4.701	4.404	+0.68	+4.7	18.0 19.8	11.1/65	66.6	11.9	72/0.48	152 .48
	28	02 22.40	+11 03.9	02 24.56	+11 14.8	4.830	4.393	+0.77	+4.9	18.1 19.8	12.3/66	58.4	11.1	73/0.44	24 .09
Mar.	10	02 30.08	+11 52.8	02 32.25	+12 03.5	4.947	4.383	+0.84	+5.0	18.1 19.9	13.3/68	50.5	10.1	74/0.39	113 .98
	20	02 38.49	+12 43.0	02 40.67	+12 53.3	5.051	4.372	+0.90	+5.1	18.1 19.9	14.1/69	42.7	8.9	75/0.34	127 .46
	30	02 47.52	+13 33.8	02 49.73	+13 43.8	5.139	4.361	+0.96	+5.1	18.1 19.9	14.8/70	35.2	7.6	76/0.28	12 .14
	Apr.	9	02 57.09	+14 24.3	02 59.31	+14 34.0	5.210	4.350	+1.00	+5.0	18.2 20.0	15.3/71	27.8	6.2	78/0.23
	19	03 07.09	+15 14.1	03 09.33	+15 23.3	5.264	4.338	+1.04	+4.8	18.2 20.0	15.7/72	20.6	4.7	80/0.17	102 .43
	29	03 17.46	+16 02.4	03 19.71	+16 11.2	5.300	4.327	+1.06	+4.6	18.2 20.0	16.0/73	13.5	3.1	84/0.11	41 .20
	May	9	03 28.11	+16 48.8	03 30.38	+16 57.1	5.317	4.316	+1.08	+4.4	18.2 20.0	16.2/74	6.6	1.5	93/0.06
	19	03 38.95	+17 32.9	03 41.25	+17 40.6	5.315	4.304	+1.10	+4.1	18.1 20.0	16.2/75	2.0	0.5	185/0.02	74 .37
	29	03 49.93	+18 14.2	03 52.25	+18 21.5	5.295	4.293	+1.10	+3.8	18.1 19.9	16.1/76	7.7	1.8	244/0.07	70 .26
	June	8	04 00.96	+18 52.6	04 03.29	+18 59.3	5.256	4.281	+1.10	+3.5	18.1 19.9	16.0/77	14.5	3.4	252/0.12
	18	04 11.95	+19 27.8	04 14.30	+19 33.9	5.200	4.270	+1.09	+3.2	18.0 19.9	15.7/78	21.4	5.0	255/0.18	45 .30
July	28	04 22.84	+19 59.7	04 25.21	+20 05.2	5.126	4.258	+1.07	+2.8	18.0 19.8	15.3/79	28.3	6.5	258/0.24	96 .31
	8	04 33.51	+20 28.1	04 35.89	+20 33.1	5.035	4.246	+1.04	+2.5	17.9 19.8	14.8/80	35.3	7.9	259/0.30	145 1.00
	18	04 43.87	+20 53.2	04 46.27	+20 57.7	4.930	4.234	+1.00	+2.2	17.9 19.7	14.1/81	42.3	9.3	261/0.36	15 .22
Aug.	28	04 53.82	+21 15.1	04 56.24	+21 19.0	4.810	4.222	+0.94	+1.9	17.8 19.7	13.3/81	49.5	10.5	262/0.42	122 .35
	7	05 03.23	+21 33.9	05 05.66	+21 37.2	4.678	4.210	+0.87	+1.6	17.7 19.6	12.3/82	56.9	11.6	264/0.47	118 1.00
	17	05 11.97	+21 49.9	05 14.41	+21 52.8	4.535	4.198	+0.79	+1.4	17.6 19.5	11.1/83	64.4	12.6	265/0.53	20 .15
