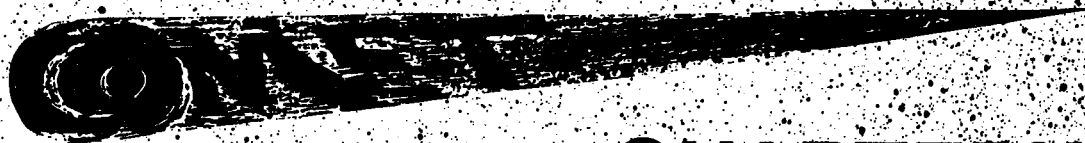


THE INTERNATIONAL

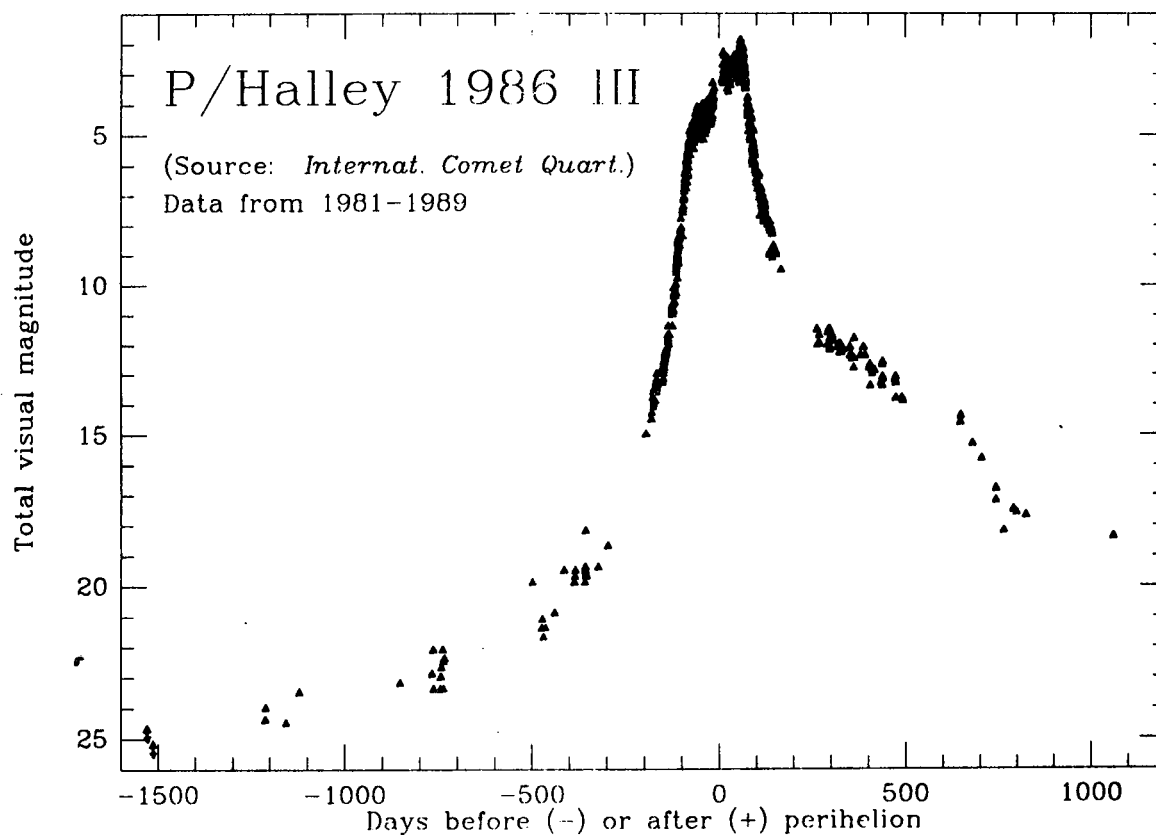


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Total visual (and CCD V) magnitude estimates of Periodic Comet Halley 1986 III. Extension to plots in the paper by D. W. E. Green and C. S. Morris in *Astron. Astrophys.* 187, 560 (1987). Total of 830 observations.

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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 normally as a special fifth issue. The ICQ is published in part by the Department of Physics and Astronomy at Appalachian State University in Boone, North Carolina. An index to each volume is published in every other January issue; the ICQ is also indexed in *Astronomy and Astrophysics Abstracts* and in *Science Abstracts Section A*.

The regular (invoiced) subscription rate is US\$24.00 per year (price includes the annual *Comet Handbook*; the price without the *Handbook* is US\$16.00 per year). Subscribers who do not wish to be billed may subscribe at the special rate of US\$18.00 per year, or US\$20.00/year outside North America (rates are \$10.00 and \$12.00, respectively, without *Handbook*). [The last set of digits (after the hyphen) on the top line of the mailing address label gives the Whole Number that signifies the last ICQ issue which will be sent under the current subscription status.] Make checks or money orders payable in U.S. funds to *International Comet Quarterly* and send to Daniel Green; Smithsonian Astrophysical Observatory, 60 Garden St.; Cambridge, MA 02138, U.S.A. [Group subscription rates available upon request.] Back issues are \$4.00 each — except for the *Comet Handbook*, which is available for \$10.00 (\$8.00 to subscribers if ordered with their ICQ subscription; see above).

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PERIODIC COMETS FOR THE VISUAL OBSERVER IN 1990

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While no short-period comets are expected to reach naked-eye brightness during 1990, three of them should become bright enough to be visible in binoculars or small telescopes. In addition, several others should be accessible to observers with moderate to large visual telescopes. [The *ICQ 1990 Comet Handbook* listing ephemerides for these comets is now available. — Ed.]

P/Encke

This famous comet ($P = 3.3$ yr) should be the best short-period comet of the year, at least for northern-hemisphere observers, where it will be the most favorable return of the comet in 10 years. In the past, the comet has shown a tendency to brighten very rapidly as it approaches perihelion ($T = \text{Oct. 28}$, $q = 0.33$ AU); thus it will probably become accessible to visual observers about August or September as a faint diffuse object of magnitude 11 or 12, well placed in the morning sky. The comet should brighten quickly during the next two months as it approaches the sun, reaching 7th magnitude by mid-October. About a week before perihelion passage the comet's elongation will decrease to the point where it will no longer be visually observable; it will then remain too close to the sun for visual observation for several months.

P/Schwassmann-Wachmann 3

During this comet's discovery apparition in 1930, it passed within 0.06 AU of the earth and reached 7th magnitude. The comet's failure to reach naked-eye visibility at such a close geocentric distance implies a very faint intrinsic brightness ($H_{10} \sim 11.5$), and in fact the comet has been observed on only one return since then (in 1979), despite a period of only 5.4 years. During 1979 the comet's perihelion date was slightly over a month later than the predicted date, and this suggests that the comet is rather strongly affected by non-gravitational forces. Because of this, predictions for the 1990 return are somewhat uncertain, but if the predicted perihelion date of May 19 ($q = 0.94$ AU) is not too far off, this return will be the best since that of 1930, with the comet closest to the earth ($\Delta_{\min} = 0.37$ AU) in mid-April. The below statements are based on the assumption that the comet will be reasonably close to its predicted path.

The comet remains in the morning sky throughout the visually observable portion of this apparition. The first visual sightings ($m_1 \sim 12-13$) may come in February or March. The comet's elongation decreases as the comet approaches perihelion, but the brightness should steadily increase; peak brightness, perhaps magnitude 9, should occur in early May. After perihelion the elongation will again increase but with the comet now fading; visual observers might be able to follow it until about August.

(Cont. on page 54)

TABULATION OF COMET OBSERVATIONS

New additions to the Reference Key (cf. ICQ 10, 34, 67, and 124):

CR = *V* magnitudes of 13 stars surrounding NGC 3627 (M66), as given by Ciatti and Rosino (1977, *Astron. Astrophys.* 56, 62). The range in *V* is 13.8-16.9, and the stars are fairly red.

SE = *V* magnitudes of 134 stars of the II Persei Association (stars of spectral types A and B, magnitude range 5.1-11.4), as given in C. K. Seyfert *et al.*, *Ap.J.* 132, 58.

— Corrigenda —

- In the January 1989 issue, page 9, Comet 1988n (SMM 5), note that the comet was *not* seen by HAL.
- In the April 1989 issue, p. 36, the four observations of P/Brorsen-Metcalf by GRE which have the instrument listed as "8.0 B" should instead read "8.0 R" with focal ratio *f*/3, as this was a pair of 20×80 binoculars used as a monocular.

Descriptive Information (to complement the Tabulated Data):

Note that some of this information pertains to Tabulated Data published in the April 1989 issue.

◊ Comet Wilson 1987 VII ⇒ 1987 Mar. 8.76: fan-shaped tail in 20-cm *f*/6.3 L (51×); strong cond. [LOV]. Mar. 25.78: wide tail w/ extension on northern edge [LOV]. Mar. 27.78: tabulated tail length is for "ion tail on northern edge of dust fan" [LOV]. Apr. 27.4: in 20-cm *f*/6.3 L (51×), hood structure visible in head, tail jets glimpsed; coma easily visible to naked eye; in 20×80 B, tail ~ 2° long [LOV].

◊ Comet Bradfield 1987 XXIX ⇒ 1987 Aug. 21.38: "slight tail" [LOV]. Aug. 27.45: "sharp" cond. [LOV]. Sept. 19.40: in 20-cm *f*/6.3 L (93×), 0°5 [LOV]. Oct. 17.38: strong bluish coma; first 8' of tail strong [LOV]. Oct. 20.39: in 20-cm *f*/6.3 L (93×), 1°5; "resembles miniature 'great' comet" [LOV].

◊ Comet Liller 1988a ⇒ 1988 Apr. 21.22: "ion tail" in p.a. 10° and "dust tail" in p.a. 340° [SPR]. Apr. 24.22: "narrow, straight tail" [SPR]. May 21.04: broad tail; in 30.5-cm *f*/5 L (47×), disk-like central cond. w/ starlike nuclear region, parabolic coma [ZAN]. June 1.90: parabolic coma, w/ large central cond. [ZAN].

◊ Comet Shoemaker-Holt-Rodriguez 1988h ⇒ 1989 June 24.50: broad fan to the south [PEA].

◊ Comet Machholz 1988j ⇒ 1988 Aug. 16.77: in 20-cm *f*/6.3 L (52×), 0°5 tail [LOV]. Aug. 18.74: in 7.8-cm *f*/8 R (30×), coma dia. 4', DC = 2 [JON]. Aug. 21.38: non-stellar nuclear cond. [ROB03]. Aug. 21.74: in 7.8-cm *f*/8 R (30×), coma dia. 4', DC = 1-2 [JON]. Aug. 25.79: in 20-cm *f*/6.3 L (52×), 0°7 tail [LOV]. Sept. 10.80: in 20-cm *f*/6.3 L (52×), deep in twilight, "only slightest smudge", mag ~ 6 [LOV].

◊ Comet Yanaka 1988r ⇒ 1989 Jan. 5.45: "0'3 cond.; tiny nucleus within?" [BOR]. Jan. 8.22: strong, bright central cond.; narrow, straight tail [ZAN].

◊ Comet Yanaka 1989a ⇒ 1989 Feb. 3.39: "comet very diffuse; surface brightness not much greater than that of background sky" [HAL].

◊ Comet Shoemaker 1989e ⇒ 1989 Jan. 27.23: sky conditions only fair; observation hurried due to impending moonrise [HAL]. Feb. 1.05: 10-min exposure on TP 2415 film, 20-cm *f*/2 Baker-Schmidt camera, mag 13, straight, narrow 25' tail in p.a. 197°, coma strongly condensed [MIK]. Feb. 7.99: 12-min exposure on TP 2415 film, 20-cm *f*/2 Baker-Schmidt camera, mag 13, coma dia. 0'4, DC = 8; straight, narrow 20' tail in p.a. 186° [MIK]. Feb. 28.23: poor sky conditions, observation terminated when clouds moved in; a candidate was suspected, but POSS prints suggests that what was observed was a faint star [HAL]. Mar. 2.23: sky conditions relatively poor [HAL]. Mar. 6.35: "estimate is of a candidate; this may indeed have been the comet (nothing was visible on POSS prints in this position), but failure of the comet to be seen on subsequent nights (when sky conditions were noticeably better) suggests that nothing was observed; the nearby galaxy MCG +8-16-08 was faint but visible" [HAL]. Mar. 7.94: 10-min exposure on TP 2415 film, 20-cm *f*/2 Baker-Schmidt camera, mag 14, coma dia. 0'3, DC = 7; fan-shaped 5' tail in p.a. 167° [MIK]. Mar. 8.22: "sky conditions significantly better than on Mar. 6; this casts strong doubt on the candidate observed that night" [HAL]. Mar. 11.29: good sky conditions [HAL]. Mar. 25 and 27: 8-min exposures on TP 2415 film, 20-cm *f*/2 Baker-Schmidt camera, not detected under excellent conditions; galaxies of mag 14 clearly visible on negatives [MIK].

