INTERNATIONAL COMET QUARTERLY

Whole Number 78 APRIL 1991 Vol. 13, No. 2

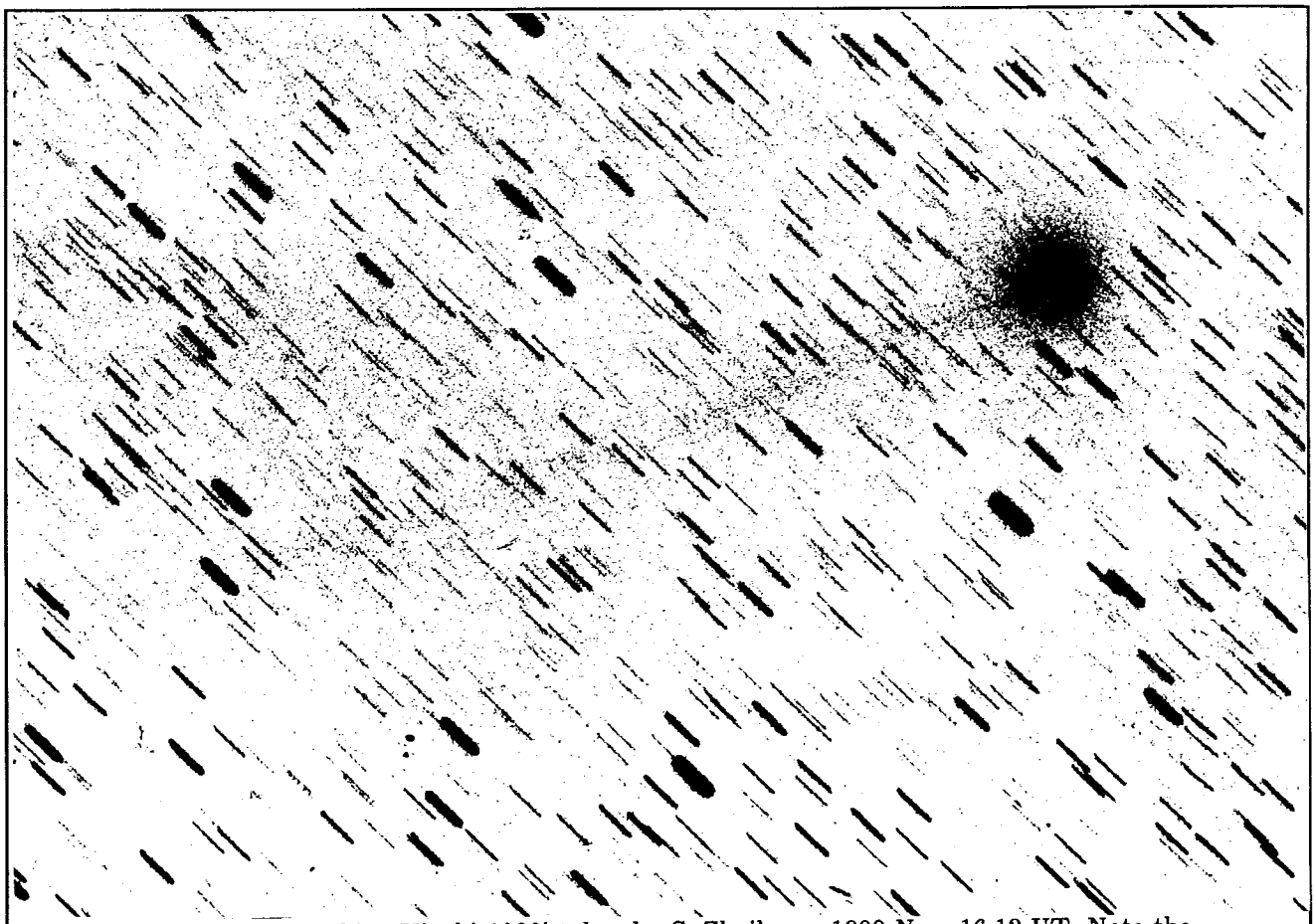

Photo of comet Tsuchiya-Kiuchi 1990i taken by S. Zhuiko on 1990 Nov. 16.12 UT. Note the faint, narrow tail pointing toward the lower left on this 60-sec exposure (details on p. 71).

SMITHSONIAN ASTROPHYSICAL OBSERVATORY
60 Garden Street · Cambridge, MA 02138 · U.S.A.

The International Comet Quarterly (*ICQ*) is a journal devoted to news and observation of comets, published by the Smithsonian Astrophysical Observatory in Cambridge, Massachusetts. Regular issues are published 4 times per year (January, April, July, and October), with an annual *Comet Handbook* of ephemerides published normally in the first half of the year as a special fifth issue. An index to each volume normally is published in every other January issue (even-numbered years); 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$20.00 per year (rate is $12.00 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 (and drawn on a U.S. bank) 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 "current" *Comet Handbooks*, which are available for $10.00 ($8.00 to subscribers if ordered with their *ICQ* subscription; see above). Up-to-date information concerning comet discoveries, orbital elements, and ephemerides can be obtained by subscribing to the *IAU Circulars* and/or the *Minor Planet Circulars* (via postal mail and also available via computer access); for further information, contact the *ICQ* Editor at the above address.

Manuscripts will be reviewed for possible publication (if possible, send via computer networks; or, send typed, double-spaced copy to the Editor at the Cambridge address above); authors should first obtain a copy of "Information and Guidelines for Authors" from the Editor. Cometary observations also should be sent to the Editor in Cambridge; all data intended for publication in the *ICQ* that is not sent via computer electronic mail should be sent on standard *ICQ* observation report forms, which can be obtained upon request from the Editor. Those who can send manuscripts and observational data in machine-readable form are encouraged to do so [especially through e-mail via the computer networks *BITNET* (GREEN@CFA) or *SPAN* (CFAPS2::GREEN), or via floppy disks that can be read on an IBM PC], and should contact the Editor for further information.

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This issue is No. 78 of the publication originally called *The Comet* (founded March 1973) and is Vol. 13, No. 2, of the *ICQ*. *[ISSN 0736-6922]*

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COMET BRADFIELD 1987 XXIX

Dietmar Boehme of Nessa in eastern Germany has sent the following photoelectric measures of this comet made with a 25-cm *f*/13 Cassegrain telescope (diaphragm size 190″):
1988 Jan. 9.76 UT, V = 8.09, $B-V$ = +0.77; Jan. 11.80, 8.44, +0.61; Jan. 12.77, 8.39, +0.68; Jan. 13.74, 8.48, +0.69; Jan. 14.78, 8.55, +0.77; Jan. 19.75, 8.79:, +0.80:; Jan. 20.76, 8.87, +0.70.

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— CORRIGENDA —

• In the October 1990 issue, page 170, under 'Other New Discoveries', first line, *for* comet of photographs *read* comet on photographs

• In the January 1991 issue, several observations by MOR had the exclamation mark in the wrong column (it should be moved two columns to the right): (1) Comet 1990i, page 56, 1990 08 12.18; (2) Comet 1989d$_1$, page 59, 1990 06 23.45 and 1990 06 30.45; (3) Comet 1990f, page 59, 1990 09 02.50; Comet 1989t, page 60, 1990 10 14.53; Comet 1990d, page 61, three observations.

• In the January 1991 issue, p. 56, the Dec. 24 observation of comet Levy 1990c by DEA has the wrong time: *instead of* 1990 12 24.32 *read* 1990 12 24.28

RECENT NEWS AND RESEARCH CONCERNING COMETS

The year 1991 has started out at a record pace for discoveries and recoveries of comets, with 12 found by the third week in March, the latest being a 14th-magnitude comet found by Eleanor F. Helin and Kenneth J. Lawrence at Palomar on Mar. 17 films. Comet Helin-Lawrence 1991*l* apparently will not pass perihelion until early next year (q = 1.9 AU), so it should continue slowly to brighten over the coming months as it moves southward, perhaps reaching 8th magnitude in early January 1992 (when it will only be a few degrees from the south celestial pole). Comet 1991*l* may still be visible in amateur telescopes past mid-1992, when it will again be visible for northern-hemisphere observers.

A little over 43 years after finding his first comet, Antonín Mrkos discovered his thirteenth comet on plates taken at Kleť Observatory in Czechoslovakia on Mar. 16-17 UT. He is one of the few observers who have discovered comets both visually and photographically, and few individuals have continued to make discoveries over so long a span of years. Mrkos sent a telex reporting the comet as a fast-moving object, without noting any diffuseness. After Eleanor Helin at Palomar was asked to photograph the object with the 18-inch Schmidt, she noted that her Mar. 18 films showed the object as somewhat diffuse. Other observers also noticed a slight coma around the obviously-strong condensation, and when Mrkos forwarded his precise measurements to the Central Bureau for Astronomical Telegrams he noted the object as being diffuse with central condensation. The object was then designated comet 1991k, and visual observations in the third week of March by Alan Hale and David Seargent place the comet at $m_1 \sim 13.8$, appearing as a faint star with slight diffuseness or softness. Numerous astrometric observations were made during the first week after discovery, showing the comet to be of short-period (P = 5.8 yr), and it is now called P/Mrkos. Comet 1991k passed perihelion during the week after discovery (q = 1.4 AU) and should now fade in brightness.

Other New Discoveries

On page 66 of the January issue, at the start of the fifth paragraph, I mentioned "P/Shoemaker 3" — this *should read* P/Shoemaker-Levy 3 (1991e). Comet 1991f turned out to be P/Shoemaker-Levy 4, with P = 6.7 years. Shortly after the announcement of comet 1991f, Robert Houston McNaught reported his discovery of comet 1991g on a U.K. Schmidt telescope plate taken by Kenneth S. Russell at Siding Spring (New South Wales, Australia). Comet McNaught-Russell was then at $m_1 \sim 16.5$ and should fade slowly over the next few months, having passed its large perihelion distance of q = 4.8 AU last October.

New Recoveries

P/Takamizawa, P/Kowal 1, and P/Hartley 1 were recovered as comets 1991h, 1991i, and 1991j, respectively. P/Takamizawa was −0.5 day off from the predicted position in its orbit, P/Kowal 1 was some 3° away from its prediction, and P/Hartley 1 was so far off its prediction position ($\sim$ 16°) that it was reported as a new discovery by Carolyn and Eugene Shoemaker and David Levy at Palomar. Brian G. Marsden identified this latest Shoemaker-Levy discovery as being P/Hartley 1 before an announcement was made, so the name remains unchanged (cf. *IAUC* 5209). Comet 1991j was near m_1 = 16.5-17 upon re-discovery. James V. Scotti (Lunar and Planetary Lab, University of Arizona) recovered P/Takamizawa and P/Kowal 1 with the 91-cm Spacewatch CCD telescope at Kitt Peak in mid-February, at m_1 = 19.6 and 18.4, respectively. All three of these recovered comets are making their first observed return to perihelion after the discovery apparition.

P/Halley and 'Minor Planet' 1991 DA

P/Halley returned to the news in February, when a significant outburst in brightness was reported by O. Hainaut, A. Smette, and Richard M. West of the European Southern Observatory. When last seen in early 1990 by West, the comet had shown an essentially stellar appearance, with magnitude $V \sim 24$. From Feb. 12 to Mar. 18, the coma gradually faded from $m_1 \simeq 19$ to $\simeq 20$, with its size being reported as nearly 40″. Besides being well observed at ESO in Chile, observations of this outburst were also made by Karen Meech at Mauna Kea in Hawaii and by C. Buil *et al.* at Pic du Midi in France (cf. *IAUC* 5189, 5196, 5202, 5206, 5213, 5217).

An unusual fast-moving object was found by McNaught on a U.K. Schmidt plate taken Feb. 18 (cf. *IAUC* 5193). What is so unusual about this object, known as minor planet 1991 DA, is that it has a 40-year period and an aphelion distance of Q = 22 AU (q = 1.58 AU), so it crosses the orbits of Jupiter, Saturn, and Uranus, and has perihelion near the heliocentric distance of Mars' orbit. For years after discovery, 1991 DA will remain far south ($-65° < \delta < -74°$ during most of this year), only coming north of the celestial equator for a short time prior to perihelion passage (next to occur around 2030). Its orbit is inclined to the ecliptic by some 62° and is very much like a comet orbit. However, attempts to find a coma at Siding Spring and at ESO in Chile (via photography and CCD) have proved negative. Perhaps its proximity at perihelion to the orbit of Mars has something to do with the evolution of 1991 DA's orbit. How many more unusual objects are lurking out there in the solar system?

1992 Comet Handbook

The *ICQ*'s *1992 Comet Handbook*, edited by Syuichi Nakano and Daniel Green, is now available. *ICQ* subscribers may purchase one copy per subscription for $8.00; additional copies for subscribers, and all copies for non-subscribers, may be purchased for $10.00 each. (Group rates are available for bulk purchase.)