Sept.	27	05 19.89	+22 03.6	05 22.35	+22 06.0	4.383	4.186	+0.69	+1.2	17.5 19.4	9.7/83	72.2	13.3	266/0.58	148 .38
	6	05 26.83	+22 15.2	05 29.29	+22 17.2	4.224	4.174	+0.58	+1.0	17.4 19.3	8.1/83	80.3	13.8	267/0.62	87 .99
	16	05 32.62	+22 25.4	05 35.09	+22 27.0	4.062	4.162	+0.45	+0.9	17.3 19.2	6.2/81	88.6	14.0	267/0.65	52 .10
	26	05 37.07	+22 34.5	05 39.55	+22 35.9	3.900	4.149	+0.29	+0.9	17.2 19.1	4.2/78	97.4	13.9	268/0.67	174 .40
Oct.	6	05 40.01	+22 43.1	05 42.50	+22 44.3	3.740	4.137	+0.13	+0.8	17.1 19.0	1.9/65	106.5	13.4	268/0.68	53 .97
	16	05 41.28	+22 51.5	05 43.78	+22 52.6	3.588	4.125	-0.05	+0.8	17.0 18.9	1.1/319	116.1	12.5	268/0.66	86 .07
	26	05 40.76	+22 59.8	05 43.26	+23 01.0	3.447	4.112	-0.23	+0.8	16.9 18.8	3.3/284	126.2	11.3	268/0.62	153 .42
Nov.	5	05 38.42	+23 08.0	05 40.93	+23 09.3	3.322	4.100	-0.41	+0.8	16.8 18.7	5.7/278	136.7	9.5	268/0.54	14 .93
	15	05 34.33	+23 15.8	05 36.85	+23 17.3	3.218	4.088	-0.56	+0.7	16.7 18.7	7.7/275	147.7	7.4	268/0.44	122 .05
	25	05 28.73	+23 22.7	05 31.26	+23 24.6	3.138	4.076	-0.67	+0.6	16.6 18.6	9.2/274	159.1	5.0	267/0.30	117 .44
Dec.	5	05 22.03	+23 28.3	05 24.56	+23 30.6	3.088	4.063	-0.73	+0.4	16.6 18.5	10.0/273	170.7	2.2	264/0.14	29 .90
	15	05 14.77	+23 32.3	05 17.30	+23 35.0	3.067	4.051	-0.72	+0.3	16.5 18.5	9.9/272	177.4	0.6	98/0.04	159 .04
	25	05 07.59	+23 34.8	05 10.12	+23 38.0	3.078	4.039	-0.65	+0.2	16.5 18.5	8.9/271	165.6	3.5	88/0.21	77 .49
1991 Jan.	4	05 01.13	+23 36.6	05 03.66	+23 40.1	3.120	4.026	-0.52	+0.2	16.5 18.5	7.2/272	154.0	6.1	86/0.37	71 .86
	14	04 55.91	+23 38.5	04 58.44	+23 42.4	3.188	4.014	-0.36	+0.3	16.6 18.6	4.9/274	142.6	8.6	85/0.50	164 .04
	24	04 52.34	+23 41.5	04 54.86	+23 45.6	3.280	4.002	-0.17	+0.5	16.6 18.6	2.4/282	131.6	10.6	84/0.60	36 .54
	Feb.	3	04 50.63	+23 46.4	04 53.15	+23 50.6	3.391	3.990	+0.02	+0.7	16.7 18.7	0.8/22	121.1	12.2	84/0.67
	13	04 50.84	+23 53.6	04 53.37	+23 57.7	3.515	3.978	+0.21	+0.9	16.7 18.7	3.0/72	111.0	13.4	84/0.71	130 .03