◊ Comet Okazaki-Levy-Rudenko 1989r ⇒ 1989 Aug. 26.29: comet slightly enhanced by Lumicon comet filter [MOR]. Aug. 30.19: possible short tail in p.a. ~ 60° [MOR]. Aug. 30.88, and Sept. 20.83 and 24.79: in 15.2-cm L (44×), "elliptical coma" [MOE]. Sept. 1.18: coma irregular in shape; possible tail [MOR]. Sept. 2.19 and 3.18: comet near bright star [MOR]. Sept. 2.90: coma boundary sharper toward N-NW [PER01]. Sept. 3.83: in 36-cm T, coma elliptical; at 434×, a faint, circular central cond. of mag ~ 14 and dia. ~ 10'' is visible [KOR]. Sept. 3.84, 7.84, 8.84, and 18.80: in 15.2-cm L (100×), "coma elongated" [MOE]. Sept. 3.87 and 4.86: coma boundary sharper toward NW [PER01]. Sept. 5.17: coma irregular in shape; possible fan tail in p.a. ~ 80° [MOR]. Sept. 7.95: definitely fainter than on Sept. 5.85 [KID]. Sept. 16.84: "11th-mag nucleus suspected"; coma could be as large as 5' [PER01]. Sept. 17.83: outer coma fan-shaped, open toward p.a. 250°; nuclear cond. of mag ~ 10.5; possible jets within the coma in p.a. ~ 50° and 80° [PER01]. Sept. 20.81: in 36-cm T (434×), faint stellar cond. of mag ~ 14.5; tail very faint [KOR].

- ◊ *Comet Helin-Roman (1989s)* $\Rightarrow$ 1989 Sept. 7.21: "Lumicon comet filter slightly enhanced comet" [MOR].
- ◊ *P/Borrelly (1987 XXXIII)* $\Rightarrow$ 1987 Dec. 15.54: very condensed coma; starlike condensation at center of mag $\sim$ 11.2; starlike at 170 $\times$; narrow fan in coma; possible tail [CLA].
- ◊ *P/Tempel 2 (1987g)* $\Rightarrow$ 1988 July 11.98: "difficult, extremely diffuse object; at 145 $\times$, occasionally a stellar nucleus of mag 13.5-14 was suspected" [BOU]. 1989 Jan. 26.11: "upper limit is based upon the extremely diffuse appearance that the comet exhibited in early January. An extremely faint candidate was suspected with a Swan Band filter, but could not be confirmed; observation hampered by zodiacal light" [HAL].
- ◊ *P/Tempel 1 (1987e₁)* $\Rightarrow$ 1989 Apr. 9.48: low altitude, twilight and skyglow [HAL]. May 5.46: low altitude [HAL].
- ◊ *P/Helin-Roman-Crockett (1989b)* $\Rightarrow$ 1989 Jan. 29.30: "the nearby galaxies NGC 2577 and UGC 4375 were relatively easy" [HAL].
- ◊ *P/Pons-Winnecke (1989g)* $\Rightarrow$ 1989 May 6.26: "observation hampered by proximity of 7th magnitude star" [HAL]. May 24.16: "the nearby galaxy Markarian 426 was faintly visible" [HAL]. June 1.18: "possible thin clouds in vicinity; the nearby galaxy UGC 6777 was faintly visible" [HAL]. June 8.26: "the nearby galaxy NGC 3971 was visible; UGC 6905 could not be positively identified" [HAL]. Aug. 24.19: "comet was very distinct in 51-cm L, despite low elevation" [MOR]. Aug. 26.18 and 27.18: "comet was threshold object in 26-cm L; very low" [MOR].
- ◊ *Periodic Comet Shoemaker-Holt 2 (1989j)* $\Rightarrow$ 1989 Mar. 11.34: observation hampered by comet's proximity to star of mag $\sim$ 11 [HAL]. Mar. 25.85 and 27.96: 10-min exposures on TP 2415 film, 20-cm $f/2$ Baker-Schmidt camera, mag 12.5, coma dia. 0'.5, DC = 8; coma strongly condensed [MIK]. Mar. 26.17: observation hampered by 5th-magnitude star (37 LMi) in field [HAL].
- ◊ *Periodic Comet Brorsen-Metcalf (1989o)* $\Rightarrow$ 1989 July 7.41: "comet very large and diffuse; significantly enhanced when viewed with Swan Band filter. Sky conditions only fair; based upon later observations the given brightness is probably an underestimate" [HAL]. July 7.44: "very poor sky - cirrus; comet very diffuse, no condensation" [MOR]. July 8.45: "Lumicon comet filter significantly enhances comet; AA chart 54 also used" [MOR]. July 11.42: "observed during breaks in clouds; comet is very large and diffuse" [HAL]. July 13.43: "Coma diameter may have been as much as 12'; outer coma was very faint" [MOR]. July 14.44: "Outer coma more obvious than previous night; comet less condensed" [MOR]. July 15.30: comet within 10' - 15' of a 6th-mag star, making observation somewhat difficult [GRE]. July 15.43: Coma elongated 1' toward p.a. 140° [MOR]. July 16.05: coma fan-shaped [HAV]. July 29.34: in 25-cm $f/7.8$ L (98 $\times$), non-starlike cond., coma slightly brighter in p.a. 70° [ROB03]. July 29.43: "comet strongly condensed, but no stellar condensation visible in 26-cm L (156 $\times$)" [MOR]. Aug. 3.37: in 25-cm $f/7.8$ L (98 $\times$), non-starlike cond., coma brighter in p.a. $\sim$ 80° [ROB03]. Aug. 6.03: "inner coma without any structure; only a small cond. visible" [KOR]. Aug. 6.31: in 20-cm T, possible streamer to NE [SPR]. Aug. 9.35: in 25-cm $f/7.8$ L (98 $\times$), non-starlike cond., coma brighter in p.a. 130° [ROB03]. Aug. 11.09: 6-min exposure on TP 2415 film with 20-cm $f/2$ Baker-Schmidt camera, coma dia. 3'.2, extensive and conspicuous central cond. of dia. 1'.8; faint, narrow 0°.43 tail in p.a. 288° [MIK]. Aug. 12.31: in 20-cm T, "bright center to coma" [SPR]. Aug. 12.43: narrow gas tail [MOR]. Aug. 13.10: tail very faint and thin [KOR]. Aug. 15.10: 6-min exposure on TP 2415 film with 20-cm $f/2$ Baker-Schmidt camera, 0°.65 tail, curved at half-way point [MIK]. Aug. 19.10: in 20.4-cm L, also 0°.8 tail in p.a. $\sim$ 340° [JAH]. Aug. 24.50: "in 30-cm L, comet appeared very blue in color" [MOR]. Aug. 27.49: "comet blue in color with no obvious structure in coma (26-cm L at 45 $\times$ and 156 $\times$)" [MOR]. Sept. 1.12: bright central cond. of diameter 1'; tail straight, narrow [MIK]. Sept. 1.50: Tail was narrow and approximately straight [MOR]. Sept. 6.15: stellar central cond. of diameter 1' [MIK]. Sept. 7-14: "comet moving into twilight and low on horizon; bright moon on Sept. 14; comparison stars used were at approximately the same elevation as the comet" [MOR]. Sept. 8.2: 1° double straight tail [KID].
- ◊ *P/Gunn* $\Rightarrow$ 1989 Jan. 19.55: "encroaching twilight" [HAL]. Apr. 6.45: "at 183 $\times$, the relatively bright central condensation was slightly off-center (toward the SW) within the coma; the overall appearance of the comet did not change significantly between this observation and early June" [HAL]. May 11.40: observation hurried because of clouds [HAL]. May 22.94: "mag 15 stellar cond.; diffuse, round coma" [KOR]. May 23.92: "stellar cond. has disappeared" [KOR]. May 24.23: observation hurried because of clouds and impending moonrise [HAL]. May 29.13: using Y Lib AAVSO chart, $m_1 = 12.7$ (tabulated data were obtained using V Lib chart) [BOR]. June 1.22: "comet seems slightly less condensed than during previous observations" [HAL]. June 3.25: "comet is noticeably more diffuse than during previous observations (including that of June 1)" [HAL]. June 4.24: "Tail was quite faint and narrow (not a fan)" [MOR]. June 25.24: "observation slightly hampered by the comet's being between two faint stars" [HAL]. July 3.20: "Comet distinctly fainter than previous night" [MOR]. July 3.24: "comet quite vague and diffuse" [HAL]. July 4.20 and 5.20: "Suspect in comet's position, but not conclusive" [MOR]. July 30.23: "comet close to relatively bright star, so no formal m_1 observation made; in 51-cm L (195 $\times$), outer coma not visible, but a small ($\ll$ 1') knot of material was observed, though there was no stellar cond." [MOR]. Aug. 5.23: "hint of condensation; coma was irregular, not round" [MOR]. Aug. 24.21: "comet very low; very faint - just glimpsed" [MOR].
- ◊ *P/Schwassmann-Wachmann 1* $\Rightarrow$ 1989 July 9.44: "sky conditions fairly poor; the comet seems quite diffuse" [HAL]. July 11.42: "observed during a break in clouds; the comet is quite diffuse and the overall surface brightness fairly low, suggesting the outburst is relatively old (despite the July 3 negative observation, which occurred in good sky conditions)" [HAL]. Aug. 12.38: "comet suspected at $m_1 = 13.2$; comet near relatively bright star - very difficult observation" [MOR]. Aug. 13.46 and 27.34: "comet suspected at $m_1 = 13.4$ " [MOR].

Key to observers with observations published in this issue, with 2-digit numbers between Observer Code and Observer's Name indicating source [16 = Yamaneke Group of Comet Observers (c/o Akimasa Nakamura, Aichi, Japan), 18 = Coordinated amateur Polish group, c/o Marek Muciek, Torun, Poland, etc.]. Those with asterisks (*) preceding the 5-character code are new additions to the Observer Key:

CODE	S	OBSERVER, LOCATION	CODE	S	OBSERVER, LOCATION
AMO		Mauro Amoretti, Italy	KOR		Stefan Korth, West Germany
AND01		Karl-Gustav Andersson, Sweden	LOO01		Frans R. van Loo, Belgium
*ARC		Brent A. Archibal, VA, U.S.A.	*MCD		David McDavid, TX, U.S.A.
BAR		Sandro Baroni, Italy	MER		Jean-Claude Merlin, France
BOA		Andrea Boattini, Italy	MIK		Herman Mikuz, Yugoslavia
BOU		Reinder J. Bouma, The Netherlands	MOE		Michael Moeller, West Germany
BUS01	11	E. P. Bus, The Netherlands	MOR		Charles S. Morris, U.S.A.
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CAM03	14	Paul Camilleri, Australia	NAK01	16	Akimasa Nakamura, Japan
*CAN03		S. Canonaco, Belgium	*OFE		Eran Ofek, Israel
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*DIB02		Alfons Diepvens, Belgium	*PEA01		Don C. Pearce, TX, U.S.A.
*DIO		Massimo Dionisi, Italy	PER01		Alfredo Jose Serra Pereira, Portugal
GAL	13	Jesus Gallego Maestro, Spain	PLE01	18	Janusz Pleszka, Poland
GAR02		Stephane Garro, France	RAF	18	Jerzy Rafalski, Poland
GRE		Daniel W. E. Green, U.S.A.	REI01		Johann Reifberger, Austria
HAS02		Werner Hasubick, West Germany	RIP	13	Jose Ripero, Spain
HAV		Roberto Haver, Italy	ROB03		Paul C. Robinson, WV, U.S.A.
*HIR02		Satoshi Hirai, Japan	SCI	18	Tomasz Sciezor, Poland
ICH	16	Kazuhiko Ichikawa, Japan	SEA	14	David A. J. Seargent, Australia
ISH02	16	Akiyoshi Ishikawa, Japan	*SOS		Giovanni Sostero, Italy
JAC01		Eric A. Jacobson, MN, U.S.A.	SPE01	18	Jerzy Speil, Poland
JAH		Jost Jahn, West Germany	SPR		C. E. Spratt, BC, Canada
JAR	18	Krzysztof Jaroszewski, Poland	SZU	18	Mieczyslaw Szulc, Poland
JON		Albert F. Jones, New Zealand	TAN01	16	Kunihiko Taniguchi, Japan
KAN	06	Kiyotaka Kanai, Japan	WAT01	16	Nobuo Watanabe, Japan
KEE		Richard A. Keen, CO, U.S.A.	WES01		Richard M. West, Chile
KEI		Graham Keitch, England	WES02		Margareta Westlund, Sweden
*KID		Mark Kidger, Canary Islands	*WOL01		Graham W. Wolf, New Zealand