— *Daniel W. E. Green (1991 March 25)*

TABULATION OF COMET OBSERVATIONS

A complete list of the Keys to abbrevations used in the *ICQ* is available from the Editor for $4.00 postpaid.

New codes to the 'Instrument Key' are:
H = hyperboloid astro-camera; W = Wright-Schmidt telescope

Descriptive Information (to complement the Tabulated Data):

◇ *Comet Ikeya-Seki 1965 VIII [all observations by BOR; these are corrections to what was published in the January issue, pp. 3-4, sent by Bortle on 1991 Mar. 16; what appeared in the January issue was taken directly from A.L.P.O. Comets Section report forms filled out by Bortle back in 1965]* ⟹ 1965 Oct. 30.42: the statement that the "tail was relatively straight out to ~ 13°-14°, at which point it suddenly bent northward (via a gentle, not a sharp, curve)" is incorrect, because that morning the bend in the comet's tail was strikingly abrupt, similar but not quite as drastic as that in a hockey stick; on preceding and following mornings, the transition from straight to curved was much more subtle. Nov. 2.42 and 5.42: the width of the tail at its terminus is given as ~ 1°.34; the original observing notes give 1°.75. Nov. 15.43: details regarding the appearance of the coma are confused and should read: "Coma elongated ~ 90°-270° (length 2'.5); w/ averted vision, there appear to be two comae superimposed, their centers separated by ~ 1'; at the center of the more sunward mass could be seen, w/ averted vision, a faint starlike nucleus of mag 8-9; the sunward mass was slightly brighter and slightly larger, of dia. 1'.5-1'.75; neither mass was very condensed; w/ averted vision, a third cond. was suggested further out in the tail and S of its axis — it was very faint and smaller than the other two."

◇ *Comet Skorichenko-George 1989e*$_1$ ⟹ 1990 Sept. 27.49: "interference from low altitude, skyglow and faint twilight" [HAL]. Oct. 27.50: "mediocre transparency; interference from skyglow" [HAL].

◇ *Comet Levy 1990c* ⟹ 1990 July 20.96: bright central cond. [KAM01]. July 25.96: in 20.3-cm T, very pronounced central cond., displaced to NE; faint, broad tail [KAM01]. Aug. 12.93: very pronounced central cond.; broad tail [KAM01]. Aug. 16.93: in 4.0-cm R (10×), 30′ tail in p.a. 59° [LOO01]. Aug. 17.97: bright inner coma w/ extended outer coma; possible extension of 0°.2 length toward p.a. ~ 90° [KAM01]. Aug. 18.17: in 20.0-cm *f*/5 L (35×), 7′ coma, DC = 7, 0°.25 tail subtends ~ 20° of p.a. [MOD]. Aug. 22.05: in 4.0-cm R (10×), 2° tail in p.a. 77° [LOO01]. Aug. 23.87: in 8×40 B, 0°.4 tail in p.a. 80° [SCH04]. Aug. 23.90: brilliant central cond.; type-II fan-shaped tail spanning p.a. 42°-110°, brightest at these two extreme p.a.s; type-I tail is at p.a. 110° [KAM01]. Aug. 24.96: tail weaker than previously; tail at p.a. 70° is type-I, straight and narrow; 0°.5 type-II tail spans p.a. 55°-85° [KAM01]. Aug. 25.12-25.15: in 20.0-cm *f*/5 L (35×), 8′ coma, DC = 7, 0°.5 tail in p.a. 95°; in 10×50 B, 30′ tail in p.a. 65°, subtending ~ 20° [MOD]. Aug. 27.24: in 10×50 B, 0°.7 tail in p.a. 70°, subtending ~ 20°; in 20.0-cm *f*/5 L (35×), 7′ coma, DC = 7, 0°.5 and 0°.25 tails in p.a. 87° and 70° — latter tail brighter than former tail [MOD]. Aug. 30.25: in 20-cm L (167×), stellar central cond. of m_2 = 9.5 ± 0.2 [MOD].

Sept. 1.09: in 20.0-cm *f*/5 L (35×), 4′ coma, DC = 7 [MOD]. Sept. 10.07: in 20-cm L (167×), stellar central cond. of m_2 = 10.2 ± 0.2 [MOD]. Sept. 20.11: "sky conditions poor — cirrus, mediocre transparency" [HAL]. Sept. 25.08: "low altitude" [HAL]. Oct. 6.43: 3°.5 tail in p.a. 100°; dust tail curved to S [CAM03]. Oct. 10.40: in 20×80 B, 0°.6 tail in p.a. 130° [WIL02]. Oct. 13.40: in 20×80 B, 0°.8 tail in p.a. 130° [WIL02]. Oct. 16.41: in 20×80 B, 0°.8 tail in p.a. 140° [WIL02]. Nov. 16.73: in 20.3-cm *f*/7.2 L, "comet is still well condensed at mag 6-7 with some hint of tail"; bright sky [CAM03]. Nov. 18.71: in 20.3-cm *f*/7.2 L (35×), m_1 ~ 7, coma dia. ~ 2′-3′, DC = 6, tail several arcmin long in p.a. 110° [CAM03]. Nov. 20.73: low in twilight; in 20.3-cm *f*/7.2 L (35×), m_1 ~ 7, coma dia. ~ 2'.5, DC = 7, 0°.5 tail in p.a. 110° [CAM03]. Nov. 23.71: in 15.2-cm L (47×), very sharp false nucleus; broad fan tail [SEA]. Nov. 24.72: in 20.3-cm *f*/7.2 L (35×), 2′ coma, DC = 7; 30′ tails in p.a. 270° and 290°, and seem to curve toward S [CAM03]. Dec. 10.53: "low altitude, twilight" [HAL]. Dec. 11.68: close to star [SEA]. Dec. 18.53: "in 41-cm L, the comet exhibits a moderately strong cond., although this is not as intense as it was prior to perihelion" [HAL]. Dec. 24.73: 10-min exposure on T-Max 400 film w/ 135-mm *f*/3.5 lens shows 2′ coma of mag 7 and 30′ tail in p.a. 280° [CAM03]. Dec. 25.54: "in 41-cm L, a broad, featureless tail toward the NW was suspected" [HAL].

1991 Jan. 7.55: in 20×80 B, m_1 = 7.5, coma dia. 3′, DC = 6, 30′ tail [CAM03]. Jan. 13.54: "tail was faint and broad; in 25.6-cm L, no stellar cond. was present" [MOR]. Jan. 19.52: in 20×80 B, anti-tail was spike-like; in 25.6-cm L (45×), there was a fan that began at the edge of the anti-tail and wrapped around toward p.a. 180°; main tail was almost invisible in the 25.6-cm L; at 156×, a non-stellar circular cond. was seen [MOR]. Jan. 21.60: in 25.4-cm *f*/4.5 L (71×), broad, faint 0°.5 tail in p.a. ~ 235° [SEA]. Feb. 4.48: in 15×80 B, sharp central cond. [SEA]. Feb. 9.27: comet low, sky bright [GRE]. Feb. 9.33: "anti-tail has faded significantly; in 25.6-cm L (156×), comet has a non-stellar cond." [MOR]. Feb. 10.29: "comet slightly elongated in a roughly N-S direction" [CHE]. Feb. 13.46: "very sharp, small cond.; comet seemed clearer through Swan Band filter than previously" [SEA]. Feb. 17.95: 9-min exp. with 0.2-m *f*/2 Baker-Schmidt Camera on TP 2415 gas-hypered film shows coma dia. 7′, DC = 5, stellar-like nucleus; coma fanned 0°.2 to p.a. 20°; tail 1°.3 to p.a. 158° [MIK]. Feb. 17.98: "with an ST-4 192×165 CCD detector on 0.2-m *f*/2 Baker-Schmidt, four consecutively-taken, co-added, unfiltered frames of 390 sec total duration show coma dia. 12′, DC = 7, straight broad tail 0°.3 in p.a. 160°; the tail is cut at the frame margins and probably extends even beyond them" [MIK]. Feb. 18.58: in 15×80 B, tail ~ 2° long [SEA]. *(Continued...)*

(Continued from previous page) Mar. 6.07: "in 32-cm L, coma appears elongated in p.a. 150°/330°, w/ area of greatest cond. offset toward p.a. 330°; sharp, nearly stellar nucleus (of mag ~ 11) heavily involved w/ surrounding coma material; at 110×, nucleus remains almost stellar, < 0'.1 in dia. and very strong" [BOR]. Mar. 7.44: more easily seen using Swan band filter [SEA]. Mar. 9.06: "in 32-cm L, coma boundaries unusually vague, w/ possible faint outer halo; coma rather suddenly condensed very near the center; occasional vague suggestions of coma extensions toward p.a. 150°; at 110×, a minute stellar or nearly stellar nucleus of mag ~ 12.5 was centered within a small, bright knot of material" [BOR]. Mar. 10.09: "in 31.7-cm *f*/6 L (55×), 5'.1 coma, DC = 4; circular coma was quite noticeably condensed w/ a faint, tenuous, outer halo; a minute false nucleus was at the center of the coma's area of greatest cond.; at 110×, the false nucleus was ~ 0'.1 in size and heavily involved w/ surrounding coma material" [BOR]. Mar. 12.06: "in 31.7-cm *f*/6 L (55×), 5'.4 coma, DC = 4; circular, fairly well condensed coma w/ a minute 12th-mag nucleus — very distinct — at its center; coma condenses steadily from the edges to the center; at 110×, nucleus is not quite stellar, ~ 0'.1 in size and very obvious" [BOR]. Mar. 13.08: "in 20×80 B, fairly bright, circular coma, quite noticeably condensed toward the center, boundaries vague; in 31.7-cm *f*/6 L (55×), 5'.4 coma, DC = 4, coma condenses to a bright center containing a tiny, apparently stellar nucleus of mag ~ 12; at 110×, false nucleus is ~ 0'.1 in dia. and strong; immediately adjacent is a small star of similar brightness over which the comet is passing" [BOR].

◇ *Comet Tsuchiya-Kiuchi 1990i* ⟹ 1990 Oct. 3.49: "interference from low altitude, twilight, and moonlight" [HAL]. Oct. 12.8: in 20×80 B, m_1 = 7.5, coma dia. 5', DC = 7 [CAM03]. Oct. 17.40: in 20×120 B, coma dia. 3'.5, DC = 5 [BOR]. Oct. 17.49: "in 41-cm L, coma appears slightly extended in anti-solar direction, although there is no sign of a true tail" [HAL]. Oct. 21.41: in 20×120 B, coma dia. 3'.2, DC = 5 [BOR]. Oct. 23.49: "in 41-cm L, a short, broad, featureless tail was suspected, but this is very vague and appears as little more than an extension of the coma" [HAL]. Oct. 24.18: in 20.3-cm *f*/10 T (51×), coma dia. 3'.2, DC = 5-6 [KAM01]. Nov. 15.41 and 18.44: in 35.9-cm *f*/7 L (85×), coma dia. 3', DC = 4 [MOD]. Nov. 16.12: 60-min exp. on ORWO ZU-21 emulsion w/ 40-cm *f*/4 double astrograph of Crimean Astrophysical Observatory shows type-I tail ~ 1°.2 long in p.a. ~ 290° [ZHU]. Nov. 16.43: in 35.9-cm *f*/7 L (85×), coma dia. 3', DC = 4; stellar central cond. of m_2 ~ 11-12 [MOD]. Nov. 16.7: in 20×80 B, comet very diffuse; coma dia. 8'-10'; m_1 ~ 7.5 [CAM03]. Nov. 17 and 18: observations made at the Majdanak Mountain Station showed a planet-like disk that was one-third of the total coma dia. of ~ 18' [KOR01]. Nov. 17.12: 45-min exp. on ORWO ZU-21 emulsion w/ 40-cm *f*/4 double astrograph of Crimean Astrophysical Observatory shows that the tail had decreased to a length of ~ 1° and looked more diffuse than on Nov. 16.12 (see above); comet was also ~ 0.5 mag fainter than on Nov. 15 and 16 [ZHU]. Nov. 20.70: in 20×80 B, m_1 ~ 7.5, coma dia. 8', DC = 4 [CAM03]. Nov. 21.12: 46-min exp. on ORWO ZU-21 emulsion w/ 40-cm *f*/4 double astrograph of Crimean Astrophysical Observatory shows that the tail visible on Nov. 16 and 17 (see above) was no longer visible [ZHU]. Nov. 24.60: in 20.3-cm *f*/7.2 L (35×), coma dia. 5'.5, w/ 3'.5 inner coma; m_1 ~ 7.5 [CAM03]. Nov. 27.51 and Dec. 18.29: "comet is large and diffuse" [HAL]. Dec. 5.42: in 15.2-cm L (47×), more readily visible w/ Swan Band filter [SEA]. Dec. 7.58: in 20.3-cm L, coma dia. 2'.5; in 20×80 B, coma dia. 4'-5' [CAM03]. Dec. 24.70: 10-min exposure on T-Max 400 film w/ 135-mm *f*/3.5 lens shows comet as a diffuse object of dia. 1'-2', DC = 2, mag 9-10 [CAM03]. 1991 Jan. 3.48: in 20.3-cm *f*/7.2 L (35×), m_1 = 10-10.5, coma dia. = 3'-4', DC = 0; stars of mag 10-11 were seen through the center of the coma [CAM03]. Jan. 7.58: in 20.3-cm *f*/7.2 L (35×), m_1 = 10, coma dia. = 2'-3', DC = 0 [CAM03]. Jan. 8.51: in 20.3-cm *f*/7.2 L (35×), m_1 = 10, coma dia. = 2', DC = 0 [CAM03]. Jan. 8.56: in 20×80 B, m_1 = 9, coma dia. 4', DC = 0 [CAM03].