Date/	Oh ET	R.A. (1950)	Decl.	R.A. (App.)	Decl.	h	m	q (AU)	e	P	Peri.	Node	Inc.	Tail (AU)	Epoch	PA/Tail	Moon Age
1993	July	25.4309	-19 15.0	20 11.13	-19 07.9	5.297	4.625	3.426995	0.150749	8.11	231.8784	242.3336	1.1025	0.200	1993 Aug. 1.0		
m1 = 6.0+5log(delta)+15.0log(r)																	
m2 = 11.0+5log(delta)+10.0log(r)																	
		h	m	h	m	Delta	r	Variation	Magnitude	Mot./PA	Elong.	P					
								for T=+1 day	m1								
									m2								
1989	Dec.	10	20 08.83	-19 15.0	20 11.13	-19 07.9	5.297	-0.32	19.6 21.3	13.5/ 78	42.9	8.3				77/0.30	100 .90
		20	20 18.09	-18 46.2	20 20.38	-18 38.6	5.393	-0.32	19.6 21.3	14.1/ 77	34.9	7.0				76/0.25	124 .50
		30	20 27.76	-18 13.8	20 30.03	-18 05.8	5.471	-0.31	19.7 21.3	14.6/ 76	27.1	5.6				74/0.20	5 .04
1990	Jan.	9	20 37.70	-17 38.1	20 39.96	-17 29.6	5.530	-0.31	19.7 21.4	15.0/ 75	19.4	4.1				73/0.14	132 .94
		19	20 47.80	-16 59.3	20 50.05	-16 50.4	5.569	-0.31	19.7 21.4	15.2/ 75	11.7	2.5				70/0.09	100 .49
		29	20 57.99	-16 17.8	21 00.22	-16 08.4	5.587	-0.30	19.7 21.4	15.3/ 74	4.1	0.9				62/0.03	24 .06
		8	21 08.15	-15 33.9	21 10.36	-15 24.2	5.585	-0.30	19.7 21.4	15.2/ 73	3.7	0.8				267/0.03	162 .96
		18	21 18.20	-14 48.2	21 20.40	-14 38.1	5.562	-0.30	19.7 21.4	15.1/ 72	11.2	2.4				257/0.08	76 .48
		28	21 28.06	-14 01.1	21 30.25	-13 50.6	5.519	-0.30	19.6 21.3	14.8/ 71	18.7	4.0				254/0.14	55 .09
		Mar. 10	21 37.64	-13 13.3	21 39.82	-13 02.5	5.456	-0.30	19.6 21.3	14.3/ 71	26.3	5.5				253/0.19	170 .98
		20	21 46.87	-12 25.4	21 49.03	-12 14.2	5.375	-0.31	19.6 21.3	13.7/ 70	33.8	7.0				252/0.25	51 .46
		30	21 55.67	-11 38.0	21 57.82	-11 26.6	5.276	-0.31	19.5 21.2	13.0/ 69	41.5	8.3				251/0.30	86 .14
		Apr. 9	22 03.94	-10 51.9	22 06.08	-10 40.2	5.162	-0.32	19.5 21.2	12.1/ 69	49.1	9.5				250/0.35	143 .99
		19	22 11.61	-10 07.8	22 13.75	-09 55.8	5.034	-0.32	19.4 21.1	11.1/ 68	56.9	10.6				250/0.40	24 .43
		29	22 18.58	-09 26.5	22 20.71	-09 14.4	4.895	-0.33	19.3 21.0	9.9/ 68	64.8	11.5				249/0.45	119 .20
		May 9	22 24.75	-08 48.9	22 26.88	-08 36.6	4.746	-0.34	19.3 21.0	8.5/ 67	72.8	12.2				249/0.49	115 .99
		19	22 30.02	-08 15.8	22 32.15	-08 03.3	4.591	-0.35	19.2 20.9	6.9/ 66	81.1	12.7				249/0.53	6 .37
		29	22 34.28	-07 48.1	22 36.41	-07 35.5	4.433	-0.36	19.1 20.8	5.1/ 65	89.5	12.9				248/0.55	152 .26
		June 8	22 37.42	-07 26.8	22 39.55	-07 14.0	4.274	-0.38	19.0 20.7	3.2/ 63	98.3	12.8				248/0.57	86 1.00
		18	22 39.34	-07 12.4	22 41.47	-06 59.6	4.118	-0.39	18.9 20.6	1.1/ 54	107.3	12.4				248/0.57	41 .30