Comet Liller 1988a

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 04 21.22	S	6.0	A	8.0	B		11	4	3	2	10	SPR
1988 04 24.22	S	5.9	A	8.0	B		11	3.5	3	1.5	15	SPR
1988 04 26.21	S	6.2	A	8.0	B		11	3.5	4	1	10	SPR
1988 04 27.22	S	6.2	A	8.0	B		11	3.5	3	0.5	0	SPR
1988 05 01.22	S	6.3	A	8.0	B		11	3	3			SPR
1988 05 02.21	S	6.3	A	8.0	B		11	3	2	0.5	355	SPR
1988 05 04.23	S	6.2	A	8.0	B		11	3	2			SPR
1988 05 05.23	S	6.0	A	8.0	B		11	3	3	0.5	0	SPR
1988 05 07.21	S	5.9	A	8.0	B		11	3	3			SPR
1988 05 08.22	S	6.0	A	8.0	B		11	3	3			SPR
1988 05 18.31	S	6.9	AC	3.5	B		7	9.5				MOR03
1988 05 23.07	B	6.3	S	5	R		8	8	6	0.25		GAR02
1988 05 24.31	S	7.2	AC	3.5	B		7	8	3			MOR03
1988 05 26.17	S	7.4	AC	3.5	B		7	7				MOR03
1988 06 04.11	S	8.0	AC	3.5	B		7	6				MOR03
1988 06 05.04	B	7.8	AA	5.0	B		10	& 8	3	0.4	100	ROB03
1988 06 05.26	S	8.5	A	8.0	B		11	4	2			SPR
1988 06 07.04	B	7.9	AA	5.0	B		10	& 7	3			ROB03
1988 06 09.13	M	8.6	AC	15	R	5	31	4	3	0.1	70	MOR03
1988 06 09.13	S	8.2	AC	3.5	B		7	6				MOR03
1988 06 12.14	M	8.8	AC	15	R	5	31	5	3			MOR03
1988 06 12.14	S	8.5	AC	3.5	B		7	5				MOR03
1988 06 13.13	M	8.7	AC	15	R	5	31	5	3			MOR03
1988 06 18.15	S	8.9	AC	15	R	5	31	5.5	3			MOR03
1988 06 19.93	B	8.9	S	20.3	T	10	62		2			GAR02
1988 07 05.13	S	10.1	AC	15	R	5	62	3.8	1			MOR03
1988 07 18.12	S	11.2	AC	44.5	L	4	80	2.0	1			MOR03

Comet Machholz 1988j

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 08 18.73	M	8.0	AA	5	B		7		4			WOL01
1988 08 18.74	M	7.8	AA	5	B		20	3	3			WOL01
1988 08 19.38	S	7.5	AC	15	R	5	31	3.5	3			MOR03
1988 08 19.74	M	7.5	AA	6.2	R	11	76	4.2	3			WOL01
1988 08 19.74	M	7.6	AA	5	B		20	3	3			WOL01

Comet Machholz 1988j [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 08 20.37	S	7.2	AC	15	R	5	31	4	3			MOR03
1988 08 20.73	M	7.4	AA	6.2	R	11	76	4.5	4			WOL01
1988 08 21.38	S	7.5	AA	5.0	B		10	&10	5	0.4	260	ROB03
1988 08 21.72	M	7.2	AA	6.2	R	11	76	4.5	4			WOL01
1988 08 22.14	B	7.7	S	5	R		8					GAR02
1988 08 22.37	S	7.3	AC	15	R	5	31	3.5	3			MOR03
1988 08 23.68	M	7.0	AA	6.2	R	11	76		4			WOL01
1988 08 24.14	B	7.5	S	5	R		8					GAR02
1988 08 27.38	S	7.1	AC	15	R	5	31	3	3			MOR03

Comet Yanaka 1988r

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 01 11.24	S	9.8	AC	15.6	L	5	45	1.7	2/			BOU
1989 01 14.47	S	10.2	AC	15	R	5	62	1.8	2			MOR03
1989 01 15.19	S	9.9	CS	12.7	T	10	40					GAR02

Comet Yanaka 1989a

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 01 11.19	S	10.8	AC	15.6	L	5	45	2.0	1			BOU
1989 01 11.21	S	10.7	AC	29.8	L	5	62	2.2	2/			KEI
1989 01 13.23	S	10.6	AC	29.8	L	5	62	2.5	2			KEI
1989 01 14.46	S	11.5	AC	15	R	5	62	2.4	1			MOR03
1989 01 18.24	S	11.4	AC	29.8	L	5	60	1.6	2			KEI
1989 01 31.05	S	11.6	AC	25.4	J	6	73	2.0	0			BOU
1989 02 08.04	S	11.7	AC	25.4	J	6	90	1.8	0			BOU
1989 02 12.20	S	12.5	AC	20.3	L	10	80	1	2	0.05	280	GAR02
1989 04 30.90	B	13.4	AC	35	T	6	96		9			AMO

Comet Shoemaker-Holt-Rodriguez 1988h

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 07 24.01	p	13.4	AC	52.0	L	4		0.43	8/			BUS01
1988 10 04.83	S	13.4	AC	51.0	L	4	186	0.4	4/			BOU
1988 10 08.82	S	13.3	AC	51.0	L	4	186	0.4	5			BOU
1989 05 05.67	S	11.7	AC	15.2	L	5	76					SEA
1989 05 05.87	S	11.4	VN	20	L	4	45	2	4			PEA
1989 05 08.74	S	12.2	RC	31.7	L	5	86		0			JON
1989 05 09.72	S	12.2	RC	31.7	L	5	86	0.5	0			JON
1989 05 10.74	S	12.1	RC	31.7	L	5	86	0.6	0/			JON
1989 05 10.88	S	11.8	VN	20	L	4	45	1.5	4			PEA
1989 05 12.72	S	12.1	RC	31.7	L	5	86	0.6	0/			JON
1989 05 12.89	S	11.3	VN	20	L	4	45	2	4			PEA
1989 05 31.54	S	11.6	SM	15.2	L	5	76					SEA
1989 06 04.89	S	11.3	VN	20	L	4	45	1.6	4			PEA
1989 06 05.75	S	11.4	SM	31.7	L	5	86	0.6	2			JON
1989 06 06.73	S	11.5	SM	31.7	L	5	86		1			JON
1989 06 07.64	S	11.8	SM	25.4	L	4	114		5			SEA
1989 06 07.88	S	11.5	VN	20	L	4	45	1.5	3			PEA
1989 06 08.87	S	11.3	VN	20	L	4	45	2.0	4			PEA
1989 06 09.89	S	11.3	VN	20	L	4	45	1.8	3/			PEA
1989 06 22.40	S	11.5	SM	20	L	7	56	3	4			CAM03
1989 06 24.50	S	11.7	VN	20	L	4	45	1.5	3/			PEA
1989 06 28.50	S	11.6	SM	20	L	7	56	3	4			CAM03
1989 06 28.75	S	12.2	VN	31.7	L	5	86	0.5	1			JON
1989 06 29.74	S	12.4	VN	31.7	L	5	86	0.5	1			JON
1989 06 30.74	S	12.2	LM	31.7	L	5	86	0.5				JON
1989 07 01.74	S	12.2	LM	31.7	L	5	86	0.5	0			JON

Comet Shoemaker-Holt-Rodriquez 1988h [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 07 03.70	S	11.6	SM	20	L	7	56	3	5			CAM03
1989 07 03.86	S	11.8	VN	20	L	4	45	1.5	2			PEA
1989 07 04.85	S	11.9	VN	20	L	4	90	1.8	2			PEA
1989 07 05.85	S	11.8	VN	20	L	4	90	1.5	2/			PEA
1989 07 06.76	S	12.0	LM	31.7	L	5	86	0.5	0			JON
1989 07 08.75	S	11.8	VN	31.7	L	5	86	& 0.5	0/			JON
1989 07 11.70	S	11.7	SM	20	L	7	40	3	5			CAM03

Comet Shoemaker 1989e

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 01 28.15	S	13.4	AC	44.5	L	4	167	1.6				MOR03
1989 02 04.12	S	13.6	AC	44.5	L	4	167	0.6	1			MOR03
1989 02 13.14	S	13.6	AC	25.4	J	6	145	0.4	3			BOU

Comet Okazaki-Levy-Rudenko 1989r

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 08 26.29	S	10.7	NP	25.6	L	4	67	3.3	1/			MOR
1989 08 26.89	S	11.1	AC	15.2	L	5	44	1.5	2			MOE
1989 08 27.10	S	9.9	GA	15.2	R	8	38	& 5	2/			GRE
1989 08 27.12	S	10.6	AC	44.5	L	4	83	& 3.5	2/			PEA01
1989 08 27.20	S	10.5	NP	25.6	L	4	45	3.4	1/			MOR
1989 08 28.21	S	10.6	AA	20.0	T	10	127	3	2			SPR
1989 08 29.15	S	11.0	AC	31.8	L	4	63	3	2			KEE
1989 08 29.84	S	9.8	AC	15.2	L	5	44	4	2			MOE
1989 08 29.84	S	10.1	AC	20.4	L	6	72	3.8	2			JAH
1989 08 29.90	S	10.3	AC	40	L	5	66	3.5	2			BOA
1989 08 30.19	M	9.8	NP	25.6	L	4	45	4.0	2			MOR
1989 08 30.22	S	10.1	AA	20.0	T	10	127	3	2			SPR
1989 08 30.83	S	9.8	AC	20.4	L	6	72	5.4	2	0.11	92	JAH
1989 08 30.84	S	9.7	AC	15.2	L	5	44	5.5	2			MOE
1989 08 30.85	S	9.8	AC	15.2	L	5	100	5	1			MOE
1989 08 30.85	S	10.1	AC	20.3	T	10	51	2.7	2			HAS02
1989 08 30.86	S	10.0	AC	15.0	L	5	25	5.0	1	0.08		MER
1989 08 31.04	S	9.8	GA	15.2	R	17	93	& 3.5	2			GRE
1989 08 31.06	B	9.7:	S	37	L		52	5	2			CHE
1989 08 31.11	S	9.9	GA	20.3	L	6	49	& 4	1/			GRE
1989 08 31.85	S	10.2	AC	20.3	T	10	51	2.7	2			HAS02
1989 09 01.18	M	9.7	NP	25.6	L	4	45	5.2	2/			MOR
1989 09 01.21	S	9.5	NP	8.0	B		20	7.0	2			MOR
1989 09 01.88	S	9.9:	AC	15.2	L	5	44	& 5	1			MOE
1989 09 02.19	M	9.7	NP	25.6	L	4	67	4.3	2/			MOR
1989 09 02.90	S	10.6	AC	15	L	4	26	2	2			PER01
1989 09 02.91	S	9.7	AC	15.2	L	5	44	5.5	2			MOE
1989 09 03.06	S	9.8	AC	37.0	L		64	7	2			CHE
1989 09 03.11	S	9.8	AC	44.5	L	4	154	& 5	3			PEA01
1989 09 03.18	M	9.6	NP	25.6	L	4	67	3.5	3			MOR
1989 09 03.19	S	9.9	AA	20.0	T	10	64	4.5	2			SPR
1989 09 03.82	S	9.5	AC	15.2	L	5	44	6	2			MOE
1989 09 03.83	S	10.2	AC	36.0	T	11	123	4	1			KOR
1989 09 03.84	S	9.7	AC	15.2	L	5	100	5.5	2			MOE
1989 09 03.87	S	10.1	AC	15	L	4	26	3	1/			PER01
1989 09 04.18	S	9.3	NP	8.0	B		20	5.8	3/			MOR
1989 09 04.20	S	9.9	AA	20.0	T	10	64	5.5	2			SPR
1989 09 04.22	S	9.8	AA	14.0	S	4	28	5	1			SPR
1989 09 04.80	S	9.7	AC	33	L	4	50	4.5	2/			BOA
1989 09 04.85	S	9.6	AC	15.2	L	5	44	5	2			MOE
1989 09 04.86	S	9.1	AA	15	L	4	26	5	1/			PER01