◇ *Comet Arai 1991b* ⟹ 1991 Jan. 8.56: w/ 20.3-cm *f*/7.2 L (56×), m_1 ~ 11, coma dia. 2', DC = 4; w/ 20×80 B, m_1 ~ 10, coma dia. 3', DC = 3 [CAM03]. Jan. 11.21: coma diameter with Lumicon comet filter = 7' [MOR]. Jan. 13.27: "coma extended toward south; coma dia. using Lumicon comet filter = 4'.7; at 67×, there is a stellar cond. that disappears as magnification is increased" [MOR]. Jan. 16.00: with an unfiltered ST-4 192×165 CCD detector on 0.2-m *f*/2 Baker-Schmidt, 120-sec exp. shows coma dia. 2'.4, DC = 7, central cond. of dia. 1'.1; straight, narrow 3'.5 tail in p.a. 226° [MIK]. Jan. 16.02: 8-min exp. with 0.2-m *f*/2 Baker-Schmidt Camera on TP 2415 gas-hypered film shows coma dia. 3'.4, DC = 7 [MIK]. Jan. 16.20: "very faint outer envelope" [BOR]. Jan. 19.22: "with an unfiltered ST-4 192×165 CCD detector on 0.2-m *f*/2 Baker-Schmidt, 90-sec exp. shows coma dia. 2'.4, DC = 6; central cond. of dia. 0'.8; no tail detected" [MIK]. Feb. 3.86: "with an unfiltered ST-4 192×165 CCD detector on 0.2-m *f*/2 Baker-Schmidt, 300-sec exp. shows coma of dia. 3'.7, DC = 5" [MIK]. Mar. 9.20: "comet suspected as a brightening of DC = 0 in the field" [MOR].

◇ *Periodic Comet Wild 2 (1989t)* ⟹ 1990 Sept. 18.49: "the comet was located 15' NE of comet 1990f; the elongation was small and there was interference from low altitude, twilight, and zodiacal light; a couple of faint candidates were suspected, but could not be confirmed; it is unlikely either was the comet" [HAL]. Sept. 27.49: "interference from low altitude and twilight" [HAL]. Oct. 17.50: "this observation confirms a suspected observation made on Oct. 16.50 under relatively poor sky conditions" [HAL]. Oct. 30.51: "comet quite faint and vague" [HAL]. Nov. 27.53: "observation difficult due to high winds" [HAL]. Dec. 20.43: "small, dense" [BOR]. 1991 Jan. 16.20: 7-min exp. with 0.2-m *f*/2 Baker-Schmidt Camera on TP 2415 gas-hypered film failed to detect the comet under very good conditions; two galaxies of mag 12 clearly visible on negative [MIK].

◇ *Periodic Comet Kearns-Kwee (1989u)* ⟹ 1990 Sept. 18.47: "rich star field; this was generally true for all observation attempts" [HAL]. Nov. 10.29: "sky transparency only fair; also, the comet was close to a star of m_v ~ 10" [HAL]. Nov. 19.38: "comet very faint and small; fairly condensed" [HAL]. Dec. 19.27: "poor seeing" [HAL]. Dec. 25.50: "comet appears somewhat brighter and larger than during previous observations" [HAL].

◇ *Periodic Comet Wolf-Harrington (1990e)* ⟹ 1990 Oct. 13.25: "comet close to star of m_v ~ 10" [HAL]. Dec. 19.08: "comet fairly close to moderately bright (m_v ~ 10) star" [HAL].

Descriptive Information (continued)

◇ *Periodic Comet Honda-Mrkos-Pajdušáková (1990f)* ⟹ 1990 Sept. 17.49: "the coma's overall appearance in 41-cm L is similar to that of a distant globular cluster (*e.g.*, NGC 2419); although the coma is very 'dense', higher magnification did not reveal a true cond.; the tail is faint, but definite, and is straight" [HAL]. Sept. 18.49: "this observation was hurried, due to preoccupation with a search for comet 1989t (located 15′ NE); the telescopic appearance of the comet was quite similar to that of the previous morning" [HAL]. Sept. 26.49: "in 10×50 B, the comet appears as little more than a faint star; in 41-cm L the comet's appearance is similar to that on Sept. 17 and 18; the tail is fainter and shorter" [HAL]. Sept. 28.43: at 88×, DC = 5, stellar central cond. of $m_2 \sim 10$ [MOD]. Oct. 13.49: "background sky fairly bright (crescent moon, early twilight); the comet is vague and hard to discern" [HAL]. Oct. 18.50: "low altitude" [HAL].

◇ *Periodic Comet Mueller 2 (1990j)* ⟹ 1990 Sept. 26.44: "observation attempted through (possibly) thin clouds" [HAL].

◇ *Periodic Comet Holt-Olmstead (1990k)* ⟹ 1990 Sept. 26.45: "observation attempted through (possibly) thin clouds" [HAL].

◇ *Periodic Comet Taylor (1990n)* ⟹ 1990 Dec. 10.30 and 20.09: rich star fields [HAL].

◇ *Periodic Comet Shoemaker-Levy 1 (1990o)* ⟹ 1990 Dec. 7.18: "comet is faint, vague and diffuse" [HAL].

◇ *Periodic Comet Metcalf-Brewington (1991a)* ⟹ 1991 Jan. 8.98: "in 10×50 B, a bright and obvious object; in 20×80 B, 4′.8 coma, DC = 5, rather sharply condensed and condensing steadily to the center; in 32-cm L, a bright, dense central region of dia. 1′.3, suggestive of an outburst envelope; a Lumicon comet filter does not noticeably alter the comet's brightness/appearance; at 110×, suggestion of a probably-near-stellar, very faint nucleus" [BOR]. Jan. 9.44: "more clearly visible w/ Swan band filter" [SEA]. Jan. 11.10: "a nearly stellar cond. fades to a round disk with increasing magnification using 26-cm *f*/4.5 L (45×-156×); Lumicon comet filter helps slightly" [MOR]. Jan. 11.44: "central cond. not as conspicuous [as on Jan. 9.44]" [SEA]. Jan. 13.16: "tail was broad and faint" [MOR]. Jan. 13.98: "in 20×80 B, comet seems much more diffuse than on the 8th; coma appears only slightly condensed; in 32-cm L, coma is distinctly changed — much less defined, more diffuse; coma condenses from edges to the center, rather than only w/in the cond. as on the 8th; very vague, thin tail suspected occasionally toward the E" [BOR]. Jan. 15.98: "in 20×80 B, comet now extremely faint, but sky not as good as previously; in 31.7-cm *f*/5.6 L (55×), coma dia. 5′.1, DC = 2, comet seems quite diffuse and boundaries cannot be defined w/ any certainty; central region still somewhat dense" [BOR]. Jan. 17.98: "in 20×80 B, comet appears moderately bright in a much better sky than on the 15th; in 32-cm L, bright, noticeably condensed coma condenses steadily from the edges to the center; at 110×, there is the impression that a new envelope might be present w/in the coma, amounting to ~ 1/3 of its total dia.; tiny non-stellar nucleus, heavily involved w/ coma material" [BOR]. Jan. 18.82: 7-min exp. with 0.2-m *f*/2 Baker-Schmidt Camera on TP 2415 gas-hypered film shows coma dia. 2′.6, DC = 8; broad, fan-shaped tail 0°.35 long in p.a. 60° [MIK]. Jan. 19.10-21.12: "appears to be much activity in coma, w/ possible streamers"; however, not much activity was evident on Jan. 26.12 [SPR]. Jan. 19.14: "using 26-cm L (156×), there was a faint stellar cond.; coma had blue tint" [MOR]. Jan. 19.98: "in 32-cm L, coma once again condenses steadily from the edges to the center; no nucleus or separate central cond. visible at 68× or 110×; vague, faint, narrow raylike tail suggested at p.a. 70°, but length is very uncertain" [BOR]. Jan. 31.75: "with an unfiltered ST-4 192×165 CCD detector on 0.2-m *f*/2 Baker-Schmidt, 60-sec exp. shows coma dia. 1′.5, DC = 8" [MIK].

Feb. 2.99: "in 32-cm L, comet is slightly enhanced w/ Lumicon comet filter; at 110×, coma seems rather suddenly condensed near center — no nucleus" [BOR]. Feb. 3.82: "with an unfiltered ST-4 192×165 CCD detector on 0.2-m *f*/2 Baker-Schmidt, 120-sec exp. shows coma dia. 2′.0, DC = 7" [MIK]. Feb. 4.00: "in 32-cm L, coma is noticeably condensed toward the center; small brightness plateau at heart of coma; no nucleus at 110×" [BOR]. Feb. 17.81: "comet close to α Psc, affecting estimate" [MIK].

◇ *Periodic Comet Encke* ⟹ 1990 Sept. 24.41: at 88×, central cond. offset ~ 30″ from center of coma, in p.a. 265° [MOD]. Oct. 1.39: in 31.7-cm *f*/6 L (55×), coma dia. 2′.3, DC = 4 [BOR]. Oct. 1.43: some twilight and light haze present; in 40-cm L (100×), central cond. offset ~ 30″ from center of coma, in p.a. 280°; 0°.02 tail in p.a. 100° [MOD]. Oct. 2.43: in 35.9-cm L (86×), almost stellar central cond. of mag 10 or 11, offset 45″ from center of coma in p.a. 275°; 0°.02 fan-shaped tail in p.a. 85° [MOD]. Oct. 3.51: "some interference from twilight" [HAL]. Oct. 5.42: at 88×, stellar central cond. of mag 10 or 11, offset ~ 30″ from center of coma in p.a. 300°; DC = 5; 0°.02 tail in p.a. 120° [MOD]. Oct. 11.49: "brightness estimate difficult due to comet's proximity to two bright stars" [HAL]. Oct. 13.50: "in 41-cm L, the beginning of a short, faint tail to the W was suspected" [HAL]. Oct. 16.41: in 20×120 B, coma dia. 2′.2, DC = 7-8 [BOR]. Oct. 17.41: in 20×120 B, coma dia. 1′.5, DC = 7-8 [BOR]. Oct. 17.44: at 88×, almost stellar central cond. of mag 9.5 [MOD]. Oct. 17.51: "the brightness estimate was inadvertently made while observing with a Lumicon Swan Band filter" [HAL]. Oct. 18.51: "some interference from twilight and low altitude" [HAL]. Oct. 22.51: "low altitude, fairly bright twilight; little more than the central cond. is visible" [HAL].

◇ *Periodic Comet Schwassmann-Wachmann 1* ⟹ 1990 Sept. 25.25: "comet appears slightly larger and more diffuse than it did earlier in Sept." [HAL]. Oct. 2.41: "comet's visibility strongly suspected" [MOD]. Oct. 10.16: "comet's position close to star of $m_v \sim 11$" [HAL]. Oct. 13.29: "a very vague, diffuse candidate was suspected, but could not be confirmed" [HAL]. Oct. 20.26: "windy conditions, mediocre transparency" [HAL]. Nov. 9.25: "comet's appearance suggests the outburst is ~ 1 week old" [HAL]. Nov. 19.27: "limiting magnitude based upon diffuse appearance the comet had exhibited earlier in Nov." [HAL].