		28	22 39.94	-07 05.9	22 42.08	-06 53.0	3.970	-0.41	18.8 20.5	1.1/262	116.6	11.6				247/0.55	175 .31
		July 8	22 39.19	-07 07.5	22 41.33	-06 54.7	3.833	-0.42	18.7 20.5	3.3/252	126.4	10.5				247/0.52	54 1.00
		18	22 37.08	-07 17.5	22 39.23	-07 04.6	3.712	-0.44	18.7 20.4	5.3/250	136.4	8.9				247/0.46	81 .22
		28	22 33.69	-07 35.3	22 35.85	-07 22.5	3.611	-0.46	18.6 20.3	7.1/250	146.9	7.1				246/0.37	140 .35
		Aug. 7	22 29.20	-07 59.9	22 31.36	-07 47.2	3.534	-0.47	18.5 20.3	8.4/249	157.6	4.9				245/0.26	17 1.00
		17	22 23.88	-08 29.7	22 26.06	-08 17.1	3.483	-0.47	18.5 20.2	9.2/249	168.6	2.6				242/0.14	123 .15
		27	22 18.10	-09 02.5	22 20.28	-08 50.1	3.461	-0.48	18.5 20.2	9.2/249	178.6	0.3				166/0.02	104 .38
		Sept. 6	22 12.30	-09 35.8	22 14.49	-09 23.5	3.470	-0.48	18.4 20.2	8.6/248	168.9	2.5				76/0.14	24 .99
		16	22 06.90	-10 07.0	22 09.10	-09 54.9	3.508	-0.47	18.5 20.2	7.3/248	157.8	4.9				73/0.26	166 .10
		26	22 02.33	-10 34.0	22 04.53	-10 22.0	3.573	-0.46	18.5 20.2	5.5/247	146.8	7.1				72/0.38	68 .40
		6	21 58.91	-10 54.9	22 01.11	-10 43.0	3.662	-0.45	18.5 20.3	3.3/245	136.1	9.0				71/0.46	65 .97
		16	21 56.84	-11 08.8	21 59.05	-10 57.0	3.772	-0.43	18.6 20.3	1.1/235	125.7	10.5				71/0.53	156 .07
		26	21 56.25	-11 14.9	21 58.46	-11 03.1	3.898	-0.41	18.6 20.4	1.3/ 82	115.5	11.7				71/0.57	35 .42
		Nov. 5	21 57.16	-11 13.1	21 59.36	-11 01.2	4.036	-0.40	18.7 20.5	3.6/ 74	105.8	12.5				70/0.59	104 .93
		15	21 59.50	-11 03.5	22 01.70	-10 51.6	4.180	-0.38	18.8 20.5	5.7/ 73	96.3	12.9				70/0.59	122 .05
		25	22 03.19	-10 46.3	22 05.38	-10 34.3	4.327	-0.37	18.8 20.6	7.6/ 72	86.2	13.0				70/0.57	3 .44
		Dec. 5	22 08.05	-10 22.0	22 10.27	-10 09.9	4.472	-0.36	18.9 20.7	9.3/ 71	78.3	12.7				69/0.54	140 .90
		15	22 14.05	-09 51.2	22 16.22	-09 38.9	4.613	-0.35	18.9 20.7	10.8/ 70	69.7	12.2				69/0.50	93 .04
		25	22 20.94	-09 14.2	22 23.11	-09 01.7	4.746	-0.34	19.0 20.8	12.1/ 70	61.3	11.4				68/0.46	28 .49
		1991 Jan. 4	22 28.62	-08 31.7	22 30.78	-08 19.1	4.868	-0.33	19.0 20.8	13.2/ 69	53.2	10.4				68/0.41	171 .86
		14	22 36.95	-07 44.3	22 39.10	-07 31.5	4.976	-0.33	19.0 20.9	14.2/ 69	45.2	9.3				67/0.36	67 .04
		24	22 45.82	-06 52.5	22 47.96	-06 39.5	5.070	-0.32	19.1 20.9	14.9/ 68	37.4	7.9				67/0.30	58 .54
		Feb. 3	22 55.12	-05 57.0	22 57.25	-05 43.8	5.147	-0.32	19.1 20.9	15.5/ 68	29.7	6.5				66/0.24	160 .83
		13	23 04.74	-04 58.3	23 06.86	-04 45.0	5.206	-0.32	19.1 20.9	16.0/ 68	22.2	5.0				65/0.19	41 .03