Comet Okazaki-Levy-Rudenko 1989r [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 09 05.17	M	9.5	NP	25.6	L	4	45	4.6	3			MOR
1989 09 05.18	S	9.3	NP	8.0	B		20	5.8	2/			MOR
1989 09 05.20	S	9.8	AA	20.0	T	10	64	5	2			SPR
1989 09 05.21	S	9.6	AA	14.0	S	4	28	4.5	2			SPR
1989 09 05.85	S	9.0	A	5.0	B		12		1/			KID
1989 09 05.85	S	9.5	AA	15	L	4	26	3	2/			PER01
1989 09 06.19	S	9.8	AA	20.0	T	10	64	4.5	2			SPR
1989 09 06.23	S	9.6	AA	14.0	S	4	28	4	3			SPR
1989 09 06.83	S	9.8	AA	20.3	T	10	51	4.0	3			HAS02
1989 09 06.84	S	9.4	AC	15.2	L	5	44	5.5	2			MOE
1989 09 07.06	S	9.6	GA	20.3	L	6	49	& 3.5	0/			GRE
1989 09 07.19	S	9.6	AA	20.0	T	10	64	4	3			SPR
1989 09 07.22	M	9.6	NP	25.6	L	4	45	2.9	3			MOR
1989 09 07.24	S	9.5	AA	14.0	S	4	28	4	3			SPR
1989 09 07.84	S	9.3	AC	15.2	L	5	44	6.5	3			MOE
1989 09 07.84	S	9.4	AC	15.2	L	5	100	6.0	2			MOE
1989 09 07.95	S	9.4	A	5.0	B		12		1/			KID
1989 09 07.98	M	9.5	AA	5.0	B		10	5	3			GAL
1989 09 08.20	S	9.5	AA	20.0	T	10	64	3.5	3			SPR
1989 09 08.83	S	10.2	AC	36.0	T	11	123	3.5	1			KOR
1989 09 08.84	S	9.2	AC	15.2	L	5	44	6	3			MOE
1989 09 08.84	S	9.3	AC	15.2	L	5	100	5.5	3		120	MOE
1989 09 09.21	S	9.4	AA	20.0	T	10	64	4	3			SPR
1989 09 11.82	S	9.2	AC	15.2	L	5	44	5.5	3			MOE
1989 09 12.82	S	9.3:	AC	15.2	L	5	44	& 5	2			MOE
1989 09 14.83	S	9.1:	AC	15.2	L	5	100	& 5.5	2			MOE
1989 09 16.81	S	8.9	AC	15.2	L	5	44	5	3			MOE
1989 09 16.84	S	8.9	AA	15	L	4	26	3	1/			PER01
1989 09 17.83	M	8.8	AA	15	L	4	26					PER01
1989 09 17.83	S	8.6	AA	15	L	4	26	4	2/		250	PER01
1989 09 17.88	S	8.4	S	7.0	B		10					DEA
1989 09 18.80	S	8.8	AC	15.2	L	5	44	5	3			MOE
1989 09 18.80	S	8.9	AC	15.2	L	5	100	4	3			MOE
1989 09 18.82	S	9.2	AC	36.0	T	11	123	4.5	2			KOR
1989 09 20.81	S	8.2	AA	12.0	R	4	20	6	6			DIE02
1989 09 20.81	S	9.0	AC	36.0	T	11	123	5	2	&0.16	120	KOR
1989 09 20.83	S	8.6	AC	15.2	L	5	44	5	3			MOE
1989 09 20.83	S	8.8	AC	8.0	B		15	6	1	&0.25	120	KOR
1989 09 21.80	S	8.4:	AC	15.2	L	5	44	& 5	3			MOE
1989 09 21.9	S	8.7:	A	5.0	B		12					KID
1989 09 23.46	B	8.5	S	6.0	B		15	5	4			HIR02
1989 09 24.79	S	7.8	AC	15.2	L	5	44	4.5	4			MOE
1989 09 24.80	S	7.8	AC	15.2	L	5	100	4.5	4			MOE
1989 09 26.12	O	8.6	A	40	L							MCD
1989 09 26.85	! B	8.9	AA	15	L	4	26					PER01
1989 09 26.85	! M	8.3	AA	15	L	4	26					PER01
1989 09 26.85	! S	8.0	AA	15	L	4	26	& 4	3/			PER01
1989 09 26.85	! S	8.2	AA	3.4	B		9	6	2			PER01
1989 09 27.83	! B	8.5:	AA	15	L	4	26					PER01
1989 09 27.83	! M	8.2	AA	15	L	4	26					PER01
1989 09 27.83	! S	8.0	AA	15	L	4	26	6	3			PER01
1989 09 27.84	S	7.6	AA	3.4	B		9	10	2/			PER01
1989 09 28.06	B	8.2	S	37	L		52	7	6	0.17	50	CHE
1989 09 29.01	S	8.0	AA	20.3	L	6	49	& 3.5	5			GRE
1989 10 01.02	S	7.6	AA	8.0	R	3	20	& 4.5	6/			GRE
1989 10 02.01	S	7.7	AA	20.3	L	6	49	& 4	6			GRE
1989 10 02.01	S	7.8	AA	8.0	R	3	20	& 4	5			GRE
1989 10 02.85	! M	8.1	AA	15	L	4	26					PER01
1989 10 02.85	! S	8.1	AA	15	L	4	26	4	5			PER01

Comet Okazaki-Levy-Rudenko 1989r [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 10 03.82	!	B 8.4	AA	15	L	4	26					PER01
1989 10 03.82	!	M 8.2	AA	15	L	4	26					PER01
1989 10 03.82	!	S 8.1	AA	15	L	4	26	3.5	3			PER01
1989 10 03.82	!	S 8.4	AA	3.4	B		9	& 4	6/			PER01
1989 10 04.03		S 7.7	AA	8.0	R	3	20	& 5	6			GRE
1989 10 05.00		S 8.0	AA	20.3	L	6	49	& 4	6			GRE
1989 10 07.99		S 8.0	AA	22.9	R	12	86	& 3	7/			GRE

Comet Helin-Roman 1989s

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 09 07.21		S 12.3	NP	25.6	L	4	111	1.9	2			MOR

Periodic Comet Pons-Winnecke (1989g)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 04 30.94		B 13.1	AC	35	T	6	96		9			AMO
1989 06 07.91		B 11.9	AC	35	T	6	96		9			AMO
1989 07 30.22		S 14.0:	NP	50.8	L	4	195	0.75	1/			MOR
1989 08 05.20		S 13.4	AC	25.6	L	4	156	1.3	2			MOR
1989 08 06.20		S 13.5	AC	50.8	L	4	195	1.1	1/			MOR
1989 08 24.19		S 12.6	AC	50.8	L	4	127	1.6	2			MOR
1989 08 26.18		12.5:		25.6	L	4	156	1.1	1/			MOR
1989 08 26.18		S 12.6:	AC	25.6	L	4	156	1.1	1			MOR

Periodic Comet Tempel 1 (1983 XI)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1983 03 06.61		S 13.0	AC	31	L	6	139	1.0	6/			NAK01
1983 03 06.62		S 12.7	AC	31	L	6	139	1.5				ICH
1983 03 08.79		S 13.0	AC	15	L	6	100	0.8				KAN
1983 03 14.63		S 12.6	AC	15	L	6	100	1.2				NAK01
1983 03 14.63		S 12.7	AC	15	L	6	100	1.2				ICH
1983 04 06.54		B 12.0	AC	30	L	6	100	0.7				OHT
1983 04 06.63		S 11.6	AC	15	L	6	100	1.6	5			NAK01
1983 04 06.65		S 12.1	AC	15	L	6	100	1.5				TAN01
1983 04 20.74		S 11.7	AC	15	L	6	50	1.8	4/			NAK01
1983 04 20.74		S 12.0	AC	15	L	6	100					TAN01
1983 05 04.52		S 11.0	AC	20	T	10	50	1.5				OHT
1983 05 04.57		S 11.7	AC	15	L	6	100	1.8	2			NAK01
1983 05 04.60		S 11.8	AC	15	L	6	100					TAN01
1983 05 07.46		S 11.6	AC	30	L	6	100	1.0	1			OHT
1983 05 07.53		S 10.9	AC	20	L	6	85	2.5	3			ISH02
1983 05 07.56		S 10.9	AC	15	L	6	50	3	3/			NAK01
1983 05 07.61		S 11.5	AC	15	L	6	50	1.5				TAN01
1983 05 07.64		S 11.0	AC	15	L	6	50	2.7	1			KAN
1983 05 08.51		S 11.6	AC	30	L	6	100	1.6	1/			OHT
1983 05 08.54		S 11.1	AC	15	L	6	50	2.5	4			NAK01
1983 05 08.56		S 11.0	AC	20	L	6	48	2	2			ISH02
1983 05 08.57		S 11.6	AC	15	L	6	50	2				TAN01
1983 05 09.69		S 11.0	AC	20	L	6	85	2	2			ISH02
1983 05 14.46		S 11.0	AC	10	L	10	30	1.5				ICH
1983 05 14.49		S 10.8	AC	15	L	6	50	2.5	4/			NAK01
1983 05 14.59		S 10.8	AC	20	T	10	50	2.9				OHT
1983 05 17.52		S 10.7	AC	10	L	10	30	2.1				ICH
1983 05 17.56		S 10.4	AC	20	L	6	85	3	3			ISH02
1983 05 17.58		S 10.4	AC	20	T	10	50	3.0	2			OHT
1983 05 17.59		S 10.8	AC	15	L	6	50	3	3			NAK01
1983 05 17.60		S 10.8	AC	15	L	6	50	2				TAN01

Periodic Comet Tempel 1 (1983 XI) [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1983 05 18.53	S	10.7	AC	20	L	6	85	2	3			ISH02
1983 05 29.54	S	10.6	AC	10	L	10	30	1.5				ICH
1983 06 01.50	S	11.1	AC	20	T	10	110					OHT
1983 06 01.62	S	10.6	AC	15	L	6	50	3.5	2			NAK01
1983 06 04.52	S	10.7	AC	15	L	6	50	3.5	1/			NAK01
1983 06 13.49	S	10.9	AC	20	L	6	85	2.5	2			ISH02
1983 06 13.51	S	10.9	AC	15	L	6	50	2.5	2			NAK01
1983 06 13.52	S	11.1	AC	15	L	6	50	2				TAN01
1983 06 28.48	S	10.9	AC	15	L	6	50	3	3			NAK01

Periodic Comet Tempel 2 (1987g)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 07 10.91	S	11.2:	CS	20.3	T	10	62	2.5	1			GAR02
1988 07 11.98	S	11.5:	AC	25.4	J	6	90	& 2	0			BOU
1988 07 18.13	S	12.7	AC	44.5	L	4	167	0.9	1			MOR03
1988 07 18.91	S	10.9:	CS	12.7	T	10	40	1	2			GAR02
1988 07 18.92	S	11.0:	CS	20.3	T	10	62	2	3	0.04	120	GAR02
1988 07 19.94	S	10.9:	CS	20.3	T	10	62	1	2			GAR02
1988 08 04.87	S	9.4	AC	11.0	L	4	23	6	1/			BUS01
1988 08 06.88	S	10.5:	AC	40.6	L	5	82	2	2			BUS01
1988 08 08.11	S	12.0	AC	15	R	5	62	2.2	1			MOR03
1988 08 09.87	S	10.3	CS	12.7	T	10	40	1	1			GAR02
1988 08 16.09	S	10.9	AC	15	R	5	62	2.5	1			MOR03
1988 08 16.10	S	10.9	AC	44.5	L	4	80	2.1	3			MOR03
1988 08 18.39	M	8.6	AA	21	L	9	105	2.1	3			WOL01
1988 09 01.06	S	10.2	AC	15	R	5	31	2				MOR03
1988 09 06.05	S	10.0	AC	15	R	5	31	3.5	2			MOR03
1988 09 14.05	S	9.7	AC	15	R	5	31	5	2			MOR03
1988 09 29.02!	S	8.8	AC	15	R	5	31	4	1			MOR03
1988 10 04.80	S	8.5	AC	15.6	L	5	45	3	2			BOU
1988 10 08.80	S	8.7	AC	15.6	L	5	36	3.5	1			BOU
1988 12 03.75	S	10.7	CS	20.3	L	10	62	2.5	1	0.08	60	GAR02

