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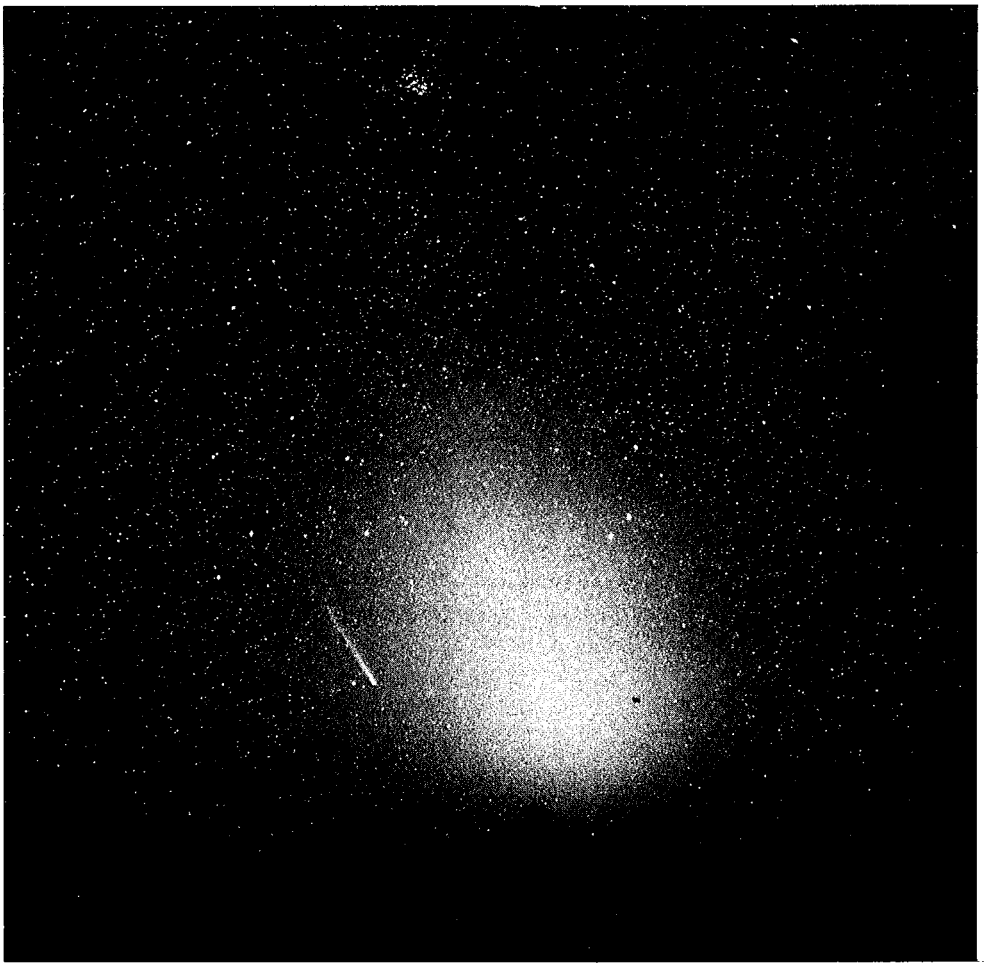

Photograph of Comet Ikeya 1963 I and zodiacal light, taken the evening of 1963 March 13 by Alan McClure. The 10-min exposure was taken on panchromatic film with a wide-angle reflex camera.

INSIDE THIS ISSUE

The International Comet Quarterly (*ICQ*) is a non-profit journal devoted to news and observation of comets. Regular issues are published 4 times per year (January, April, July, and October), with an annual *Comet Handbook* of ephemerides published as a special fifth issue in the second half of the year. 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 the January issue of the following volume; 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).

Manuscripts will be reviewed for possible publication (send 2 copies of 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* 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 mail via the computer networks *BITNET* (GREEN@CFA) or *SPAN* (CFAPS2::GREEN), or via floppy disks], and should contact the Editor for further information.