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

CODE	S	OBSERVER, LOCATION
BEN03	21	Hans Bengtsson, Sweden
BOR		John E. Bortle, NY, U.S.A.
CAM03	14	Paul Camilleri, Australia
CHE		G. R. Chester, VA, U.S.A.
DAN01	21	Jorgen Danielsson, Sweden
DEA		Vicente Ferreira de Assis Neto, Brazil
DUS	21	Grzegorz Duszanowicz, Sweden
GAL		Jesus Gallego Maestro, Spain
GRA04	24	Bjoern Haakon Granslo, Norway
GRE		Daniel W. E. Green, U.S.A.
HAL		Alan Hale, U.S.A.
HAS02		Werner Hasubick, West Germany
ICH	16	Kazuhiko Ichikawa, Japan
ISH02	16	Akiyoshi Ishikawa, Japan
IWA01	16	Yoshitaka Iwaki, Japan
KAM01		Andreas Kammerer, West Germany
KAM03	16	Toshiyuki Kamijima, Japan
*KAM04	21	Lars Kame'l, Sweden
KAN	16	Kiyotaka Kanai, Japan
KOR01	19	Valeriy L. Korneyev, Zelenograd, U.S.S.R.
MIK		Herman Mikuz, Yugoslavia
MOD		Robert J. Modic, OH, U.S.A.
MOE		Michael Moeller, West Germany
MOR		Charles S. Morris, U.S.A.
MOR03		Warren C. Morrison, Canada
*NAG04	16	Kazuro Nagashima, Japan
NAK01	16	Akimasa Nakamura, Japan
NII	16	Tsuneo Niijima, Japan
OKA05	16	Takuma Oka, Japan
PRY		Jim Pryal, WA, U.S.A.
SEA	14	David A. J. Seargent, Australia
SHA04		Gregory T. Shanos, U.S.A.
SPR		C. E. Spratt, BC, Canada
TAN01	16	Kunihiko Taniguchi, Japan
*TSU02	16	Mitsunori Tsumura, Japan
WAS	16	Shinsyo Washi, Japan
*WAS01	16	Izumi Washi, Japan
WIL02	14	Peter F. Williams, Australia
YAS	16	Masanori Yasuki, Japan

Comet Austin 1982 VI

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1982 08 18.45	S	5.6	AA	6	R	12	22	3				NAK01
1982 08 20.45	S	4.4	AA	6	R	12	22	8	6			NAK01
1982 08 24.42	S	5.1	S	7	R	5	11					NII
1982 08 24.43	B	5.4	S	7.0	B		10		5			ISH02
1982 08 24.44	B	5.7	S	7.0	B		10	3	7	0.3	20	KAN
1982 08 28.44	B	5.4	S	7.0	B		10					ICH
1982 08 28.44	B	5.7	S	15	L	6	23	5	6			NAK01
1982 08 28.44	B	5.9	S	7.0	B		10					KAN
1982 08 28.44	S	5.6	S	7.0	B		10					NII
1982 08 28.45	B	5.5	S	7.0	B		10		7			ISH02
1982 08 29.43	S	5.6	AA	7.0	B		10	5				TAN01
1982 09 01.43	S	5.7	S	6	R	12	22	5	5			NAK01
1982 09 01.43	S	6.4	AA	7.0	B		10					TAN01
1982 09 04.43	B	6.8	S	7.0	B		10	3	5			KAN
1982 09 04.43	S	6.0	S	5.0	B		7	& 5				NII
1982 09 04.44	B	6.5	S	7.0	B		10	5	5	0.7		ISH02
1982 09 04.44	S	6.1	S	6	R	12	22	5	5		45	NAK01
1982 09 05.42	S	6.3	AA	6	R	12	22	5	5			NAK01
1982 09 05.43	B	6.6	AA	15	L	6	28	5		0.7	40	NAK01
1982 09 05.45	B	6.6	S	7.0	B		10	5				ISH02
1982 09 13.41	S	7.0	S	6	R	12	22	5	4			NAK01
1982 09 13.45	B	6.9	S	20	L	6	38	3	5			ISH02
1982 09 15.42	S	7.0	S	7.0	B		10	3				KAN
1982 09 15.44	B	7.1	S	20	L	6	38	3	4			ISH02
1982 09 21.42	S	7.6	AA	15	L	6	28	& 3.5	4			KAN
1982 09 26.41	S	8.0	AA	15	L	6	28	3	2			KAN
1982 10 20.82	S	10.4	AC	15	L	6	28	2				KAN
1982 10 22.80	S	10.2	AC	15	L	6	50	4	3			NAK01
1982 10 22.81	S	10.3	AC	15	L	6	28	& 2.5				KAN
1982 10 24.80	S	10.1	AC	15	L	6	50	3.5	1			NAK01
1982 10 24.81	S	10.3	AC	15	L	6	28	& 2.5				KAN
1982 10 25.82	S	10.2	AC	20	L	6	61	4	3			ISH02
1982 10 26.81	S	10.3	AC	15	L	6	50	3	1			NAK01
1982 10 26.81	S	10.8	AC	15	L	6	50	3				ICH
1982 10 26.82	S	10.3	AC	20	L	6	61	3	2			ISH02
1982 11 12.82	S	11.2:	AC	20	L	6	61	2	2			ISH02
1982 11 12.84	S	11.3	AC	15	L	6	28	& 3.5				KAN
1982 11 24.82	S	11.8	AC	15	L	6	50	& 3				ICH
1982 11 25.82	S	11.5	AC	15	L	6	50	2.5				NAK01
1982 11 25.82	S	11.9	AC	15	L	6	50	3				ICH
1982 11 26.81	S	11.6	AC	15	L	6	50	2.5				NAK01
1982 11 26.82	S	11.4	AC	15	L	6	50					TAN01

Comet Bradfield 1987 XXIX

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1987 08 29.45	S	9.5	S	10	R	8	25	5	1			KAM03
1987 09 14.43	S	8.7	S	13	L	6	33	4	5			KAM03
1987 09 22.43	S	8.0	S	13	L	6	33	4	5			KAM03
1987 10 09.41	S	6.8	S	13	L	6	33	4	5			KAM03
1987 10 10.40	S	6.7	S	13	L	6	33	4	5			KAM03
1987 10 13.40	S	6.7	S	13	L	6	33	4.5	5	0.15		KAM03
1987 10 14.41	S	6.7	S	13	L	6	33	4.5	5	0.15		KAM03
1987 10 18.40	S	6.4	S	13	L	6	33	5	5	0.25		KAM03
1987 10 19.40	S	6.3	S	13	L	6	33	4.5	6	0.5		KAM03
1987 10 21.40	S	6.4	S	13	L	6	33	4.5	6	0.3		KAM03
1987 10 25.40	S	6.5	S	13	L	6	33	4.5	7	0.6		KAM03
1987 10 27.40	S	6.4	S	13	L	6	33	5	7	0.4		KAM03
1987 10 28.40	S	6.4	AA	13	L	6	33	5	6	0.5		KAM03
1987 11 08.38	S	5.9	AA	13	L	6	33	5	6	0.8		KAM03
1987 11 09.40	S	5.7	AA	13	L	6	33	5	6	1.0		KAM03
1987 11 10.40	S	5.8	AA	13	L	6	33	5	6	0.7		KAM03
1987 11 15.40	S	5.6	AA	13	L	6	33	6	6	1.0		KAM03
1987 11 16.42	S	5.5	AA	13	L	6	33	6	7	1.0		KAM03
1987 11 17.43	S	5.5	AA	13	L	6	33	6	6	1.0		KAM03
1987 11 20.42	S	5.5	AA	13	L	6	33	6	7	1.0		KAM03
1987 11 24.42	S	5.4	AA	13	L	6	33	6	6	1.3		KAM03
1987 12 14.43	S	5.8	AA	13	L	6	33	8	6	1.0		KAM03
1987 12 17.47	S	6.0	S	13	L	6	33	8	7	2.0		KAM03
1987 12 19.45	S	5.9	AA	13	L	6	33	7	6	2.0		KAM03
1987 12 27.42	M	6.7	S	13	L	6	33	7	6			KAM03
1988 01 06.44	S	7.0	S	13	L	6	33	7	6	0.3		KAM03
1988 01 10.43	S	7.4	S	13	L	6	33	7	6	0.25		KAM03
1988 01 11.45	S	8.1	S	13	L	6	33	6	6	1.0		KAM03
1988 01 13.43	B	7.1	AA	7.5	R	7	11			.		TSU02
1988 01 13.46	S	7.4	S	13	L	6	33	7	6	0.5		KAM03
1988 01 14.46	S	7.6	S	13	L	6	33	7	6	0.5		KAM03
1988 01 16.45	S	8.1	S	15	L	9	33	5	3			IWA01
1988 01 17.45	S	7.3	S	13	L	6	33	6	6	0.4		KAM03
1988 01 20.46	M	7.3	S	13	L	6	33	6	6	0.3		KAM03
1988 01 20.57	B	8.6	S	20	L	6	30	5.9	3/	1.3	67	NAG04
1988 02 07.45	S	8.8	S	15	L	9	33	3	1			IWA01
1988 02 15.46	M	8.8	AA	16	W	4	49	7	4			TSU02
1988 02 19.46	M	9.1	AA	31	L	5	52	5.5	4			TSU02

Comet Liller 1988 V

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 01 20.44	M	9.0	S	31	L	5	51	3.5	3			TSU02
1988 02 15.42	M	8.4	AA	16	W	4	49	3	4			TSU02
1988 02 19.42	M	8.5	AA	31	L	5	52	3	5			TSU02
1988 03 13.42	M	7.8	AA	31	L	5	52	3.5	5			TSU02
1988 04 15.80	B	6.6	S	20	L	6	30	4	6	1.0	355	NAG04
1988 04 24.79	M	5.0	S	3.5	B		7		6			TSU02
1988 04 24.80	B	6.1	S	7.0	B		10					NAG04
1988 04 25.46	S	6.0	AC	7.0	B		10	3	4			YAS
1988 04 25.80	B	6.8	S	20	L	6	30					NAG04
1988 04 27.76	S	5.7	AC	7.0	B		10	3.5	5	1.5	5	YAS
1988 04 27.79	B	6.5	S	20	L	6	30	3	5	1.2	0	NAG04
1988 04 30.78	B	6.0	AA	20	T	10	67	7	5	>0.5		WAS
1988 04 30.79	B	6.0	AA	20	T	10	67	6	6			WAS01
1988 05 02.46	S	5.7	AC	7.0	B		10	6	5			YAS
1988 05 04.78	S	5.8	AC	7.0	B		10	6	5			YAS
1988 05 05.47	M	6.2	S	3.5	B		7		6			TSU02
1988 05 05.49	S	5.9	AC	7.0	B		10	5.5	5	0.5	5	YAS

Comet Liller 1988 V [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 05 06.49	M	6.3	S	3.5	B		7		6			TSU02
1988 05 08.46	S	6.0	AC	7.0	B		10	5	5	0.5	25	YAS
1988 05 08.49	B	7.3	AA	8.0	B		11	6	6			WAS
1988 05 08.49	M	6.1	S	3.5	B		7					TSU02
1988 05 08.49	M	6.6	AA	13	L	6	33	6	6	0.5		KAM03
1988 05 08.50	B	7.8	AA	20	T	10	67	6	6			WAS01
1988 05 08.57	B	6.9	S	20	L	6	30	5.5	5	0.67	10	NAG04
1988 05 12.48	S	6.2	AC	7.0	B		10	5	5	0.4	30	YAS
1988 05 13.47	S	6.4	AC	7.0	B		10	4.5	4			YAS
1988 05 13.48	M	6.5	S	3.5	B		7					TSU02
1988 05 13.51	M	6.6	AA	13	L	6	33	7	7	0.6		KAM03
1988 05 13.69	B	7.2	S	20	L	6	30	4.5	4	0.67	40	NAG04
1988 05 16.48	M	7.1	AA	13	L	6	33	7	7	0.3		KAM03
1988 05 16.50	M	6.7	S	3.5	B		7		6			TSU02
1988 05 18.50	S	7.1	AC	7.0	B		10	5	4			YAS
1988 05 18.51	M	7.1	AA	13	L	6	33	6	6	0.3		KAM03
1988 05 18.76	B	7.1	S	20	L	6	30	7	3	0.58	50	NAG04
1988 06 04.48	M	7.3	S	13	L	6	33	7	5	0.2		KAM03
1988 06 04.53	B	8.4	S	20	L	6	30	5.5	2/	0.08	50	NAG04
1988 06 04.54	M	7.5	S	3.5	B		7	5	5			TSU02
1988 06 04.56	B	8.5	S	5	R	8	13		3			OKA05
1988 06 05.49	M	7.8	S	13	L	6	33	7	6	0.1		KAM03
1988 06 05.49	S	8.0	S	15	L	9	33	4	3			IWA01
1988 06 06.54	S	8.0	S	15	L	9	33	4	2			IWA01
1988 06 07.52	M	7.7	AA	13	L	6	33	7	6	0.1		KAM03
1988 06 10.51	M	7.7	S	13	L	6	33	6	5	0.1		KAM03
1988 06 13.52	M	8.2	S	10	R	3	24	5	5			TSU02
1988 06 13.54	S	8.4	S	15	L	9	33		1			IWA01
1988 06 14.57	M	8.2	S	13	L	6	33	6	4			KAM03
1988 07 04.50	S	9.3	S	31	L	5	52	3	4			TSU02

Comet Machholz 1988 XV

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 08 13.79	S	8.3	AC	12	L	7	44	3	4			YAS
1988 08 20.79	B	7.5	AA	23	W	4	40	5	4			WAS
1988 08 20.80	M	8.3	S	16	W	4	49	4	5			TSU02
1988 08 20.80	S	7.2	AC	12	L	7	44	4	4			YAS