Periodic Comet Gunn

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 04 08.32	S	13.8	AC	44.5	L	4	167	0.7	1			MOR03
1989 04 11.35	S	13.5	AC	44.5	L	4	167	1.0	2			MOR03
1989 05 04.82	S	12.5	VN	20	L	4	90	1.2	2			PEA
1989 05 27.16	S	13.1	AC	44.5	L	4	167	0.6	3			MOR03
1989 05 28.13	S	13.1	AC	44.5	L	4	167	0.7				MOR03
1989 05 28.50	S	12.4	AC	25.4	L	4	114					SEA
1989 05 29.99	S	12.2	AC	20.0	T	10	77	& 4	2/			COM
1989 05 30.44	S	12.3	AC	25.4	L	4	71	0.6	5			SEA
1989 05 30.95	S	12.4	AC	20.0	T	10	77	3	2/			COM
1989 06 02.95	S	12.6:	AC	20.0	T	10	77	& 3	2			COM
1989 06 07.46	S	11.9	AC	25.4	L	4	71					SEA
1989 06 07.94	B	12.4	AC	35	T	6	96		9			AMO
1989 06 24.55	S	12.3	VN	25	L	4	58	1.2	2			PEA
1989 07 29.22	S	12.8	AC	25.6	L	4	156	1.7	1/			MOR
1989 07 31.20	S	13.1	AC	25.6	L	4	156	1.5	1			MOR
1989 08 05.23	S	12.8	AC	25.6	L	4	156	0.9	3			MOR
1989 08 06.22	S	13.1	AC	50.8	L	4	120	0.9	2			MOR
1989 08 24.21	S	13.5:		50.8	L	4	195	1.5	1			MOR

Periodic Comet Howell (1987 VI)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1987 09 14.75	S	12.8	AC	25	L	5	82	1.0	2			WAT01

Periodic Comet Brooks 2 (1987 XXIV)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1987 09 14.19	S	13.4:	L	25	L	4	179					JAC01
1987 09 15.33	S	13.4:	L	25	L	4	179	& 0.7	0			JAC01
1987 09 19.67	S	13.3	AC	20	L	6	106	1				NAK01
1987 09 19.78	S	13.2	AC	25	L	5	82	1.0	4			WAT01
1987 09 20.50	S	12.6	AC	25	L	5	82	0.8	2			WAT01
1987 09 28.71	S	13.2	AC	25	L	5	57	1.2	2			WAT01
1987 10 01.75	S	13.5	AC	25	L	5	82	2.1	2			WAT01
1987 10 03.38	S	12.8	L	25	L	4	179	1	2			JAC01
1987 10 13.12	S	12.4	L	25	L	4	82	1.2	2			JAC01
1987 10 18.46	S	12.8	AC	20	L	6	106	1.5				NAK01
1987 10 24.17	S	12.2	L	25	L	4	82	1.9	3			JAC01
1987 11 09.05	S	12.6	L	25	L	4	82	2	4/			JAC01
1987 11 12.16	S	12.6	L	25	L	4	82	1.4	3			JAC01
1987 11 18.14	S	12.9	L	25	L	4	82	1	1			JAC01

Periodic Comet Halley (1986 III)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1987 04 15.86	S	13.5:	AC	40	L	5	254	1.0	1			MER
1987 04 16.90	S	13.5:	AC	40	L	5	170	1.0	1			MER
1987 04 30.91	S	13.8:	AC	40	L	5	170	1.5	1			MER
1988 04 10	V	17.5:	GP	150	C	8		> 1.78				WES01
1988 04 19	V	17.6:	GP	150	C	8		> 1.78				WES01
1988 05 15	V	17.7:	GP	150	C	8		> 1.78				WES01
1989 01 04	V	18.4:	SS	150	C	8		& 1.33				WES01

Periodic Comet Brorsen-Metcalf (1989o)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 07 09.36	S	10.2	AC	44.5	L	4	154	& 6	0/			PEA01
1989 07 10.00	S	10.4	AC	20.5	L	4	48	1.6	3			HAS02
1989 07 11.97	S	10.4	AC	15.2	L	5	44	4	3			MOE
1989 07 12.82	S	9.1	AA	8.0	B		20	8	2			PEA
1989 07 12.82	S	9.5	AA	20	L	4	45	6	2			PEA
1989 07 13.70	S	9.8	SM	8	B		20	& 3.5	3			CAM03
1989 07 13.77	S	8.6	AA	8.0	B		15	4	4			SEA
1989 07 14.04	S	10.0	AA	17.1	R	18	200	2.5				CAN03
1989 07 14.80	S	8.4	SM	8	B		20	4	3			CAM03
1989 07 16.04	S	10.0	AA	17.1	R	18	200	2.5				CAN03
1989 07 16.05	S	8.8	AA	8.0	B		15	7	2/			HAV
1989 07 16.95	S	10.1	AC	15.2	L	5	44	4.5	3			MOE
1989 07 16.95	S	10.2	AC	15.2	L	5	100	3.5	2			MOE
1989 07 17.02	S	9.0	AA	12.0	B		20	3	3			LOO01
1989 07 20.10	S	8.5	AA	8.0	B		20		2			DIO
1989 07 20.46	S	8.5	AA	8.0	R	4	19	10	1			SPR
1989 07 20.95	S	9.6	AC	15.2	L	5	44	4	2			MOE
1989 07 21.09	S	8.2	AA	8.0	B		20	6	3			DIO
1989 07 22.15	S	8.1	A	5.0	B		12					KID
1989 07 23.43	S	8.0	AA	8.0	R	4	19	8	2			SPR
1989 07 24.28	S	6.9	AA	8.0	R	3	20	&12	4			GRE
1989 07 24.31	S	7.0	AA	5.0	B		7	&12	3/			GRE
1989 07 25.28	S	7.6	AA	8.0	R	4	19	6	3			SPR
1989 07 25.28	S	7.7	AA	14.0	S	4	28	6	3			SPR
1989 07 25.44	M	7.5	AA	8.0	B		20	7	4			MOR
1989 07 26.29	S	7.6	AA	14.0	S	4	28	6	3			SPR
1989 07 26.30	S	7.6	AA	8.0	R	4	19	6	3			SPR
1989 07 27.06	S	8.0	AA	15	L	4	26	6	2			PER01
1989 07 27.10	S	7.0	AA	5.0	B		10	8.0				KEI
1989 07 27.10	S	7.1	AA	8.0	B		20	6.0	2/	0.23	5	KEI

Periodic Comet Brorsen-Metcalf (1989o) [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 07 27.2	S	7.7	A	5.0	B		12	4	1			KID
1989 07 27.29	S	7.5	AA	14.0	S	4	28	5.5	3			SPR
1989 07 27.44	M	7.4	AA	8.0	B		20	6	5			MOR
1989 07 27.97	S	8.2	AC	15.2	L	5	44	6.5	3			MOE
1989 07 28.1	S	7.1	A	5.0	B		12		1			KID
1989 07 28.98	S	8.0	AC	15.0	L	5	25	6.0	3			MER
1989 07 29.00	S	8.2	AA	15	L	6	36		3			DIO
1989 07 29.01	S	7.8	AA	8.0	B		15	9.5	3			HAV
1989 07 29.02	S	7.5	AA	5.0	B		10	8	3			BOA
1989 07 29.02	S	7.6	AA	8.0	B		15	8	2/			BOA
1989 07 29.02	S	7.7	AA	5.0	B		10	9.5	2			HAV
1989 07 29.15	S	7.6	A	5.0	B		12	6				KID
1989 07 29.33	M	6.9	SC	5.0	B		10					OME
1989 07 29.34	B	7.7	AA	8.0	B		11	& 5	3			ROB03
1989 07 29.43	M	7.5	AA	8.0	B		20	5.5	5			MOR
1989 07 29.66	B	7.5	S	6.0	B		15	7	3			HIRO2
1989 07 30.02	S	7.3	AA	8.0	B		20		4			DIO
1989 07 30.02	S	7.5	AA	8.0	B		15	11	4	0.30	290	HAV
1989 07 30.03	B	8.2	AA	5.0	B		10		2			REI01
1989 07 30.03	S	7.4	AA	5.0	B		10	11	3			HAV
1989 07 30.03	S	7.5	AA	5.0	B		10	8.5	3/			BOA
1989 07 30.03	S	7.5	AA	8.0	B		20	9	3			BOA
1989 07 30.07	M	7.6	AA	8.0	B		15	8	3			MIK
1989 07 30.12	O	7.5	AA	15.2	L	10	76	10				ARC
1989 07 30.15	S	7.5	A	5.0	B		12	8	3			KID
1989 07 30.26	S	7.3	S	5.0	B		7					CHE
1989 07 30.33	S	7.0	AA	8.0	B		11	10	3			SPR
1989 07 30.33	S	7.1	AA	14.0	S	4	28	9	3			SPR
1989 07 30.38	S	7.3	SC	7.0	B		10	12	3/			PEA01
1989 07 30.43	M	7.6	AA	8.0	B		20	5	5			MOR
1989 07 30.43	S	7.6	AA	8.0	B		20					MOR
1989 07 30.97	S	6.8	AA	5.0	B		10	8.6	3			KEI
1989 07 30.97	S	8.1	AC	8.0	B		15	5	3			KOR
1989 07 31.02	S	7.4	AA	8.0	B		15	11	4	0.47	290	HAV
1989 07 31.03	S	7.2	AA	5.0	B		10	11.5	3			HAV
1989 07 31.03	S	7.3	AA	8.0	B		20	12	4			DIO
1989 07 31.04	S	7.3	AA	5.0	B		10	10	4			BOA
1989 07 31.07	S	7.3	AA	10.0	B		14	7	6			LOO01
1989 07 31.2	S	7.4	A	5.0	B		12	6	4			KID
1989 07 31.44	M	7.0	AA	8.0	B		20	5	5			MOR
1989 07 31.64	B	7.0	S	6.0	B		15	8	4			HIRO2
1989 07 31.93	O	7.0	SC	6.0	B	4	12	8	4			AND01
1989 07 31.99	S	7.8	AC	15.2	L	5	44	8	4			MOE
1989 08 01.15	S	7.4	A	5.0	B		12					KID
1989 08 01.65	B	6.8	S	6.0	B		15	7	4	0.02	270	HIRO2
1989 08 01.79	M	6.8	AA	8.0	B		15	8	5			SEA
1989 08 01.96	O	7.0	SC	8.0	B	4	20	10	4			AND01
1989 08 01.97	S	6.9	AA	5.0	B		10	11	4			BOA
1989 08 02.02	S	7.6	AA	8.0	B		20	7	2			BAR
1989 08 02.03	S	7.3	AA	8.0	B		20		4			DIO
1989 08 02.06	S	7.0	SC	8.0	B		11	11	3			SOS
1989 08 02.1	S	7.2	A	5.0	B		12	& 4.5				KID
1989 08 02.32	B	7.2	S	7.0	B		10	10				DEA
1989 08 02.33	B	7.3	SE	5.0	B		7					GRE
1989 08 02.33	S	7.0	SE	5.0	B		7	&11	7			GRE
1989 08 02.34	B	7.3	SE	3.5	B		7		8			GRE
1989 08 02.34	M	6.9	SE	8.0	R	3	20	&11	6			GRE
1989 08 02.46	M	6.7	AA	5.0	B		10	8	6			MOR
1989 08 02.46	M	6.7	AA	8.0	B		20	7	5/			MOR