(Cont. from page H2)

Ephemerides. The comets chosen to appear in this 1990 edition are generally (1) those which have been under observation in the second half of 1989, and (2) those which are estimated as having a reasonable chance of being recovered or observed sometime in 1990. While no exact formula was followed, comets with predicted $m_1 > 22$ throughout 1990 generally were not included in this *Handbook*. It is acknowledged that many of the comets will not be observed (because they are too faint), though most of the comets listed herein would probably be observable with telescopes of 4- or 5-meter aperture with CCDs. These ephemerides for faint comets are provided (1) in the event that individuals at large telescopes may try observing these objects and (2) for monitoring such comets for possible outbursts in brightness.

The top line of each comet ephemeris lists: (1) the comet's designation (name, and roman-numeral and/or provisional-letter designations), (2) individual who computed the orbital elements, (3) with reference. The second and third lines contain the orbital elements (as presented on pages 3-5); the only addition here is the column titled *Tail(AU)*, which indicates a chosen "standard" tail length in AU for the comet, which is used in computing an estimated apparent tail length in the ephemeris below.

The magnitude parameters are placed into formulae for m_1 and m_2 on line 4 of each ephemeris, and these parameters are discussed further below. The actual ephemerides have columns which contain the following information, computed with allowance for perturbations (*i.e.*, epoch of ephemeris date): (1) Date for 0^h ET, (2-5) right ascension (α) and declination (δ) for both equinox 1950.0 and for true equinox of date (apparent positions), (6-7) geocentric (Δ) and heliocentric (r) distances of the comet, in AU.

Columns 8-9 contain as a heading one of two possible titles ("Daily Motion" and "Variation for $T=+1$ day"), depending on the individual comet. The "Daily Motion" (in minutes of α and arcmin of δ) is given for all long-period comets and all "recently recovered" short-period ones. In ephemerides for yet-to-be-recovered short-period comets, where this column is titled "Variation for $T=+1$ day", the so-called "line of variation" is given; this is for locating the comet when it hasn't been seen in years (because the most uncertain element is often T). Thus, if one adds one day to T , then one must add the value given in Column 8 to α , and add the value listed in Column 9 to δ , in order to find the comet; the orbits of most short-period comets are known well enough such that ΔT is $< 1^d$, so the correction to the ephemeris will normally be quite small.

Columns 10-11, m_1 and m_2 , contain the predicted m_1 and m_2 magnitudes (described above and below). Column 12 (*Mot./PA*) gives the comet's daily rate of motion in arcmin and its direction (position angles are measured with north = 0°, west = 270°). Column 13, *Elong.*, lists the comet's apparent elongation (in degrees) from the sun, and column 14 (*P*) lists the phase angle of the comet. Column 15 (*PA/Tail*) lists the computed anti-solar direction for a possible tail, and the estimated tail length (based on the "standard" parameter described above). Columns 16 (*Moon*) and 17 (*Age*) list the elongation of the comet from the moon and the percent-illumination of the moon (1.0 = full moon, 0.0 = new moon), respectively.

Magnitudes. The magnitude parameters used herein were selected by D. W. E. Green, in collaboration with B. G. Marsden and C. S. Morris. Ephemerides for short-period comets very often utilize m_2 magnitude parameters based on E. Roemer's carefully-derived "nuclear" magnitudes (see "Introduction" to 1987 *Comet Handbook*). Most periodic-comet m_2 parameters in use in this *Handbook* are identical with those used by the Minor Planet Center in its generation of ephemerides. Total magnitude (m_1) parameters are sometimes taken from published studies by ICQ Staff members, though several previously unpublished m_1 parameters were derived recently by Green and by Morris.

The general practice was to eliminate m_1 ephemeris values for $m_1 > 20$. Since Roemer stopped her valuable observing program in 1976, the reporting of photographic (and more recently, CCD-obtained) magnitudes of comets by astrometrists has resulted in highly ambiguous magnitudes, in that most such magnitudes are probably something between the true m_1 and Roemer's m_2 . It has thus been our practice, for comets discovered in the past 10 years, to simply add 4 or 5 magnitudes for H_0 in changing from m_1 to m_2 (and to subtract 5 from $2.5n$), but observers using these ephemerides should be aware that the predicted values for both m_1 and m_2 could be off by several magnitudes in either direction. Note, then, the problems of defining m_1 when a comet is fainter than $\text{mag} \sim 14$ and of defining m_2 at any time. We have therefore rarely given H_0 or $2.5n$ to tenths of a digit, as the magnitude formula in this form is not accurate to that level over a large range in r . Observers are encouraged to try observing comets whose ephemeris magnitudes are a couple of mag fainter than the limiting magnitude of the available telescope.

We note that predicted magnitudes for two comets of particular interest are highly uncertain: It is unknown as to what the total magnitude of P/Halley will be as it fades from view during the next couple of years. The portion of the light curve for P/Brorsen-Metcalf following perihelion is also rather uncertain.

As this *Handbook* replaces the need for publishing most ephemerides in the ICQ, interested individuals should subscribe to the *IAU Telegrams*, the *IAU Circulars*, and/or the *Minor Planet Circulars/Minor Planets and Comets (MPCs)* and the complementing dial-in computer service for up-to-date orbital elements and ephemerides of newly-discovered comets. Information concerning subscription to these astronomical news media can be obtained from: Central Bureau for Astronomical Telegrams; Mail Stop 18; Smithsonian Astrophysical Observatory; 60 Garden St.; Cambridge, MA 02138; U.S.A.

— D. W. E. Green (1989 Sept. 26)

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Alphabetical Index is at bottom of page H5

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