Comet Austin 1989c1

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 03 27.03	S	6.6	AA	15	R	5	31	2				MOR03
1990 04 13.04	S	4.8:	AA	15	R	5	31	1				MOR03
1990 04 19.38	S	5.4	AA	3.5	B		7					MOR03
1990 04 24.37	S	5.1	AA	3.5	B		7	5.5				MOR03
1990 05 02.35	S	5.1	AA	3.5	B		7	9				MOR03
1990 05 04.36	S	5.1	AA	3.5	B		7	11				MOR03
1990 05 12.34	S	5.7	AA	3.5	B		7	12.5				MOR03
1990 05 22.29	S	5.7	AA	3.5	B		7	18				MOR03
1990 05 26.30	S	5.7	AC	3.5	B		7	21				MOR03
1990 05 27.30	S	5.7	AC	3.5	B		7	17	3			MOR03
1990 05 28.32	S	5.9	AC	3.5	B		7	15				MOR03
1990 05 30.34	S	6.0	AC	3.5	B		7	17				MOR03
1990 05 31.30	S	6.3	AC	3.5	B		7	18	3			MOR03
1990 06 01.30	S	6.3	AC	3.5	B		7	16		0.9	320	MOR03
1990 06 12.14	S	8.8	AC	15	R	5	31	6.5	0			MOR03

Comet Skorichenko-George 1989e1

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 01 29.03	S	10.9	AC	44.5	L	4	80	1.9	3			MOR03
1990 02 21.02	S	10.6	AC	15	R	5	62	2.4	3			MOR03
1990 03 27.07	S	10.2	AC	44.5	L	4	80	1.8	4			MOR03
1990 03 28.04	S	10.2	AC	15	R	5	62	2.1	3			MOR03
1990 04 13.06	S	10.2	AC	15	R	5	62	2.3	1			MOR03
1990 04 19.07	S	10.6	AC	15	R	5	62	2.0	1			MOR03
1990 09 27.49	I[	12.5		41	L	4	183					HAL
1990 10 20.40	S[	12.5	GA	35.9	L	7	85	! 1				MOD
1990 10 27.50	I[	13.0		41	L	4	244					HAL

Comet Cernis-Kiuchi-Nakamura 1990b

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 04 13.06	S	10.3	AC	15	R	5	62	2.4	3			MOR03
1990 04 14.15	S	10.7	AC	15	R	5	62	2.2	2			MOR03
1990 04 19.07	S	10.9	AC	15	R	5	62	2.7	0			MOR03
1990 04 22.13	S	11.0	AC	15	R	5	62	2.3	0			MOR03

Comet Levy 1990c

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 06 20.26	S	9.3	AC	15	R	5	62	2.2	5			MOR03
1990 06 25.94	S	8.6	S	20.3	T	10	80	1.7	4/			KAM01
1990 07 20.96	S	6.8	AA	6.3	B		9	8	6			KAM01
1990 07 21.20	S	7.4	AC	3.5	B		7	5.5				MOR03
1990 07 24.33	S	6.7	AC	3.5	B		7	10				MOR03
1990 07 25.96				20.3	T	10	80	4	6/	0.4	225	KAM01
1990 07 25.96	S	6.5	AA	6.3	B		9	& 8				KAM01
1990 07 26.33	S	6.6	AC	3.5	B		7	9.5				MOR03
1990 07 27.33	S	6.4	AC	3.5	B		7	12.5				MOR03
1990 07 28.33	S	6.1	AC	3.5	B		7	12				MOR03
1990 08 01.35	S	5.9	AC	3.5	B		7	11				MOR03
1990 08 02.33	S	5.8	AC	3.5	B		7	10				MOR03
1990 08 04.96	S	5.8	AA	6.3	B		9	11	5/	?		KAM01
1990 08 12.93	S	4.6	AA	6.3	B		9	13	5	0.9	195	KAM01
1990 08 15.13	S	4.8	AA	3.5	B		7	17	4	0.3	170	MOR03
1990 08 16.24				20.0	L	5	35	6	7	0.25	165	MOD
1990 08 16.24	M	4.5	SC	5.0	B		10	12	5			MOD
1990 08 17.20	M	4.6	SC	5.0	B		10	11	5			MOD
1990 08 17.21				20.0	L	5	35	5	7	0.25	145	MOD
1990 08 17.97	S	4.5	AA	6.3	B		9	20.5	6/	0.6	170	KAM01
1990 08 18.15	M	4.1	SC	0.7	E		1	25	4			MOD
1990 08 18.15	M	4.6	SC	5.0	B		10	12	5	0.25		MOD
1990 08 19.08				20.0	L	5	35	6	7	0.4	175	MOD
1990 08 19.08	M	4.1	SC	0.7	E		1	&20	3			MOD
1990 08 19.08	M	4.6	SC	5.0	B		10	11	5			MOD
1990 08 20.08	S	4.3	AA	3.5	B		7	21	4	0.4	160	MOR03
1990 08 22.11	S	4.2	AA	3.5	B		7	14	4	0.8	155	MOR03
1990 08 23.10	S	4.2	AA	3.5	B		7	20.5		0.5	135	MOR03
1990 08 23.90	S	4.0	AA	6.3	B		9	16	7	0.5	76	KAM01
1990 08 24.22	M	3.9	SC	0.7	E		1	15	3			MOD
1990 08 24.22	M	4.3	SC	5.0	B		10	10	5	0.25	95	MOD
1990 08 24.96				6.3	B		9	16	7	1.5	70	KAM01
1990 08 24.97	B	3.9	SC	5.0	B		7		8			KAM04
1990 08 25.12	B	3.7	SC	0.7	E		1					MOD
1990 08 25.12	I	4.0	SC	0.7	E		1	5	8			MOD
1990 08 25.12	M	4.3	SC	5.0	B		10	10	5	2.0	95	MOD
1990 08 25.16	M	4.4	AA	3.5	B		7	10.5	5	0.6	80	MOR03
1990 08 26.13	I	4.0	SC	0.7	E		1	5	8			MOD

Comet Levy 1990c [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 08 26.14				5.0	B		10			0.5	65	MOD
1990 08 26.14	M	4.4	SC	5.0	B		10	10	5	2.0	95	MOD
1990 08 26.92	B	4.1	SC	5.0	B		7		8			KAM04
1990 08 26.93	I	4.2	SC	0.0	E		1		9			KAM04
1990 08 27.22	I	4.1	SC	0.7	E		1	5	8			MOD
1990 08 27.23				5.0	B		10			0.7	70	MOD
1990 08 27.23	M	4.5	SC	5.0	B		10	10	5	2.5	87	MOD
1990 08 28.05	M	4.5	SC	5.0	B		10	9	4			MOD
1990 08 30.25				20.0	L	5	35	6	7	0.5	75	MOD
1990 08 30.25	I	4.2	SC	0.7	E		1	5	8			MOD
1990 08 30.25	M	4.6	SC	5.0	B		10	10	4	1.5	75	MOD
1990 09 01.09	M	4.6	SC	5.0	B		10	8	4			MOD
1990 09 03.11	S	4.7	AC	3.5	B		7	17				MOR03
1990 09 09.80	S	4.3	AA	6.3	B		9	&12	4			KAM01
1990 09 10.07	M	5.1	SC	5.0	B		10	8	5			MOD
1990 09 10.07	M	6.0	SC	20.0	L	5	35	3.5	7			MOD
1990 09 12.13	M	5.0	SC	5.0	B		10			1.5	85	HAL
1990 09 18.02	S	6.3	SC	5.0	B		10	7	2			MOD
1990 09 18.03	M	7.2	SC	20.0	L	5	35	3.0	6			MOD
1990 09 20.11	M	5.5:	SC	5.0	B		10					HAL
1990 09 25.08	M	5.6	SC	5.0	B		10					HAL
1990 10 06.43	S	6.5	SC	8.0	B		20	2	7	2.5	90	CAM03
1990 10 07.42	S	6.5	SC	8.0	B		20	2	8	3.5	85	CAM03
1990 10 10.40	S	5.9	A	5.0	B		10		9			WIL02
1990 10 12.44				20	L	7	35	2	8	1.5	95	CAM03
1990 10 13.40	S	6.1	A	5.0	B		10		9			WIL02
1990 10 15.41	S	6.0	SC	8.0	B		20		8	3.0	100	CAM03
1990 10 16.41	S	6.0	A	5.0	B		10		9			WIL02
1990 10 16.44	S	5.8	SC	5.0	B		12	3	7	3.0	100	CAM03
1990 10 18.40	S	6.0	A	5.0	B		10		9			WIL02
1990 10 20.40	S	6.0	A	5.0	B		10		9			WIL02
1990 10 22.42	S	6.1	SC	20	L	7	35	1.5	9	0.8	100	CAM03
1990 10 22.42	S	6.2	SC	8.0	B		20	2	8	1.75	100	CAM03
1990 10 23.43	S	6.2	SC	8.0	B		20	2	8	1.5	100	CAM03
1990 10 28.42	S	6.4	SC	8.0	B		20	2	8			CAM03
1990 11 23.71	S	6.4	AA	8.0	B		15	3	7		230	SEA
1990 12 10.53	S	7.5:	SC	20	L	6	55					HAL
1990 12 11.68	S	7.0	AA	8.0	B		15					SEA
1990 12 11.69				25.4	L		71	2	7	0.3	250	SEA
1990 12 14.64	S	6.7	AA	8.0	B		15					SEA
1990 12 14.65	S	7.7	SC	8.0	B		20	2	6	0.75	255	CAM03
1990 12 18.53	S	7.6	SC	5.0	B		10					HAL
1990 12 24.70	S	7.6	SC	20.3	L	7	35	1.5	7	0.75	280	CAM03
1990 12 25.54	S	7.6	SC	5.0	B		10					HAL
1991 01 07.58	S	7.1	AA	8.0	B		15					SEA
1991 01 08.58	S	7.5	SC	8.0	B		20	3.5	4	0.25	285	CAM03
1991 01 13.41	S	7.8	AC	15	R	5	31	4.5	3			MOR03
1991 01 13.54	M	7.0	AA	8.0	B		20	7.5	7	0.5	285	MOR
1991 01 19.52				8.0	B		20			0.75	305	MOR
1991 01 19.52	M	7.1	AA	8.0	B		20	5	7	0.75	145	MOR
1991 01 21.60	M	6.8	AA	8.0	B		15					SEA
1991 01 27.47	S	8.5	GA	35.9	L	7	85	2.0	1			MOD
1991 02 04.48	S	7.3	AA	5.0	B		10	8	5			SEA
1991 02 05.09	B	7.6	S	7.0	B		10	7.5	4			DEA
1991 02 05.25	S	8.0:	AA	20.0	T	10	87	1.5	6			SHA04
1991 02 07.47	S	6.9	AA	5.0	B		10	12	6			SEA
1991 02 08.29	S	8.0	AA	20.0	T	10	87	1.3	6	&0.7	320	SHA04
1991 02 09.27	S	8.1	AA	8.0	R	3	20	& 6	2			GRE
1991 02 09.33				8.0	B		20			0.33	320	MOR

Comet Levy 1990c [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1991 02 09.33	M	7.1	AA	8.0	B		20	7.5	5	0.33	140	MOR
1991 02 10.28	M	7.3	AA	8.0	B		20	6	5			MOR
1991 02 10.29	B	7.6	SC	6.3	B		9				330	CHE
1991 02 10.29	S	8.3	AA	20.0	T	10	87	1.7	5			SHA04
1991 02 11.21	S	8.3	AA	20.0	T	10	87	2.7	5	&0.7	278	SHA04
1991 02 12.21	S	8.4	AA	20.0	T	10	87	2.1	5	&0.7	285	SHA04
1991 02 13.46	S	6.9	AA	8.0	B		15		5			SEA
1991 02 14.09	B	7.6	S	7.0	B		10	14	4			DEA
1991 02 15.10	S	8.8	AA	8.0	B		15	5.5	3			MIK
1991 02 16.04	M	7.4	AA	8.0	B		11		7	0.83		GAL
1991 02 17.89	M	8.1	AA	8.0	B		15	& 9	5	0.7	165	MIK
1991 02 17.91	S	7.9	AA	5.0	B		7	&10	6			MIK
1991 02 18.21	S	8.5	AA	20.0	T	10	87	1.7	6	&0.4	285	SHA04
1991 02 18.25	S	7.1	AA	5.0	B		12	&10	1/			GRE
1991 02 19.19	S	8.5	AA	20.0	T	10	87	2.1	5	&0.4	353	SHA04
1991 02 19.50	S	7.1	AA	8.0	B		15					SEA
1991 02 20.08	M	8.2	AA	8.0	B		15	& 8	6			MIK
1991 02 20.09	S	7.9	AA	5.0	B		7	& 8	3			MIK
1991 02 20.21	S	8.6	AA	20.0	T	10	87	1.9	5	&0.4	368	SHA04
1991 02 21.05	S	8.4	S	7.0	B		10	7.5	4			DEA
1991 02 21.21	S	8.7	AA	20.0	T	10	87	1.9	5	&0.7	0	SHA04
1991 02 22.88	S	9.3:	AC	15.2	L	5	100	& 2.5	2			MOE
1991 03 03.42	S	7.6	AA	8.0	B		15					SEA
1991 03 04.95	S	8.7	S	7.0	B		10	4.1	2			DEA
1991 03 06.07				31.7	L	6	55	5.6	4	?	150	BOR
1991 03 06.07	S	8.0	AC	5.0	B		10	8	3			BOR
1991 03 06.07	S	8.1	AC	8.0	B		20	6.8	3	?		BOR
1991 03 06.43	S	8.4	AC	8.0	B		15		5			SEA
1991 03 07.44	S	8.5	AC	8.0	B		15	3	5			SEA
1991 03 09.06				31.7	L	6	55	4.6	4	?	150	BOR
1991 03 09.06	S	8.1	AC	5.0	B		10	7	2			BOR
1991 03 09.06	S	8.3	AC	8.0	B		20	5.1	3			BOR
1991 03 09.23				25.6	L	4	45	6.5		0.33	165	MOR
1991 03 09.23	M	8.4	AA	8.0	B		20	8	4			MOR
1991 03 10.09	S	8.1	AC	5.0	B		10	8	2			BOR
1991 03 12.06	S	8.2	AC	5.0	B		10	9	2			BOR
1991 03 12.91	S	9.3	AA	8.0	B		15	4.5	6			MIK
1991 03 13.08	S	8.2	AC	5.0	B		10	10	1			BOR
1991 03 13.08	S	8.3	AC	8.0	B		20	7.2	3			BOR