Periodic Comet Brorsen-Metcalf (1989o) [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 08 02.96	M	7.0:	SC	9.0	M	11	56	8	1			WES02
1989 08 02.96	O	7.0	SC	6.0	B	4	12	10	4			AND01
1989 08 02.96	S	7.5	AC	8.0	B		15	7	3			KOR
1989 08 03.00	S	7.4	AA	5.0	B		10					CAN03
1989 08 03.01	S	6.9	AA	5.0	B		10	6	6	0.22	318	LOO01
1989 08 03.08	S	6.6	AA	5.0	B		10	9.2	4			KEI
1989 08 03.08	S	7.3	AA	8.0	B		20	8	3			BAR
1989 08 03.10	S	6.6	AA	13	R	4	21	12	4			CAM
1989 08 03.29	S	6.6	AA	8.0	B		11	12	3			SPR
1989 08 03.37	B	7.3	AA	8.0	B		11	&10	3			ROB03
1989 08 03.44	M	6.7	AA	8.0	B		20	6.5	5/			MOR
1989 08 03.70	B	6.8	S	6.0	B		15	8	4			HIRO2
1989 08 04.04	B	7.6	AC	35	T	6	96	6	3			AMO
1989 08 04.08	S	6.2	AA	2.5	B		3					KEI
1989 08 04.08	S	6.2	AA	5.0	B		10	6.8	5			KEI
1989 08 04.08	S	6.3	AA	8.0	B		20	6.8	6			KEI
1989 08 04.12	S	6.6	AA	3.4	B		9	8	6			PER01
1989 08 04.13	S	6.9	AA	8.0	B		20	14	4			DIO
1989 08 04.2	S	7.0	A	5.0	B		12	8	4			KID
1989 08 04.29	S	6.5	AA	8.0	B		11	10	2			SPR
1989 08 04.49	M	6.6	AA	5.0	B		10	8	5/			MOR
1989 08 05.08	B	7.3	S	5.0	R	10	13	&16	4			JAH
1989 08 05.08	S	6.9	AA	5.0	B		10	8				CAN03
1989 08 05.15	S	6.9	A	5.0	B		12	5	5			KID
1989 08 05.33	S	6.3	AA	8.0	B		11	8	3			SPR
1989 08 05.49	M	6.8	AA	5.0	B		10	6.5	6/			MOR
1989 08 05.49	M	6.8	AA	8.0	B		20	6.5	6			MOR
1989 08 05.69	B	6.7	S	6.0	B		15	8	4			HIRO2
1989 08 05.79	M	6.5	AA	8.0	B		15	5	6			SEA
1989 08 06.03	S	6.8	AC	8.0	B		15	7	2			KOR
1989 08 06.03	S	7.3	AC	36.0	T	11	123	4	3			KOR
1989 08 06.05	B	7.2	AA	5.0	B		10		3			REI01
1989 08 06.07	S	7.0	S	5.0	R	10	13	&12	2			JAH
1989 08 06.08	S	6.8	AA	5.0	B		10	10				CAN03
1989 08 06.2	S	7.0	A	5.0	B		12	5	5			KID
1989 08 06.29	S	6.6	SE	5.0	B		7	&10	6			GRE
1989 08 06.30	S	6.0	AA	8.0	B		11	7	4			SPR
1989 08 06.31	S	6.2	AA	20.0	T	10	64	12	4	?		SPR
1989 08 06.36	M	6.8	AA	5.0	B		10	6.5	6/			MOR
1989 08 06.79	M	6.3	AA	8.0	B		15		6			SEA
1989 08 06.97	O	6.7	SC	8.0	B	4	20	10	4			AND01
1989 08 07.04	B	6.9	S	10.0	B		14	5.4	4			HAS02
1989 08 07.06	S	6.2	AA	5.0	B		10	7.8	4/	0.10	270	KEI
1989 08 07.46	S	5.9	AA	8.0	B		11	7	4			SPR
1989 08 07.46	S	6.0	AA	20.0	T	10	64	8	4	?	290	SPR
1989 08 07.48	M	6.5	AA	5.0	B		10	6	6/			MOR
1989 08 07.94	B	7.2	AC	5.0	B		7	7	4			MOE
1989 08 08.05	S	6.7	AA	8.0	B		15	13	5	0.53	295	HAV
1989 08 08.06	S	6.2	AA	0.0	E		1					HAV
1989 08 08.06	S	6.4	AA	5.0	B		10	14	4/			HAV
1989 08 08.2	S	6.4	A	5.0	B		12		4/			KID
1989 08 08.28	S	5.7	AA	8.0	B		11	6	5			SPR
1989 08 08.43	S	6.7	S	4.0	B		8	8	5			KEE
1989 08 08.44				31.8	L	4	150	5	6	0.08	260	KEE
1989 08 08.92	M	6.9	SC	9.0	M	11	56	8	2			WES02
1989 08 09.08	S	6.4	AA	8.0	B		20	10	4			BAR
1989 08 09.09	S	6.5	AA	5.0	B		10	9	6	0.38		LOO01
1989 08 09.10	S	6.7	AA	5.0	B		10	8				CAN03
1989 08 09.28	S	5.7	AA	8.0	B		11	6	5			SPR

Periodic Comet Brorsen-Metcalf (1989o) [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 08 09.29	B	7.6	SE	8.0	R	3	20					GRE
1989 08 09.29	S	6.6	SE	8.0	R	3	20	& 6	7			GRE
1989 08 09.35	B	6.0	AA	8.0	B		11	&10	7	0.7	270	ROB03
1989 08 09.35	M	5.9	SC	5.0	B		10					OME
1989 08 09.47	M	6.3	AA	5.0	B		10	6	7			MOR
1989 08 09.89	O	6.5	SC	8.0	B	4	20	12	4			AND01
1989 08 09.95	B	7.1	AC	5.0	B		7	5	4			MOE
1989 08 10.06	B	6.8	S	10.0	B		14	5.6	4			HAS02
1989 08 10.06	S	6.4	SC	6.0	B		20	10	4	0.5	125	SOS
1989 08 10.09	S	5.8	AA	3.0	B		8	& 5.5	7			LOO01
1989 08 10.28	S	5.8	AA	8.0	B		11	5	4			SPR
1989 08 10.32	S	6.2	AA	8.0	R	3	20	& 7	6			GRE
1989 08 10.35				25	L	8	98	& 5	4	0.5	290	ROB03
1989 08 10.35	B	6.0	AA	8.0	B		11	&10	7			ROB03
1989 08 11.02	S	5.9	AA	3.0	B		8	4	6/			LOO01
1989 08 11.10	B	6.8	S	5.0	R	10	13	&10	4	&0.35	280	JAH
1989 08 11.10	S	6.3	S	5.0	R	10	13					JAH
1989 08 11.47	M	6.1	AA	5.0	B		10	5.5	7			MOR
1989 08 12.08	S	6.1	SC	20	L	5	40	12	4	0.5		SOS
1989 08 12.10	S	6.0	AA	0.0	E		1	12				HAV
1989 08 12.10	S	6.3	AA	8.0	B		15	9	5/	0.70	290	HAV
1989 08 12.11	S	5.8	AA	5.0	B		10	9	4/	0.60	290	HAV
1989 08 12.11	S	6.2	AA	8.0	B		20	7	5	0.5	280	DIO
1989 08 12.31	S	5.5	AA	8.0	B		11	5	4			SPR
1989 08 12.31	S	5.6	AA	20.0	T	10	64	5	4			SPR
1989 08 12.43	M	6.1	AA	5.0	B		10	5.5	7			MOR
1989 08 12.49				25.6	L	4	45			0.67	275	MOR
1989 08 12.50	B	5.9	AA	0.7	E		1		9			MOR
1989 08 12.92	O	6.3	SC	6.0	B	4	9	11	5			AND01
1989 08 12.99	B	6.4	AC	5.0	B		7	7	5			MOE
1989 08 13.03	S	5.8	AA	5.0	B		10	6.2	5/	0.57	289	KEI
1989 08 13.04	S	6.1	AA	8.0	B		20		5			DIO
1989 08 13.05	S	6.6	AA	15	R	15		& 6.5		0.5		DIE02
1989 08 13.06	S	6.0	AA	3.0	B		8	4	7	&0.17		LOO01
1989 08 13.07	B	6.5	AA	3.0	B		8					LOO01
1989 08 13.07	S	6.2	SC	20	L	5	40	10	4	0.3		SOS
1989 08 13.08	B	6.6:	S	5.0	R	10	13	&13	4			JAH
1989 08 13.10	S	5.7	AA	0.0	E		1	12				HAV
1989 08 13.10	S	6.1	AA	8.0	B		15	7.5	6	1.13	290	HAV
1989 08 13.10	S	6.2	AC	8.0	B		15	14	4	0.67	260	KOR
1989 08 13.50	M	6.1	AA	5.0	B		10	4.0	7/	1.25	278	MOR
1989 08 14.00	M	6.8	SC	9.0	M	11	56	10	2			WES02
1989 08 14.05	S	6.0	AA	12.0	B		20	3.5	7	0.38	288	LOO01
1989 08 14.08	S	6.0	SC	4.0	B		8	12	4			SOS
1989 08 14.09	S	6.2	AA	5.0	B		10	6.2				KEI
1989 08 14.2	S	6.5	A	5.0	B		12					KID
1989 08 14.71	B	5.8	S	6.0	B		15	9	5	&0.25	300	HIR02
1989 08 15.07	B	6.4	S	5.0	R	10	13	&13	4	&0.52	280	JAH
1989 08 15.07	S	6.2	S	5.0	R	10	13					JAH
1989 08 15.08	S	5.7	AA	0.0	E		1	12				HAV
1989 08 15.08	S	6.1	AA	8.0	B		15	6	6	0.87	295	HAV
1989 08 15.09	S	6.2	AA	5.0	B		10	4	7	0.2	286	LOO01
1989 08 15.10	B	6.3	AA	5.0	B		10					LOO01
1989 08 15.2	S	6.1	A	5.0	B		12					KID
1989 08 15.50	M	6.0	AA	5.0	B		10		7			MOR
1989 08 16.0	B	6.5	S	5.0	B	4	10	& 8	4/			PLE01
1989 08 16.06	B	6.9:	S	5.0	B		10	& 5	5			SCI
1989 08 16.11	S	5.8	AA	5.0	B		10	3.6	5	1.0		KEI
1989 08 17.06	B	6.4	S	5.0	B	4	10	&10	5			PLE01

Periodic Comet Brorsen-Metcalf (1989o) [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 08 17.09	S	5.9	AA	5.0	B		10	10.5	6			BOA
1989 08 17.09	S	6.0	AA	8.0	B		20		6			DIO
1989 08 17.13	B	6.2	AC	35	T	6	96	12	5			AMO
1989 08 17.17	O	7.0	AA	33.5	L	4	45	& 3.5		0.5		RIP
1989 08 18.32	S	6.2	AA	8.0	R	3	20	& 5	7/			GRE
1989 08 18.91	B	7.1	S	5.0	B		10	7	6			SZU
1989 08 19.08	B	6.1	S	5.0	R	10	13	& 11	3			JAH
1989 08 19.08	S	5.7	S	5.0	R	10	13					JAH
1989 08 19.10	S	5.7:	S	20.4	L	6	72	2.3	5	0.11	55	JAH
1989 08 20.01	M	5.7	SC	9.0	M	11	56	8	3			WES02
1989 08 21.94	B	7.0	S	5.0	B		10	7.5	6			SZU
1989 08 22.04	B	6.0:	S	5.0	B	4	10	& 8	4			PLE01
1989 08 22.06	B	6.0	S	10.0	B		14	3.4	5			HAS02
1989 08 22.07	S	5.5:	S	5.0	B		10	& 7	4			SCI
1989 08 22.09	S	5.7	AC	15.2	L	5	44	6	6	0.5	300	MOE
1989 08 22.10	B	5.8	AC	5.0	B		7	& 5	7			MOE
1989 08 22.95	B	6.9	S	5.0	B		10	8	6			SZU
1989 08 23.45	S	6.0	AA	8.0	B		11	4	6	0.25	290	SPR
1989 08 24.02	B	5.6	AC	5.0	B		7	& 6	7			MOE
1989 08 24.32	B	6.2	Y	3.5	B		7	& 5	9			GRE
1989 08 24.32	B	6.4	Y	5.0	B		7	& 5	8/			GRE
1989 08 24.32	S	5.9	Y	5.0	B		7	& 5	8/			GRE
1989 08 24.34	S	5.8	Y	8.0	R	3	20	& 5	8			GRE
1989 08 24.46	S	5.8	AA	8.0	B		11	5.5	6	0.25	285	SPR
1989 08 24.49	M	6.1	AA	5.0	B		10		8/	2.33	298	MOR
1989 08 25.09	S	5.3:	S	5.0	B		10	& 7	4			SCI
1989 08 25.31	B	6.0	Y	8.0	R	3	20	& 3	7/			GRE
1989 08 25.32	B	5.9	Y	5.0	B		7	& 4	8/			GRE
1989 08 25.32	S	5.8	Y	8.0	R	3	20	& 3	7/			GRE
1989 08 25.45	S	5.8	AA	8.0	B		11	5.5	6	0.5	280	SPR
1989 08 25.47	B	6.0	SP	4.0	B		8	5	6			KEE
1989 08 25.49	M	5.7	AA	5.0	B		10		8/			MOR
1989 08 25.94	B	6.8	S	5.0	B		10	8	6	& 1.2		SZU
1989 08 26.02	B	5.4	AC	5.0	B		7	7.5	7	0.3	300	MOE
1989 08 26.04	B	6.3	S	6.5	R	12	11	& 2	6			RAF
1989 08 26.04	B	6.5	S	6.5	R	12	11		6			JAR
1989 08 26.07	B	6.1	S	8.0	B		20	2.9	6	& 0.1	310	SPE01
1989 08 26.17	S	5.1	AA	15	L	4	26	2.5	5			PER01
1989 08 26.17	S	5.2	AA	3.4	B		9	6	6	0.4	295	PER01
1989 08 26.45	S	5.5	AA	8.0	R	4	19	3.5	7			SPR
1989 08 26.45	S	5.6	AA	8.0	B		11	4	6	0.25	280	SPR
1989 08 27.07	B	5.6	AA	10.0	B		14	4.8	5	1.2	305	HAS02
1989 08 27.07	B	5.6	AA	10.0	B		14	4.8	5	1.2	305	HAS02
1989 08 27.16	S	5.2	AA	3.4	B		9	5.5	7			PER01
1989 08 27.17	S	5.3:	AA	15	L	4	26	2.5	4			PER01
1989 08 27.18	B	5.9	AA	3.4	B		9			0.7	300	PER01
1989 08 27.43	M	6.8	SC	44.5	L	4	62	& 9	5/	& 0.75	300	PEA01
1989 08 27.45	S	5.3	AA	8.0	B		11	3	7	0.17	280	SPR
1989 08 27.48	M	5.7	AA	5.0	B		10		8/	3.2	308	MOR
1989 08 27.49				25.6	L	4	45	2.3	8			MOR
1989 08 29.12	M	4.9	AA	8.0	B		20	8	8	0.50	300	BAR
1989 08 30.05	B	5.2	AC	5.0	B		7	4	8	0.4	300	MOE
1989 08 30.11	S	5.7	AA	8.0	B		15	4	8	2.53	307	HAV
1989 08 30.12	S	5.3	AA	0.0	E		1					HAV
1989 08 30.13	B	5.9	S	5.0	R	10	13	3.2	8			JAH
1989 08 30.13	S	5.6	S	5.0	R	10	13					JAH
1989 08 30.45	B	5.7	SP	4.0	B		8			0.4	310	KEE
1989 08 30.47				31.8	L	4	63	3	7	1.0	310	KEE
1989 08 30.49	M	5.7	AA	5.0	B		10		8/	4.5	308	MOR