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— *CORRIGENDA* —

• January 1988 issue, p. 22, Comet Furuyama, line 15 of data should be deleted (*i.e.*, SHA02 did not see the comet on Dec. 13.90 UT, and the magnitude should be given as [11.0:).

• July 1988 issue, p. 85, Comet Liller 1988*a*, in the observation by Stefan Korth (KOR) on 1988 June 18.94 UT, the instrument aperture *should read* 12.5 cm (instead of 8.1).

• October 1988 issue, p. 124, line –2, *for* this new sources *read* this new source

• December 1988 issue (*1989 Comet Handbook*), p. H56, "Magnitudes.", second paragraph, delete the second half of the first sentence, beginning with ". . . though we have retained"

• December 1988 issue (*1989 Comet Handbook*), p. H5, "Index to Ephemerides", note that the long-period comets after "M" are listed alphabetically after the short-period comets (contrary to what is stated in the heading)

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THE LAST 32 COMETS TO RECEIVE PROVISIONAL LETTER DESIGNATIONS

Listed below, for handy reference, are the last 32 comets which have been given letter designations (1985a is the first comet to be discovered or recovered in 1985, 1985b 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 parenthetically are such values as the date of perihelion, T (month/date/year), and the perihelion distance, q (in AU). Four-digit numbers following the letter "I" (in brackets) indicate the IAU Circular containing the discovery/recovery announcement. [This list updates the previous list in the October 1987 issue, p. 140.]

1987b1 = * McNaught (T = 12/11/87, q = 0.84)
1987c1 = P/Longmore (T = 10/12/88, q = 2.4, P = 7.0)

1987d1 = * Ichimura (T = 1/10/88, q = 0.20)
1987e1 = P/Tempel 1 (T = 1/4/89, q = 1.5, P = 5.5)
1987f1 = * Furuyama (T = 2/28/88, q = 1.7)
1987g1 = * Jensen-Shoemaker (T = 1/17/88, q = 3.3)
1988a = * Liller (T = 3/31/88, q = 0.84) [I4527]

1988b = * Shoemaker (T = 3/19/87, q = 5.0) [I4547]
1988c = * Maury-Phinney (T = 12/26/87, q = 1.9) [I4549]
1988d = * P/Hartley 3 (T = 7/14/87, q = 2.4, P = 6.8) [I4553]
1988e = * Levy (T = 11/29/87, q = 1.17) [I4566]
1988f = P/Finlay (T = 6/6/88, q = 1.09, P = 7.0) [I4586]

1988g = * Shoemaker-Holt (T = 2/14/88, q = 1.17) [I4598]
1988h = * Shoemaker-Holt-Rodriquez (T = 6/12/89, q = 2.5)
1988i = P/Churyumov-Gerasimenko (T = 6/18/89, q = 1.3)
1988j = * Machholz (T = 9/17/88, q = 0.17) [I4636]
1988k = P/Kopff (T = 1/20/90, q = 1.6, P = 6.5) [I4647]

1988l = * SMM 3 (T = 6/27/88, q = 0.0053) [I4648]
1988m = * SMM 4 (T = 8/21/88, q = 0.0058) [I4660]
1988n = * SMM 5 (T = 10/12/88, q = 0.0053) [I4668]
1988o = * P/Ge-Wang (T = 5/23/88, q = 2.5, P = 11.7) [I4676]
1988p = * SMM 6 (T = 11/18/88, q = 0.0056) [I4684]

1988q = * SMM 7 (T = 10/24/88, q = 0.0058) [I4692]
1988r = * Yanaka (T = 12/11/88, q = 0.43) [I4696]
1989a = * Yanaka (T = 11/1/88, q = 1.9) [I4697]
1989b = * P/Helin-Roman-Crockett (T = 9/6/88, q = 3.4) [I4701]
1989c = * P/Bradfield 2 (T = 12/5/88, q = 0.42) [I4703]