Comet Tsuchiya-Kiuchi 1990i

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 07 20.92	S	8.2	AA	20.3	T	10	51	3.8	2			KAM01
1990 07 21.81	B	8.6	A	10	R	4	19	8	2			KOR01
1990 07 29.83	B	8.8	A	10	R	4	19	6	3			KOR01
1990 08 02.09	S	9.1	AC	15	R	5	31	3.5				MOR03
1990 10 03.49	! M	7.7	AC	41	L	4	52					HAL
1990 10 06.44	S	7.6	AA	20.0	L	5	35	3.0	2			MOD
1990 10 11.51	! M	7.7	AC	41	L	4	83					HAL
1990 10 16.41	S	7.7	AC	15	R	5	31	4	4			MOR03
1990 10 17.43	S	7.6	SC	20.0	L	5	35	2.7	3			MOD
1990 10 17.49	M	7.6	AC	5.0	B		10					HAL
1990 10 20.43	M	7.9	SC	20.0	L	5	35	1.3	3			MOD
1990 10 20.44	B	8.2	AA	5.0	B		10	2.0	2			MOD
1990 10 21.42	S	7.7	AC	15	R	5	31	4.5	4			MOR03
1990 10 22.06	B	7.0	A	8.0	B	4	11	14	2			KOR01
1990 10 23.49	M	7.6	AC	5.0	B		10					HAL
1990 10 24.18	S	7.5	S	6.3	B		9					KAM01

Comet Tsuchiya-Kiuchi 1990i [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 10 25.06	B	7.2	A	8.0	B	4	11	12	2			KOR01
1990 10 27.43	S	8.0	AC	15	R	5	31	4	4			MOR03
1990 10 27.45	M	8.0	SC	20.0	L	5	35	2.3	4			MOD
1990 10 28.71	S	6.7	SM	8.0	B		20	7	4			CAM03
1990 10 30.43	S	8.3	AC	15	R	5	31	4	4			MOR03
1990 10 30.49	M	7.6	AC	5.0	B		10					HAL
1990 10 31.43	S	8.2	AC	15	R	5	31	5	4			MOR03
1990 11 08.44	S	7.8	AC	15	R	5	31	5.5	3			MOR03
1990 11 11.42	S	7.9	AC	15	R	5	31	5	3			MOR03
1990 11 12.70	S	7.5	SC	8.0	B		20	4.5	5			CAM03
1990 11 13.44	S	7.9	AC	6	R	15	36	5	3			MOR03
1990 11 13.50	M	7.2	SC	5.0	B		10					HAL
1990 11 14.45	I	7.9	AA	5.0	B		10	2.0	2			MOD
1990 11 14.45	M	8.1	AA	20.0	L	5	35	2.0	3			MOD
1990 11 15.41	M	7.7	SC	5.0	B		10	6	2			MOD
1990 11 16.42	B	7.7	SC	5.0	B		10					MOD
1990 11 16.42	M	7.7	SC	5.0	B		10	6	2			MOD
1990 11 16.42	S	7.7	SC	5.0	B		10					MOD
1990 11 17.00	B	7.4	A	8.0	B	4	11	17	3			KOR01
1990 11 18.08	B	7.4	A	8.0	B	4	11	19	4			KOR01
1990 11 18.41	S	8.0	AC	15	R	5	31	5	3			MOR03
1990 11 18.44	M	7.6	SC	5.0	B		10	6	2			MOD
1990 11 19.44	M	8.2	SC	20.0	L	5	35	3	3			MOD
1990 11 19.44	S	7.8	SC	5.0	B		10	5	1			MOD
1990 11 20.72	S	8.0	SC	20.3	L	7	35	4.5	3			CAM03
1990 11 23.24	S	7.3	S	6.3	B		9	6.5	4/			KAM01
1990 11 23.54	S	7.3	AA	8.0	B		15					SEA
1990 11 24.20	S	7.5	S	6.3	B		9	7.5	3/			KAM01
1990 11 26.42	S	8.3	AC	6	R	15	36	5.5	2			MOR03
1990 11 27.14	S	7.5	S	6.3	B		9	7	3			KAM01
1990 11 27.51	S	7.6	SC	5.0	B		10					HAL
1990 12 05.42	S	7.9	AA	8.0	B		15					SEA
1990 12 07.44	S	7.4	AA	5.0	B		10	10	2			SEA
1990 12 10.33	! S	8.3	NP	5.0	B		10					HAL
1990 12 11.44	S	7.8	AA	5.0	B		10	10				SEA
1990 12 13.45	S	7.5	AA	5.0	B		10	10	3			SEA
1990 12 14.65	S	8.5	SC	8.0	B		20	5	2			CAM03
1990 12 16.47	S	9.1	LM	20.3	L	7	35	3	2			CAM03
1990 12 18.29	! S	8.8	NP	5.0	B		10					HAL
1990 12 24.70	S	9.0	LM	20.3	L	7	35	2	2			CAM03
1991 01 03.46	S	9.0	AA	8.0	B		15	&10	1			SEA
1991 01 13.23	S	10.2	AA	25.6	L	4	67	2.9	1/			MOR
1991 01 15.75	S	8.5:	S	10.0	B		25	1.8	3			HAS02
1991 01 19.19	S	10.2	AA	25.6	L	4	45		1/			MOR
1991 02 09.14	S	11.5	NP	25.6	L	4	111	2.7	1			MOR
1991 02 10.13	S	11.5	NP	25.6	L	4	111	2.7	1			MOR

Comet Arai 1991b

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1991 01 09.83	S	10.7	AC	20.3	T	10	51	2.8	2			HAS02
1991 01 11.21	S	10.3	NP	25.6	L	4	67	5	1/			MOR
1991 01 12.84	S	10.3	AC	15.2	L	5	42	2.5	3			MOE
1991 01 12.85	S	10.4	AC	15.2	L	5	100	2	2			MOE
1991 01 13.27	M	10.0	NP	25.6	L	4	67	2.5	3/			MOR
1991 01 13.83	S	10.4	AC	15.2	L	5	42	2.5	2			MOE
1991 01 13.83	S	10.5	AC	15.2	L	5	100	2	2			MOE
1991 01 14.14	S	10.1	AC	31.7	L	6	68	2.4	2			BOR
1991 01 14.91	S	10.6	AC	15.2	L	5	42	2.5	1			MOE

Comet Arai 1991b [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1991 01 14.92	S	10.7	AC	15.2	L	5	100	2	1			MOE
1991 01 15.76	S	10.6	AC	15.2	L	5	42	2.5	1			MOE
1991 01 16.20	S	10.0	AC	31.7	L	6	68	3.9	3			BOR
1991 01 16.77	S	10.6	AC	15.2	L	5	42	2.5	1			MOE
1991 01 16.78	S	10.8	AC	15.2	L	5	100	2	1			MOE
1991 01 17.86	S	10.9	AC	15.2	L	5	42	2	1			MOE
1991 01 19.00	S	11.0	AC	15.2	L	5	42	1.5	1			MOE
1991 01 19.24	S	9.6	NP	8.0	B		20	10.4	1			MOR
1991 01 19.24	S	9.6	NP	25.6	L	4	45	7.3	2/			MOR
1991 02 01.78	S	10.8:	AC	20.0	L	4	40	5.5	2			MIK
1991 02 03.80	S	11.0	AC	20.0	L	4	40	& 4	3			MIK
1991 02 09.20	S	11.2	NP	25.6	L	4	45	4	1/			MOR
1991 02 10.22	S	11.3	NP	25.6	L	4	67	4	1			MOR
1991 03 09.20	S[	12.0	NP	25.6	L	4	67					MOR

Comet Shoemaker-Levy 1991d

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1991 03 09.26	S	13.7	NP	25.6	L	4	156	0.7	3			MOR

Periodic Comet Encke

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 09 15.40	S	9.6	S	20	T	10	100	4.5	2			PRY
1990 09 17.14	S	8.9	S	20.3	T	10	51	2.3	1/			KAM01
1990 09 17.39	S	10.0	AC	15	R	5	31	3.5	1			MOR03
1990 09 17.44	S	9.5	CA	41	L	4	83					HAL
1990 09 21.43	S	9.1	S	20	T	10	63	4.1	3			PRY
1990 09 24.41	S	10.3	GA	20.0	L	5	35	2.8	3			MOD
1990 09 26.47	M	8.8	CA	5.0	B		10					HAL
1990 09 28.42	M	9.4	GA	40	L	7	52	2.0	4			MOD
1990 09 29.13	S	8.4	S	20.3	T	10	51	2.2	3/			KAM01
1990 10 01.43	M	9.6	GA	40	L	7	52	2.4	5			MOD
1990 10 01.43	S	8.6	AA	5.0	B		10	2	0			MOD
1990 10 02.42	M	8.6	AA	5.0	B		10	2.8	3			MOD
1990 10 02.42	M	8.9	GA	20.0	L	5	35	2.4	5			MOD
1990 10 02.43	M	9.4	GA	35.9	L	7	45	2.1	5			MOD
1990 10 03.39	S	8.7	AC	15	R	5	31	3.5				MOR03
1990 10 03.42	M	9.1	AA	20.0	L	5	35	2.0	4			MOD
1990 10 03.51	S	8.0	AC	5.0	B		10					HAL
1990 10 05.42	M	8.7	AA	20.0	L	5	35	1.7	4			MOD
1990 10 06.43	M	8.7	AA	20.0	L	5	35	1.7	4			MOD
1990 10 11.16	S	7.9	SC	20.0	R	5	111		6			KAM04
1990 10 11.49	! M	7.7	AC	41	L	4	83					HAL
1990 10 12.16	S	8.0	SC	20.0	R	5	111		6			KAM04
1990 10 13.50	! M	7.8	CA	5.0	B		10					HAL
1990 10 16.41	S	8.3	AC	15	R	5	31	1.5	6			MOR03
1990 10 17.44	M	8.1	AA	20.0	L	5	35	1.0	5			MOD
1990 10 17.51	M	7.3:	SC	41	L	4	83					HAL
1990 10 18.51	M	7.6	SC	41	L	4	83					HAL
1990 10 21.43	S	8.5	AC	15	R	5	62	0.7	7			MOR03
1990 10 22.51	M	7.6:	SC	41	L	4	83					HAL

Periodic Comet Tempel 2 (1988 XIV)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 08 11.48	S	10.9	AC	12	L	7	44	2	2			YAS
1988 10 03.44	M	9.5	S	16	W	4	49	4	2			TSU02

Periodic Comet Schwassmann-Wachmann 3 (1989d1)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 04 19.33	S	10.5	AC	15	R	5	62	1.5	2			MOR03
1990 04 22.37	S	10.3	AC	44.5	L	4	80	1.8	4			MOR03
1990 04 26.37	S	10.6	AC	15	R	5	62	1.2				MOR03