Periodic Comet Brorsen-Metcalf (1989o) [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 08 30.89	B	6.2	S	5.0	B		10	10	6	&1.6		SZU
1989 08 31.09	B	5.9	S	4.0	B		11					RAF
1989 08 31.10	B	5.6	AA	10.0	B		14	3.5	6	0.87	300	HAS02
1989 08 31.10	B	6.0	S	6.5	R	12	11	& 3	7			RAF
1989 08 31.10	S	5.6	SC	20	L	5	40	4	7	0.5		SOS
1989 08 31.11	S	5.4	AC	8.0	B		15	5	7	0.75	315	KOR
1989 08 31.12	B	6.1	AA	5.0	B		10		8			REI01
1989 08 31.32	B	6.1	AA	10.2	R	4	16					GRE
1989 08 31.32	S	5.9	AA	10.2	R	4	16	& 3.5	8	&1.5	310	GRE
1989 08 31.33	B	5.8	AA	5.0	B		7	& 5	8	&1.5	310	GRE
1989 08 31.35	B	5.9	AA	3.5	B		7		8/	&1.2	310	GRE
1989 08 31.35	B	6.0	AA	8.0	R	3	20	& 5	7/	&1.5	310	GRE
1989 08 31.49	M	5.8	AA	5.0	B		10		8/	4.0	307	MOR
1989 08 31.92	B	6.2	S	5.0	B		10	11	6	&1.8		SZU
1989 09 01.11	B	5.7	AA	10.0	B		14	3.6	6	1.6	305	HAS02
1989 09 01.12	M	5.8	AA	8.0	B		15	4.5	7	1.9	300	MIK
1989 09 01.12	S	5.3	AA	0.0	E		1					HAV
1989 09 01.12	S	5.5	SC	20	L	5	40	4.5	7	0.6		SOS
1989 09 01.12	S	5.6	AA	8.0	B		15	4	8	2.33	305	HAV
1989 09 01.36	M	5.3	SC	5.0	B		10					OME
1989 09 01.50	M	5.6	AA	5.0	B		10		8/	7.0	305	MOR
1989 09 01.92	B	6.1	S	5.0	B		10	11	5/	&2.3	25	SZU
1989 09 02.05	B	5.2	AC	5.0	B		7	3	9			MOE
1989 09 02.07	B	5.9	S	6.5	R	12	11	& 3	7			RAF
1989 09 02.07	B	6.0	S	6.5	R	12	11		6			JAR
1989 09 02.09	B	5.9	S	5.0	B		7	& 3.5	8	&0.25	310	SPE01
1989 09 02.25	O	6.0	AA	33.5	L	4	45	5		1.5		RIP
1989 09 02.45	B	5.5	AA	4.0	B		8	3	8	3	310	KEE
1989 09 02.50	B	5.6	AA	5.0	B		10		9	7.0	303	MOR
1989 09 02.58	S	5.8	SP	5.0	B	4	7		8			OFE
1989 09 03.44	M	6.4	SC	44.5	L	4	62		6			PEA01
1989 09 03.44	S	5.8	SC	7.0	B		10		6			PEA01
1989 09 03.46	B	5.6	AA	4.0	B		8	3	8	3	310	KEE
1989 09 03.48	S	5.7	AA	8.0	B		11	3.5	6	0.25	270	SPR
1989 09 03.49	B	5.6	AA	5.0	B		10		9	7.0	300	MOR
1989 09 04.46	B	5.7	AA	4.0	B		8			3	310	KEE
1989 09 04.48	S	5.6	AA	8.0	B		11	3.5	7	1.5	265	SPR
1989 09 04.50	B	5.6	AA	5.0	B		10		9	7.0	303	MOR
1989 09 04.91	B	5.6	S	5.0	B		10	11	5/	&3	25	SZU
1989 09 05.12	B	5.4	AC	5.0	B		7	4	8			MOE
1989 09 05.14	S	5.2	SC	5.0	B		10	6.5	8			BOA
1989 09 05.21	S	5.3	AA	15	L	4	26	& 2	5			PER01
1989 09 05.21	S	5.4	AA	3.4	B		9	& 4	7/	0.3	290	PER01
1989 09 05.45	B	5.6	AA	4.0	B		8			2	310	KEE
1989 09 05.48	S	5.6	AA	8.0	B		11	3	8	0.5	270	SPR
1989 09 05.49	B	5.6	AA	5.0	B		10		9	6.0	303	MOR
1989 09 06.15	M	6.5	AA	8.0	B		15	2	8			MIK
1989 09 06.22	! S	5.2	AA	3.4	B		9	& 4	7			PER01
1989 09 06.35	! B	5.7	AA	5.0	B		7		8/	&3.5	308	GRE
1989 09 06.36	B	5.8	AA	3.5	B		7		8/			GRE
1989 09 06.37	B	5.9	AA	5.0	B		7					GRE
1989 09 06.49	S	5.5	AA	8.0	B		11	3	8	2.5	270	SPR
1989 09 07.10	B	5.5	AA	10.0	B		14		6	1.87	310	HAS02
1989 09 07.11	B	6.2:	S	5.0	B		7		7			SPE01
1989 09 07.12	B	6.1:	S	8.0	B		20	& 2.3	6	&0.1	305	SPE01
1989 09 07.49	S	5.7	AA	8.0	B		11	3	8	3	275	SPR
1989 09 07.51	B	5.9	AA	5.0	B		10		9	4.0	302	MOR
1989 09 08.2	S	5.5	A	5.0	B		12		7	1	330	KID
1989 09 08.23	M	6.2	AA	5.0	B		10	9	8	2	290	GAL

Periodic Comet Brorsen-Metcalf (1989o) [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 09 08.50	S	5.5	AA	8.0	B		11	3.5	8	4.5	280	SPR
1989 09 08.51	B	5.9	AA	5.0	B		10		9	6.0	306	MOR
1989 09 09.12	B	5.6	AC	5.0	B		7	3	8	0.5	300	MOE
1989 09 09.12	S	5.4	SC	8.0	B		11	3	8	1		SOS
1989 09 09.50	S	5.6	AA	8.0	B		11	3.5	8	4.5	280	SPR
1989 09 09.51	B	5.9	S	5.0	B		10		9	6.0	305	MOR
1989 09 10.51	B	5.9	S	5.0	B		10		9	5.0	305	MOR
1989 09 10.51	S	5.7	AA	8.0	B		11	4	8	4	280	SPR
1989 09 11.51	B	5.9	AA	5.0	B		10		9	6.0	306	MOR
1989 09 11.51	S	5.9	AA	8.0	B		11	4	8	3.5	280	SPR
1989 09 12.14	B	6.0:	AC	5.0	B		7	& 1.5	9			MOE
1989 09 12.51	S	5.9	AA	8.0	B		11	4	7	3	280	SPR
1989 09 13.51	B	6.2	AA	5.0	B		10		9			MOR
1989 09 13.51	B	6.2	AA	8.0	B		20		9	2.0	306	MOR
1989 09 14.14	S	5.8	AA	8.0	B		15	2.5	8	0.87	295	HAV
1989 09 14.48	B	6.1	AA	4.0	B		8			0.6	300	KEE
1989 09 14.51	B	6.3	AA	5.0	B		10		9			MOR
1989 09 14.51	B	6.3	AA	8.0	B		20		9	1.5	304	MOR
1989 09 15.48	B	6.3	AA	4.0	B		8					KEE
1989 09 15.49	M	6.4	AA	15.2	L	3	16	2	6	0.3	300	KEE
1989 09 18.22	! S	6.3:	AA	15	L	4	26	& 3	1/			PER01
1989 09 20.25	S	6.2	A	5.0	B		12					KID
1989 09 21.25	[	6.0:	A	5.0	B		12					KID

Periodic Comet Schwassmann-Wachmann 1

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 07 03.85	S	13.0	VN	20	L	4	190					PEA
1989 07 29.40	S	13.5	NP	25.6	L	4	156	1.0				MOR
1989 07 30.36	S	13.5	NP	50.8	L	4	195	1.1	0			MOR
1989 07 31.02	S	12.5:		29.8	L	5	62					KEI
1989 07 31.05	S	13.4	AC	20	L	10	167	1.5	2/			BOA
1989 07 31.45	S	13.4	NP	25.6	L	4	156	1.4	1			MOR
1989 08 05.47	S	13.2	NP	25.6	L	4	156	1.9	1			MOR
1989 08 06.31	S	13.3	NP	50.8	L	4	120	1.5	1/			MOR
1989 08 12.38	S	13.1	NP	25.6	L	4	156	1.5	1			MOR
1989 08 13.46	S	13.3	NP	25.6	L	4	156	1.1	1			MOR
1989 08 27.34	S	13.3	NP	25.6	L	4	156	1.5	0			MOR
1989 08 30.03	S	13.5	AC	40	L	5	333					BOA
1989 08 31.02	I	16.0	AC	40	L	5	170					MER
1989 09 02.30	S	13.3	NP	25.6	L	4	156					MOR
1989 09 03.94	S	14.0:	AC	36.0	T	11	434	0.2	4			KOR
1989 09 20.89	S	13.0:	AC	36.0	T	11	434					KOR
1989 10 01.08	S	12.8	GA	40.6	C	18	228	& 1	2			GRE

Periodic Comet Klemola (1987 XIV)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1987 06 27.72	S	12.9	AC	20	L	6	106	1.2				NAK01
1987 07 07.73	S	12.8	AC	20	L	6	106	1.1				NAK01
1987 07 26.71	S	12.7	AC	20	L	6	106	1.4	2/			NAK01
1987 08 17.60	S	12.7	AC	20	L	6	106	1.3				NAK01
1987 08 29.75	S	11.7	AC	25	L	5	82	1.4	1			WAT01
1987 09 14.59	S	11.6	AC	25	L	5	82	2.4	4			WAT01
1987 09 15.53	S	12.9	AC	25	L	5	82	1.0	3			WAT01
1987 09 19.69	S	13.0	AC	20	L	6	106	1.2				NAK01
1987 09 19.75	S	12.7	AC	25	L	5	82	1.7	2			WAT01
1987 09 20.48	S	12.9	AC	25	L	5	82	1.4	2			WAT01
1987 09 22.74	S	13.1	AC	25	L	5	82	1.3	6			WAT01

Periodic Comet Klemola (1987 XIV) [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1987 10 01.74	S	13.2	AC	25	L	5	82	1.4	3			WAT01
1987 10 03.72	S	14.2	AC	25	L	5	82	1.6	4			WAT01

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PERIODIC COMETS FOR THE VISUAL OBSERVER IN 1990

(Cont. from page 38)

P/Honda-Mrkos-Pajdušáková

After two successive unfavorable returns, this comet ($P = 5.3$ yrs) returns to perihelion under tolerably-good viewing conditions in 1990, at least for the northern hemisphere. Perihelion ($q = 0.54$ AU) occurs on Sept. 12; the comet will remain in the morning sky throughout this apparition. Like P/Encke, this comet brightens very rapidly as it approaches perihelion; thus, the first visual observations may occur about the beginning of August, the comet at that time being at its smallest geocentric distance (0.29 AU). By perihelion the comet should be about 8th magnitude, but will be fairly close to the sun in the sky (elongation $\sim 30^\circ$). After this, the elongation will gradually increase, but the comet should rapidly decrease in brightness; the last visual observations will probably occur about the end of October. This return is rather similar to that of 1969; a synopsis of visual observations at that return is given by Bortle and Scovil (1969).