1989d = P/Russell 3 (T = 5/17/90, q = 2.5, P = 7.5) [I4710]
1989e = * Shoemaker (T = 2/25/89, q = 2.6) [I4717]
1989f = * Shoemaker (T = 11/2/88, q = 2.2) [I4724]
1989g = P/Pons-Winnecke (T = 8/19/89, q = 1.3) [I4736]
1989h = P/Clark (T = 11/28/89, q = 1.6, P = 5.5) [I4742]

RECENT NEWS AND RESEARCH CONCERNING COMETS

New Discoveries and Recoveries

In the last edition of this column (July 1988 issue, p. 92), I mentioned the discovery of comet 1988*j* by Don Machholz on August 6. A much-delayed report from the National Astronomical Observatory in Tokyo (cf. *IAUC* 4641) revealed the independent discoveries of this comet by no fewer than five Japanese amateurs on August 8; three of the five have previously discovered comets (K. Takamizawa, M. Terasako, and S. Fujikawa), and a fourth was soon to discover two comets (T. Yanaka). Comet Machholz 1988*j* went the way of Comet Machholz 1985 VIII (1985*e*), fizzling out as it approached perihelion ($q \simeq$ 0.17 AU, $T \simeq$ 1988 Sept. 17), fading intrinsically and not becoming very condensed; the final definite observations were obtained during the first week in September. No definite post-perihelion observations were recorded, despite some false alarms. NASA's *Solar Maximum Mission (SMM)* satellite did not detect the comet near the time of perihelion with its coronograph, and it was concluded that the comet was then fainter than mag $\sim$ 4. Photographic and CCD observations by various observers during the first two weeks in October (when the comet's orbit would have carried it again into a dark sky) quickly revealed that it must have completely broken apart (negative reports giving the magnitude fainter than 16 to 20).

The *SMM* staff discovered further images gathered by the on-board coronograph which were suggestive of comets, and Brian G. Marsden (Harvard-Smithsonian Center for Astrophysics) showed that Kreutz-sungrazing-type cometary orbits could fit all of the objects. Unlike the numerous presumed sungrazing comets from *SOLWIND* and *SMM* during the past decade, these new objects were reported within weeks (often within days) of appearance, and it was decided to give these objects preliminary letter designations (in addition to the eventual Roman-numeral designations). Thus, comets SMM 3, SMM 4, SMM 5, SMM 6, and SMM 7 were given the respective designations Comets 1988*l*, 1988*m*, 1988*n*, 1988*p*, and 1988*q*, having all passed perihelion during June–November. The comets ranged from estimated magnitudes +1 to "much brighter than" −4; the brightest comet, SMM 5, also had the longest tail seen amongst the *SMM* comets, > 2 solar radii. Attempts were made by Rob H. McNaught to find the brighter comets on pre- and post-perihelion Schmidt photographs exposed at Siding Spring Observatory (Australia), but nothing was found; at best, the brighter sungrazing *SMM* comets would be around mag 18–20 at pre-perihelion elongations > 50°. Unfortunately, the earth's upper atmosphere rapidly is causing *SMM*'s orbit to decay, and it is predicted that the satellite has only a few more months (at best) to collect data.

Y.-l. Ge and Q. Wang discovered comet 1988*o* photographically (40-cm Schmidt telescope; cf. *IAUC* 4677) on 1988 November 4 as a 16^{th}-magnitude diffuse object in Cetus. Carolyn and Eugene Shoemaker, observing with the 18-inch (46-cm) Schmidt telescope at Palomar Mountain, had recorded this comet on two nights prior to this (Oct. 11, Nov. 4) but had not yet been able properly to scan the films; nonetheless, their observations were sufficient to show that the object was a new short-period comet, with $T \simeq$ 1988 May 23, an orbital period around 11 years, and a perihelion distance of 2.5 AU.