Periodic Comet Honda-Mrkos-Pajdušáková (1990f)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 08 02.34	S	11.7	AC	44.5	L	4	80	2.0	0			MOR03
1990 08 21.37	S	9.2	AC	15	R	5	62	2.8	1			MOR03
1990 08 24.37	S	9.1	AC	15	R	5	31	2.5	3			MOR03
1990 08 25.38	S	9.0	AC	15	R	5	31	3	2			MOR03
1990 08 30.37	S	8.3	AC	15	R	5	31	3	4			MOR03
1990 09 03.38	S	8.4	AC	15	R	5	31	2.5	3			MOR03
1990 09 12.39	S	8.4	AC	6	R	15	36	2				MOR03
1990 09 17.39	S	8.3	AC	15	R	5	62	1.7	6			MOR03
1990 09 17.49				41	L	4	83		8/	0.13	270	HAL
1990 09 17.49	M	7.9	AC	5.0	B		10					HAL
1990 09 18.49	M	7.9	AC	41	L	4	83					HAL
1990 09 24.43	S	9.0	GA	20.0	L	5	35	0.7	5			MOD
1990 09 26.49	M	8.7	AC	5.0	B		10					HAL
1990 09 28.43	S	9.6	GA	20.0	L	5	35	0.5	3			MOD
1990 10 02.43	S	10.5	GA	35.9	L	7	85	0.4	2			MOD
1990 10 13.49	! S	11.0	CA	41	L	4	83					HAL
1990 10 18.50	I[	12.0		41	L	4	183					HAL

Periodic Comet Borrelly (1981 IV)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1981 01 30.42	S	9.3	AC	15	L	6	50	2	4			TAN01
1981 01 30.42	S	9.3	AC	15	L	6	50	2.5	5			NAK01
1981 01 30.43	B	9.4	AC	15	L	6	50	2.5				ICH
1981 01 31.40	S	9.5	AC	15	L	6	50	2.5	5			NAK01
1981 01 31.41	S	9.7	AC	15	L	6	50	2	4			TAN01
1981 01 31.42	B	9.9	S	15	L	6	36	3	3			ISH02
1981 01 31.43	B	9.6	AC	15	L	6	50	2				ICH
1981 02 02.41	S	9.3	AC	15	L	6	50	3	5			NAK01
1981 02 02.43	S	9.5	AC	15	L	6	50	3	4			TAN01
1981 02 02.44	B	9.9	AC	15	L	6	50	3				ICH
1981 02 04.42	S	9.4	AC	15	L	6	50	3	5			NAK01
1981 02 07.40	S	9.6	AC	15	L	6	50	2.5	5			NAK01
1981 02 07.41	B	9.5	S	20	L	6	61	3				KAN
1981 02 07.46	S	9.5	AC	15	L	6	50	2				TAN01
1981 02 11.41	S	9.6	AC	15	L	6	50	2	5			NAK01
1981 02 11.41	S	9.6	AC	20	L	6	61	2.5	3			ISH02
1981 02 11.41	S	9.8	AC	15	L	6	50	2				KAN
1981 02 11.42	S	9.4	AC	15	L	6	50	2	4			TAN01
1981 02 21.42	S	9.6	AC	20	L	6	61	3	3			ISH02
1981 02 21.42	S	9.8	AC	15	L	6	28	3				KAN
1981 02 26.42	S	9.9	AC	15	L	6	28	3				KAN
1981 02 26.43	S	10.5	AC	15	L	6	50	2	4			NAK01
1981 02 26.46	B	10.7	AC	15	L	6	50	1.5				ICH
1981 02 26.47	S	10.2	AC	15	L	6	50	2				TAN01
1981 02 27.42	S	10.4	AC	15	L	6	50	3	5			NAK01
1981 02 27.43	S	10.5	AC	15	L	6	50	2	3/			TAN01
1981 02 27.47	B	10.3	AC	15	L	6	50	2.5				ICH
1981 03 02.42	S	10.2	AC	15	L	6	28	2				KAN
1981 03 02.42	S	10.5	AC	15	L	6	50	2.5	6			NAK01
1981 03 02.43	S	10.0	AC	20	L	6	61	2	3			ISH02
1981 03 06.42	S	10.2	AC	15	L	6	28	2				KAN

Periodic Comet Borrelly (1981 IV = 1987 XXXIII) [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1981 03 07.44	S	10.8	AC	15	L	6	50	2.5				NAK01
1981 03 10.43	S	10.7	AC	15	L	6	28	2				KAN
1981 03 22.44	S	11.0	NP	15	L	6	50					KAN
1981 03 23.44	S	11.2	NP	15	L	6	28	1				KAN
1987 11 21.54	S	8.4	S	13	L	6	33	4	5			KAM03
1987 11 22.53	S	8.0	S	13	L	6	33	6	7			KAM03
1987 12 14.48	S	8.5	S	13	L	6	33	4	4			KAM03
1987 12 16.54	S	8.5	S	13	L	6	33	6	5			KAM03
1987 12 17.48	S	8.2	S	13	L	6	33	6	5			KAM03
1987 12 19.46	S	8.9	S	13	L	6	33	5	5			KAM03
1987 12 26.59	S	8.5	S	13	L	6	33	6	6			KAM03
1988 01 06.46	S	8.6	S	13	L	6	33	5	5			KAM03
1988 01 10.44	S	8.0	S	13	L	6	33	5	6			KAM03
1988 01 11.46	S	8.8	S	13	L	6	33	4	5			KAM03
1988 01 13.46	S	9.0	S	13	L	6	33	5	5			KAM03
1988 01 13.50	M	8.8	S	31	L	5	51	7				TSU02
1988 01 13.50	S	9.2	AC	12	L	7	44	2.5	3			YAS
1988 01 14.47	S	8.8	S	13	L	6	33	5	5			KAM03
1988 01 14.49	S	9.2	AC	12	L	7	44	2.5	3			YAS
1988 01 17.46	S	8.3	S	13	L	6	33	4	5			KAM03
1988 01 17.60	S	9.2	AC	12	L	7	44	3	4			YAS
1988 01 19.50	S	9.3	AC	12	L	7	44	3.5	4			YAS
1988 01 20.47	M	8.5	AA	31	L	5	51	4.5	6			TSU02
1988 01 20.47	S	8.5	S	13	L	6	33	4	5			KAM03
1988 01 20.50	S	9.3	AC	10	R	10	30	2.5	4			YAS
1988 01 20.63	B	9.2	S	20	L	6	30	3.5	2/			NAG04
1988 01 21.52	S	9.4	AC	12	L	7	44	3	3			YAS
1988 02 15.48	M	9.2	AA	16	W	4	49	5.5	3			TSU02

Periodic Comet Taylor (1990n)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 12 10.30	I	[13.5		41	L	4	183					HAL
1990 12 20.09	I	[13.5		41	L	4	183					HAL

Periodic Comet Johnson (1990h)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 09 25.13	I	[13.0		41	L	4	183					HAL
1990 10 09.13	I	[13.0		41	L	4	183					HAL
1990 11 09.13	I	[13.0		41	L	4	183					HAL
1990 11 19.11	I	[13.5		41	L	4	183					HAL

Periodic Comet Wild 2 (1989t)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 09 18.49	S	[12.0:	AC	41	L	4	183	1.0				HAL
1990 09 27.49	I	[12.0		41	L	4	183					HAL
1990 10 17.50	S	12.5	AC	41	L	4	183					HAL
1990 10 23.50	S	12.5	AC	41	L	4	183					HAL
1990 10 30.51	S	12.6	AC	41	L	4	183					HAL
1990 11 15.52	S	12.3	AC	41	L	4	83					HAL
1990 11 27.53	S	12.2	AC	41	L	4	183					HAL
1990 11 28.53	S	12.3	AC	41	L	4	83					HAL
1990 12 18.51	S	12.3	AC	41	L	4	83					HAL
1990 12 20.43	S	12.3	AC	31.7	L	6	170	0.9	2			BOR
1990 12 25.53	S	12.4	AC	41	L	4	183					HAL
1991 01 13.56	S	12.2	NP	25.6	L	4	111	1.9	2/			MOR
1991 01 19.55	S	11.9	NP	25.6	L	4	111	2.0	2/			MOR
1991 02 10.53	S	12.5	NP	25.6	L	4	111	1.6	2			MOR

Periodic Comet Wild 4 (1990a)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 02 21.04	S	13.1	AC	44.5	L	4	167	0.8	4			MOR03
1990 03 21.08	S	12.8	AC	44.5	L	4	167	1.0	3			MOR03
1990 03 27.08	S	12.9	AC	44.5	L	4	167	0.8				MOR03
1990 04 16.18	S	13.3	AC	44.5	L	4	167	0.5	4			MOR03

Periodic Comet Holt-Olmstead (1990k)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 09 26.45	I	[13.0		41	L	4	183					HAL

Periodic Comet Mueller 2 (1990j)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 09 26.44	I	[13.0		41	L	4	183					HAL
1990 09 27.42	I	[13.5		41	L	4	183					HAL
1990 10 13.27	I	[13.5		41	L	4	183					HAL
1990 10 26.28	I	[13.5		41	L	4	183					HAL
1990 11 09.21	I	[13.5		41	L	4	183					HAL
1990 11 19.12	I	[13.5		41	L	4	183					HAL

Periodic Comet Metcalf-Brewington (1991a)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1991 01 07.46	S	9.5	SM	8.0	B		20	3	4			CAM03
1991 01 08.47	S	9.4	SM	8.0	B		20	3	4			CAM03
1991 01 08.98				31.7	L	6	55	4.0	5/	?		BOR
1991 01 08.98	S	8.4	AC	5.0	B		10	5.5	4			BOR
1991 01 09.44	S	8.4	AA	8.0	B		15	& 4	7			SEA
1991 01 09.73	S	8.5	S	10.0	B		25	2.4	4			HAS02
1991 01 10.77	S	8.4	S	10.0	B		25	3.2	4			HAS02
1991 01 10.80	S	8 :	S	8.0	B	4	20	4	5			DAN01
1991 01 11.10	M	8.4	AA	8.0	B		20	8	6			MOR
1991 01 11.44	S	8.5	AA	8.0	B		15					SEA
1991 01 11.72	S	8.3	AC	8.0	R	12	57	3	3			MOE
1991 01 11.72	S	8.5:	AC	48.5	L	4	115	& 3	3			MOE
1991 01 12.73	S	8.9	AC	15.2	L	5	42	3.5	2			MOE
1991 01 12.73	S	9.0	S	15	L	5	63	3				BEN03
1991 01 12.77	S	8.5	S	25.4	L	6	45	5/	3			DAN01
1991 01 13.16	M	8.4	AA	8.0	B		20	9	5/	0.5	70	MOR
1991 01 13.72	S	8.9	AC	15.2	L	5	42	4	3			MOE
1991 01 13.72	S	9.0	AC	15.2	L	5	100	3	3			MOE
1991 01 13.74	S	9.0	S	8.0	B		15	4	1/			DUS
1991 01 13.76	S	8.6	S	25.4	L	6	45	6	2			DAN01
1991 01 13.76	S	8.7	S	25.4	L	6	145	5	3	0.2	155	DAN01
1991 01 13.98				31.7	L	6	55	3.7	3	?		BOR
1991 01 13.98	S	8.6	AC	5.0	B		10	6	2			BOR
1991 01 13.98	S	8.6	AC	8.0	B		20	5.6	1/			BOR
1991 01 14.71	S	8.9	AC	15.2	L	5	42	4	2			MOE
1991 01 14.71	S	9.0	AC	15.2	L	5	100	3.5	2			MOE
1991 01 14.76	S	8.7	S	25.4	L	6	45	5	4			DAN01
1991 01 14.76	S	8.7	S	25.4	L	6	145	3	5	0.1	230	DAN01
1991 01 14.77	S	9.1	S	8.0	B		15	5	2			DUS
1991 01 15.73	S	9.1	AA	10.0	B		25	1.8	3			HAS02
1991 01 15.74	S	9.3	AC	15.2	L	5	42	3	1			MOE
1991 01 15.98	S	8.5	AC	8.0	B		20					BOR
1991 01 15.98	S	8.5	HR	8.0	B		20	6.3	1			BOR
1991 01 16.74	S	9.1	AA	10.0	B		25	1.8	3			HAS02
1991 01 16.75	S	9.3	AC	15.2	L	5	42	3.5	1			MOE
1991 01 16.76	S	9.4	AC	15.2	L	5	100	3	1			MOE