At the present time, it seems likely that both the Sakigake and Giotto spacecraft will be sent for a flyby of this comet in early 1996 (cf. Green 1989). The comet will then be outbound from the sun, having passed perihelion late in 1995.

P/Tuttle-Giacobini-Kresák (1989b₁)

Chronologically, this is the first of 1990's fainter visual comets to pass perihelion ($T = \text{Feb. 8}$, $q = 1.07$ AU); it is also the most interesting but may be the most difficult to observe. The interest in this comet stems from its 1973 return, when a few days prior to its perihelion passage it experienced a 10-magnitude outburst (from magnitude 14 to 4). Although it settled back to its pre-outburst brightness within a couple of weeks, a month later it again rose to magnitude 5. (Details of the comet's behavior in 1973 may be gleaned from the article in *Sky Telesc.* 46, 144, 1973.) No unusual behavior was noted at the comet's 1978 return, when it remained poorly placed, and except for a couple of unconfirmed images the comet was not observed during its 1984 return. Although not especially favorable, the 1990 return is the best since 1973; the comet will remain in the morning sky throughout the apparition.

Because of the comet's past behavior, predicting its brightness at this return is difficult. It is possible that the comet may become visually observable in December 1989 or January 1990 at perhaps $m_1 \sim 13$; a peak brightness of $m_1 \sim 12.5$ might be expected around the time of perihelion, with subsequent fading. On the other hand, the comet may well be significantly fainter than this. Regardless, the comet's behavior in 1973 suggests that monitoring throughout this return would be very worthwhile.

P/Russell 3 (1989d)

Discovered in 1983, this comet ($P = 7.5$ yr) makes its first predicted return to perihelion in 1990. Perihelion occurs on May 17, at $q = 2.52$ AU. The comet has already been recovered, this being accomplished in January 1989 by Jim Gibson at Palomar.

The current return is very favorable, with opposition occurring less than two weeks after perihelion — although since the comet remains south of $\delta = -20^\circ$ for most of the apparition southern hemisphere observers will be somewhat more favored. Since no visual observations seem to have been made during the comet's discovery return, predicting its brightness in 1990 is somewhat difficult; however a single photographic estimate by Merlin (1983) suggests that a peak brightness of $m_1 \sim 12.5$ might be expected around the time of perihelion.

P/Peters-Hartley

This comet ($P = 8.1$ yrs) is also making its first predicted return in 1990. The expected perihelion date is June 21 ($q = 1.63$ AU) but, as was the case with P/Schwassmann-Wachmann 3, some uncertainty exists in this prediction. As long as the comet is not too far off track, its 1990 return should be the best since its original discovery in 1846.

Assuming the current prediction is reasonably correct, the comet will remain deep in the southern sky during the months prior to perihelion passage. Its visibility then will be probably be limited to the southern hemisphere; at opposition in late April the comet will still be as far south as $\delta = -52^\circ$. By the time of perihelion the declination will be -28° , which should make the comet visible (with some difficulty) to the northern hemisphere.

As with the above two comets, the peak brightness is difficult to predict. No visual observations seem to have been made at the previous return in 1982 (when, however, Hartley's discovery did not occur until two months after perihelion), but the photographic estimates made then suggest that the comet should reach at least 13th magnitude around the time of perihelion passage. On the other hand, the comet seems to have become at least as bright as 9th magnitude (and possibly brighter) during 1846 — when the perihelion date was similar to that of 1990 but the perihelion distance slightly smaller ($q = 1.50$ AU). Thus, it is remotely possible that the comet may become as bright as $m_1 \sim 10$.

P/Kearns-Kwee (1989u)

Perihelion passage for this comet ($P = 9.0$ yrs) occurs on Nov. 22, at $q = 2.22$ AU. As was the case with each of the three previously-observed returns of this comet, the viewing circumstances are quite favorable; opposition will occur in early Jan. 1991.

Despite this repetition of viewing geometry at successive returns, brightness analyses (cf. Morris 1983) suggest that the comet has been fading by 0.5-1.0 magnitude per return. Since the peak brightness at the preceding return (1981) did not exceed $m_1 \sim 13.5$, this trend does not bode especially well for visual observations at this return. Under the somewhat optimistic assumption that the trend will have abated somewhat since the last return, a peak brightness of $m_1 \sim 13-14$ might be expected around the end of 1990.

P/Wild 2 (1989t)

This comet ($P = 6.4$ yrs) passes perihelion on Dec. 16, at $q = 1.58$ AU. After being hidden behind the sun during the middle months of 1990, it emerges into the morning sky about October, and should at that time be within the range of visual instruments ($m_1 \sim 12$). Brightness analyses from earlier returns (Bortle 1978; Morris 1985) suggest that the brightness could reach 11th magnitude around the time of perihelion and peak at $m_1 \sim 10.5$ in early 1991. The comet may remain visible for some time, since opposition will not occur until June 1991.

This comet is currently the "back up" target for the *Comet Rendezvous/Asteroid Flyby (CRAF)* mission, currently slated for launch in 1995 and which may finally receive "new start" funding (cf. Green 1989). Observations of the comet during this moderately favorable return are thus very worthwhile. (Note: the primary comet for CRAF, P/Kopff, also passes perihelion in 1990. While it has already been recovered — as comet 1988k — and has been under astrometric observation, the 1990 return is extremely unfavorable as far as visual observations are concerned.)

P/Wolf-Harrington

Although not due at perihelion until Apr. 1991, this comet may become accessible to visual observers at $m_1 \sim 13$ during the last couple of months of 1990. Although the brightness may increase slightly in early 1991, the elongation will be steadily decreasing; by the time of perihelion passage, the comet will be a rather difficult object for observation.

P/Schwassmann-Wachmann 1

The 1989-90 viewing season of this annual comet, now outbound from its perihelion passage in Oct. 1989, will end about Feb. 1990. Following solar conjunction, the comet will emerge into the morning sky and begin the new viewing season near the beginning of June. Opposition will occur in the latter part of October, and the comet's position should remain accessible until Mar. 1991.

Since about 1987 the comet has been quite active, with at least two or three outbursts occurring every year. There have been suggestions in the past that a relationship may exist between solar activity and this comet's outbursts; if so, the fact that the current solar cycle — which has already been unusually strong — is expected to peak in 1990 suggests that several more outbursts are yet to come. As always, careful monitoring of the comet is worthwhile.

Although this survey is generally restricted to those short-period comets which may reasonably be expected to become brighter than $m_1 \sim 14$, observers with telescopes in the 30- to 50-cm range may wish to try finding some additional comets that are not expected to become this bright but which may nevertheless be worthwhile for visual observing attempts. Chief among these in 1990 are P/Johnson ($T = \text{Nov. 18}$) and P/Taylor ($T = \text{Dec. 28}$); no visual observations seem to have been attempted for these comets in several decades. Viewing conditions for P/Taylor are especially favorable, with opposition occurring in early Jan. 1991. Also worthwhile for attempts is P/Gunn, which has been well observed at its 1989 opposition; the total brightness should remain near $m_1 \sim 14-15$ for most of 1990, with opposition occurring in mid-September. A final target is P/Swift-Gehrels, making a rather unfavorable return in 1991 ($T = \text{Feb. 22}$), but which may reach magnitude ~ 15 near the end of 1990.

Observers may also wish to attempt observations of two objects normally classed as asteroids but which are often mentioned as candidates for being defunct or inert comets. First, there is (2060) Chiron, which has recently begun showing cometary characteristics (cf. Meech and Belton 1989) as it approaches its perihelion, due in Feb. 1996. The object is at opposition in early Jan. 1990, and should be accessible for the next several months. It is again visible at the end of the year, enroute to another opposition in Jan. 1991. The object should be about 15th or 16th magnitude, but unfortunately its position in the Gemini Milky Way will contribute to the difficulty of observation attempts.

Another such object is (944) Hidalgo, which passes perihelion on 1991 Apr. 1 ($q = 2.00$ AU), but which will be best placed for observation around the time of opposition in mid-Oct. 1990. The object should be about 14th magnitude around that time, fading to about 15th magnitude by the end of the year. Hidalgo is considered a candidate for a defunct comet primarily because of its orbit (Marsden 1970; also reviews by Kresák 1979; Degewij and van Houten 1979; Degewij and Tedesco 1982); however at the object's previous perihelion passage, no spectroscopic evidence for a cometary nature was observed (cf. Soderblom and Harlan 1976).

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The Last 25 Comets to Receive Provisional Letter Designations

Listed below, for handy reference, are the last 25 comets which have been given letter designations (1989a is the first comet to be discovered or recovered in 1989, 1989b is the second comet..., etc.). After the "equal sign" is given the name, preceded by an asterisk (*) if the comet is a new discovery (as opposed to a recovery from predictions of a previously-known short-period comet). Also given are such values as the orbital period (in years) for periodic comets, date of perihelion, T (month/date/year), and the perihelion distance, q (in AU). Four-digit numbers in the last column indicate the *IAU Circular* containing the discovery/recovery announcement. [This list updates the previous list in the January 1989 issue, p. 2.]

<i>Desig.</i>		<i>Comet</i>	<i>P</i>	<i>T</i>	<i>q</i>	<i>IAUC</i>
1989e	= *	Shoemaker		2/25/89	2.6	4717
1989f	= *	Shoemaker		11/2/88	2.2	4724
1989g	=	P/Pons-Winnecke	6.4	8/19/89	1.3	4736
1989h	=	P/Clark	5.5	11/28/89	1.6	4742
1989i	= *	P/Parker-Hartley	8.9	8/15/87	3.0	4752
1989j	= *	P/Shoemaker-Holt 2	7.8	9/4/88	2.7	4755
1989k	= *	P/West-Hartley	7.6	10/6/88	2.1	4784
1989l	=	P/du Toit-Neujmin-Delporte	6.4	10/18/89	1.7	4787
1989m	= *	SMM 8		6/2/89	0.0056	4793
1989n	=	P/Gehrels 2	7.9	11/3/89	2.3	4800
1989o	=	P/Brorsen-Metcalf	71	9/11/89	0.48	4804
1989p	=	P/Lovas 1	9.1	10/10/89	1.7	4813
1989q	= *	SMM 9		7/8/89	0.0046	4815
1989r	= *	Okasaki-Levy-Rudenko		11/11/89	0.64	4840
1989s	= *	Helin-Roman		8/20/89	1.3	4846
1989t	=	P/Wild 2	6.4	12/16/90	1.6	4860
1989u	=	P/Kearns-Kwee	9.0	11/22/90	2.2	4866
1989v	= *	Helin-Roman-Alu		12/15/89	1.05	4869
1989w	= *	P/Helin-Roman-Alu 1	9.6	11/8/87	3.7	4872
1989x	= *	SMM 10		9/28/89	0.005	4884
1989y	= *	P/Helin-Roman-Alu 2	9.0	10/31/89	1.9	4886
1989z	=	P/Sanguin	12.5	4/2/90	1.8	4903
1989a ₁	= *	Aarseth-Brewington		12/28/89	0.31	4907
1989b ₁	=	P/Tuttle-Giacobini-Kresak	5.5	2/8/90	1.1	4908
1989c ₁	= *	Austin		4/10/90	0.35	4919