Periodic Comet Metcalf-Brewington (1991a) [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1991 01 17.72	S	9.5	AC	15.2	L	5	44	3.5	1			MOE
1991 01 17.73	S	8.9:	S	8.0	B		15	3	2			DUS
1991 01 17.73	S	9.6	AC	15.2	L	5	100	3	1			MOE
1991 01 17.98	S	8.6	HR	8.0	B		20	5.3	3			BOR
1991 01 17.98	S	9.0	HR	31.7	L	6	55	4.3	3			BOR
1991 01 18.72	B	9.6	AC	10.0	B		14	2.5	1			MOE
1991 01 18.80	S	10.1	AA	20.0	L	4	40	4	6			MIK
1991 01 19.10	S	8.6	AA	20.0	T	10	64	5.5	3			SPR
1991 01 19.14	M	8.7	AA	8.0	B		20	8	5	0.5	80	MOR
1991 01 19.73	S	9.1	S	8.0	B		15	4	2			DUS
1991 01 19.98	S	8.7	HR	8.0	B		20	5.3	2			BOR
1991 01 19.98	S	9.0	HR	31.7	L	6	55	3.5	3	?	70	BOR
1991 01 20.11	S	8.6	AA	20.0	T	10	64	5.0	3			SPR
1991 01 21.12	S	8.5	AA	20.0	T	10	64	5.0	4			SPR
1991 01 26.12	S	8.9	AA	20.0	T	10	125	3.5	3			SPR
1991 01 31.73	S	10.4	AC	15.2	L	5	42	3	1			MOE
1991 02 01.74	S	10.5	AC	48.5	L	4	115	2.5	1			MOE
1991 02 01.75	S	9.8	AA	20.0	L	4	40	4.5	6			MIK
1991 02 01.76	S	9.7	AA	6.0	B		20	4	3			MIK
1991 02 02.74	S	10.5	AC	15.2	L	5	42	2.5	1			MOE
1991 02 02.99	S	8.9	AC	8.0	B		20	4.9	2			BOR
1991 02 02.99	S	9.5	AC	31.7	L	6	68	2.7	3			BOR
1991 02 03.76	S	10.2	AC	20.0	L	4	40	4	6			MIK
1991 02 04.00	S	9.1	AC	8.0	B		20	5.3	2			BOR
1991 02 04.00	S	9.6	AC	31.7	L	6	68	3.2	3			BOR
1991 02 05.80	S	9.2	S	20.3	T	10	123	2.7	2			GRA04
1991 02 09.17	M	9.8	AC	25.6	L	4	45	3.6	4			MOR
1991 02 09.18	S	9.8	AC	8.0	B		20	3.6	2			MOR
1991 02 10.14	M	9.8	AA	25.6	L	4	45	3.2	3			MOR
1991 02 12.00	S	10.1	AC	31.7	L	6	68	& 2.6	2			BOR
1991 02 17.81	S	10.5	AC	20.0	L	4	40	3.5	6			MIK
1991 02 18.79	S	11.0:	AC	15.2	L	5	100	1.5	2			MOE
1991 03 09.18	! S	10.8	NP	25.6	L	4	67	2.6	2/			MOR

Periodic Comet Wolf-Harrington (1990e)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 09 27.39	I	[13.5		41	L	4	183					HAL
1990 10 13.25	I	[13.0		41	L	4	183					HAL
1990 11 09.16	I	[13.5		41	L	4	183					HAL
1990 12 07.13	I	[13.5		41	L	4	183					HAL
1990 12 18.16	S	13.3	AC	41	L	4	183					HAL
1990 12 19.08	S	13.4	AC	41	L	4	183					HAL
1990 12 20.16	S	13.3	AC	41	L	4	183					HAL
1991 01 11.13	S	13.1	NP	25.6	L	4	156	1.2	1/			MOR
1991 01 13.19	S	13.3	NP	25.6	L	4	156	1.6	1			MOR
1991 01 19.18	S	12.6	NP	25.6	L	4	156	1.4	2/			MOR
1991 02 09.15	S	12.4	NP	25.6	L	4	111	2.0	1/			MOR
1991 02 10.16	S	12.5	NP	25.6	L	4	111	1.8	1/			MOR
1991 03 09.16	S	12.3	NP	25.6	L	4	111	3.0	2/			MOR

Periodic Comet Kearns-Kwee (1989u)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 09 18.47	I	[13.5		41	L	4	183					HAL
1990 10 16.47	I	[13.5		41	L	4	183					HAL
1990 10 26.32	I	[13.5		41	L	4	244					HAL
1990 11 10.29	I	[13.0		41	L	4	183					HAL
1990 11 11.31	I	[13.5		41	L	4	183					HAL

Periodic Comet Kearns-Kwee (1989u) [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 11 19.38	S	14.0	WA	41	L	4	183	0.5				HAL
1990 11 24.53	S	13.7	WA	41	L	4	183					HAL
1990 12 10.27	S	13.7	WA	41	L	4	183					HAL
1990 12 19.27	S	13.8	WA	41	L	4	183					HAL
1990 12 25.50	S	13.5	CA	41	L	4	183					HAL
1991 01 11.18	S	12.8	NP	25.6	L	4	156	1.3	2			MOR
1991 01 13.25	S	12.8	NP	25.6	L	4	111	2.0	2			MOR
1991 01 19.23	S	13.0	NP	25.6	L	4	156	0.9	2/			MOR
1991 02 10.20	S	13.6	NP	25.6	L	4	156	0.8	1			MOR

Periodic Comet Brorsen-Metcalf (1989 X)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 08 04.68	E	7.0	AC	8.0	B		11	6	4			WAS
1989 08 07.78	E	6.7	S	8.0	B		11	12	5			WAS
1989 08 07.79	B	6.9	S	12.0	B		20	10	5			WAS01
1989 08 30.79	E	5.7	AC	12.0	B		20	8	7	0.5		WAS
1989 08 31.78	E	5.7	AC	12.0	B		20	7	7	2		WAS

Periodic Comet Schwassmann-Wachmann 1 (1989 XV)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 09 12.21	S	12.8	AC	41	L	4	183					HAL
1990 09 13.23	S	12.7	AC	41	L	4	183					HAL
1990 09 25.25	S	12.6	AC	41	L	4	183					HAL
1990 09 28.40	S	12.7	GA	40	L	7	52	2.4	1			MOD
1990 10 01.36	S	12.8	GA	40	L	7	100	1.7	1			MOD
1990 10 02.41	S	13.2	GA	40	L	7	100	1.2	1			MOD
1990 10 10.16	I[	13.0		41	L	4	183					HAL
1990 10 13.29	I[	13.5		41	L	4	183					HAL
1990 10 16.40	S[	13.5	GA	40	L	7	100	! 1				MOD
1990 10 20.26	I[	13.0		41	L	4	183					HAL
1990 10 20.38	S[	13.7	GA	35.9	L	7	85	! 1				MOD
1990 10 26.29	I[	13.5		41	L	4	183					HAL
1990 11 09.25	S	12.7	AC	41	L	4	183	1.5	3			HAL
1990 11 11.28	S	12.8	AC	41	L	4	183					HAL
1990 11 15.25	S[	13.2	GA	35.9	L	7	85	! 1				MOD
1990 11 16.28	S[	13.0	GA	35.9	L	7	85	! 1				MOD
1990 11 18.25	S[	13.0	GA	35.9	L	7	85	! 1				MOD
1990 11 19.27	I[	13.0		41	L	4	183					HAL
1990 12 07.15	I[	13.5		41	L	4	183					HAL
1990 12 08.09	S[	13.5	GA	40	L	7	100	! 1				MOD
1990 12 12.14	S[	13.5	GA	40	L	7	100	! 1				MOD
1990 12 18.18	I[	13.0		41	L	4	183					HAL
1990 12 20.19	S[	12.9	GA	35.9	L	7	85	! 1				MOD
1991 01 11.16	S[	13.0	NP	25.6	L	4	156					MOR
1991 01 13.20	S[	13.3	NP	25.6	L	4	156					MOR
1991 02 10.18	S[	13.3	NP	25.6	L	4	156					MOR

Periodic Comet Shoemaker-Levy 1 (1990o)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 11 17.25	S	12.6	AC	41	L	4	183					HAL
1990 11 19.31	S	12.6	WA	41	L	4	183					HAL
1990 12 07.18	S	13.2	AC	41	L	4	183					HAL
1990 12 19.24	I[	13.5		41	L	4	183					HAL

Review of Recent Books from the University of Arizona Press

The Galaxy and the Solar System, edited by R. Smoluchowski, J. N. Bahcall, and M. S. Matthews (1986, 483 pp.), US$29.95.
Meteorites and the Early Solar System, edited by J. F. Kerridge and M. S. Matthews (1988, 1269 pp.), US$55.00.
Asteroids II, edited by R. P. Binzel, T. Gehrels, and M. S. Matthews (1989, 1258 pp.), US$50.00.

A civilization which destroys what little remains of the wild, the spare, the original, is cutting itself off from its origins and betraying the principle of civilization itself. If industrial man continues to multiply his numbers and expand his operations he will succeed in his apparent intention, to seal himself off from the natural and isolate himself within a synthetic prison of his own making. — Edward Abbey, *Desert Solitaire*

Those words from Abbey's best-known book should hit home to all astronomers — particularly those who actually observe themselves. Light pollution is worsening worldwide as every year passes, and astronomers must become aware of the fact that development equals outdoor lighting. For this reason, it is imperative that astronomers join with environmentalists to slow the destruction of wild lands and to preserve what is left of wilderness areas — areas that lack artificial lighting almost "by definition". Visual observers are suffering more than are high-tech professional observers due to efforts at using specific types of light bulbs (rather than working on proper shielding of lights). All astronomers should support the International Dark Sky Association and actively lobby for *light shielding* and strict lighting laws.

The University of Arizona Press (Suite 102, 1230 N. Park Ave., Tucson, AZ 85719-4140) is one of the more impressive publishers that I have seen, particularly among university presses. They publish many good books that may not become national best sellers but which serve very useful purposes, and these books are always attractively printed and are distributed at reasonable prices. While specializing in books on the southwestern United States — some of which I can enthusiastically recommend to lovers of nature, including such interesting monographs as *Desert Solitaire*, Dellenbaugh's *A Canyon Voyage*, and Kolb's *Through the Grand Canyon from Wyoming to Mexico* — the U.A. Press has been known for some time as a publisher of authoritative books on astronomy. Their so-called "Space Science Series" has had three recent additions that are of interest to cometary scientists — *The Galaxy and the Solar System*, *Meteorites and the Early Solar System*, and *Asteroids II*, all of which are hardbound books.

The Galaxy and the Solar System is a collection of 22 papers, divided into six broad topic sections and representing a meeting held in 1985 January. This book has the broadest topical coverage and the strongest coverage of comets of the three "Space Science series" books reviewed here, as is illustrated by the following paper titles: "Stars Within 25 Parsecs of the Sun", "Molecular Clouds and Periodic Events in the Geologic Past", "A Local Recent Supernova: Evidence from X-Rays, ^{26}Al Radioactivity, and Cosmic Rays", "Dynamical Evidence for Planet X", "Dynamical Influence of Galactic Tides and Molecular Clouds on the Oort Cloud of Comets", and "Deflection of Comets and other Long-Period Solar Companions into the Planetary System by Passing Stars". Other papers stressing comets include J. M. Greenberg's "The Chemical Composition of Comets and Possible Contribution to Planet Composition and Evolution", A. H. Delsemme's "Cometary Evidence for a Solar Companion?", and P. R. Weissman's "The Oort Cloud and the Galaxy: Dynamical Interactions". The debate concerning significance of periodicity of mass extinctions in the geological record is continuing, with little change in the six years since this conference was held in Tucson. This book includes the argument in favor of a 33-Myr period of mass extinction by M. R. Rampino and R. B. Stothers, and S. Tremaine's paper argues that "the statistical evidence for periodicity is very weak". Several papers deal with attempts to account for a possible solar companion that might cause such periodical extinctions. One of the more interesting and detailed articles in this monograph is "Mass Extinctions, Crater Ages, and Comet Showers", by E. M. Shoemaker and R. F. Wolfe. If you are interested in these topics, you should look at *The Galaxy and the Solar System.*

Meteorites and the Early Solar System is a mammoth book that discusses the physical chemistry, classification, and potential initial sources of meteorites. Co-editor Kerridge notes in the "Preface" that the book is intended to be of value to "established scientists in other disciplines who [need] to draw upon the results of meteorite research in connection with their own studies". Comets are touched on in numerous papers as authors speculate on their contributions to the formation of the early solar nebula and the Oort cloud, and to the existence of interplanetary dust particles.

Asteroids II is another large book, intended to update its 1979 predecessor, *Asteroids*, which I reviewed in the the Oct. 1984 of the *ICQ*. As in that earlier review, this book brings comets into active discussion when dealing with the connection between asteroids and comets. Since *Asteroids* was published, numerous candidates have been discovered to add evidence to the evolution of comets into objects of asteroidal appearance, and some of these candidates have been discussed in the "Recent News and Research Concerning Comets" column that I regularly write. Paul Weissman, Michael A'Hearn, Lucy McFadden, and Hans Rickman author the chapter specifically dealing with this problem in *Asteroids II*. A paper by Linda French *et al.* discusses "Distant Asteroids and Chiron"; (2060) Chiron is the only numbered minor planet that definitely exhibits a coma, or atmosphere. Earth-approaching asteroids are dealt with in a paper by McFadden *et al.*, and a couple of papers discuss the *IRAS* satellite observations of asteroids and comets. *Asteroids II* also contains articles on the meteorite connection and on hypotheses of solar system evolution, bringing us full circle again to the other books discussed above — *The Galaxy and the Solar System* and *Meteorites and the Early Solar System.* There is complex interaction, not only among objects in the solar system, but also among solar system objects and extra-solar systems. The University of Arizona press should be commended for continuing publication of this valuable series on solar system astronomy. — D. W. E. Green