Tetsuo Yanaka (Motegi, Tochigi, Japan) discovered two new comets in rapid succession with 25×150 binoculars on 1988 Dec. 29 (comet 1988*r*) and 1989 Jan. 1 (1989*a*). Comet Yanaka 1988*r* was near total visual magnitude 9 at discovery in the morning sky (elongation from sun 38°); it sported a short tail toward the northwest, and the comet was located in Ophiuchus (moving southwestward). The last-quarter moon occurred on Dec. 31, and it appears that Yanaka got a jump on other comet hunters by observing in bright moonlight. Comet 1989*a* was in Bootes (not far from Arcturus; elongation from sun 80°) upon discovery, near total visual mag 11 and moving northeastward. Both of Yanaka's comets had passed perihelion in late 1988, and both faded quite rapidly during January and February.

The Central Bureau for Astronomical Telegrams was kept busy as new comet discoveries kept coming in quick succession. Next was comet 1989*b*, a sixteenth-magnitude object near opposition discovered photographically with the 18-inch (46-cm) Schmidt telescope at Palomar by Eleanor Helin, Ron Helin, Brian Roman, and Randy Crockett, which turned out to be a new short-period comet. P/Helin-Roman-Crockett passed perihelion in early Sept. 1988 at a distance of $q \simeq$ 3.4 AU; it has an orbital period around eight years.

Then came P/Bradfield 2 (1989*c*), the fourteenth comet discovered by William A. Bradfield (Dernancourt, Australia): this diffuse object was near total visual mag 12, moving northeastward in the southern constellation of Indus (elongation from sun 40°) when found by Bradfield on January 6. P/Bradfield 2's elongation rapidly decreased and its brightness faded, but enough observations were obtained to determine that it has a period around 72 years (T = 1988 Dec. 5, q = 0.42 AU, i = 83°; cf. *MPC* 14154). McNaught reports that comet 1989*c* had a faint 3′ tail toward the south on a February 5 plate taken by Malcolm Hartley with the U.K. Schmidt telescope. [Note that Comet Bradfield 1983 XIX (= 1984*a*) now becomes P/Bradfield 1.]

Despite the Shoemakers' missing P/Ge-Wang, they quickly found two new comets in January. This created a new record of the number of new comet discoveries at a single dark run: six. But the Shoemakers continue to extend their record number of comet discoveries among active observers, and they are now tied for third place on the all-time discovery list. As of this writing, those observers with ten or more comets named after them are (asterisks indicating they are still actively observing): Pons, 26; Brooks, 21; Shoemaker, 16*; Barnard, 16; Bradfield, 14*; Swift, 14; Tempel, 13; Honda, 12*; Mrkos, 12*; Giacobini, 12; Messier, 12; Borrelly, 11; Hartley, 10*; Peltier, 10; Winnecke, 10. (As we go to press, Malcolm Hartley has just discovered his tenth comet — 1989*i* — along with Q. Parker, using the U.K. Schmidt Telescope.)

Comet Shoemaker 1989*e* was near total visual mag 13 when discovered in mid-January as it moved northwestward in the 'sickle' of Leo. On the discovery films, it appeared strongly condensed with a tail > 5′ long toward the southwest (cf. *IAUC* 4717). This comet — visible in large amateur telescopes — is passing perihelion about the time of this writing, at q = 2.6 AU.

Comet Shoemaker 1989*f* passed perihelion early last November at $q = 2.2$ AU, prior to its discovery by the Shoemakers. Discovery films taken on Jan. 11 and 14 showed the 16^{th}-mag diffuse object to be somewhat asymmetric toward the southwest (cf. *IAUC* 4724); it was then moving northwestward in Ursa Major.

The 1980s have been amazing years for comet observation at Palomar Observatory, in which all four (18-, 48-, 60-, and 200-inch) telescopes have been employed for such work. The number of overall new discoveries really stands out: in this decade, no fewer than 27 comets have been named for discoverers using the two Schmidt telescopes — all during 1981-date. For comparison, during that same $\sim$ 8-year span, there were 80 new comets found worldwide (excluding *SOLWIND* and *SMM* comets), meaning that the Palomar comets constitute one-third of the total. [Visual discoverers have their names on some 30 percent of the 80 comets in that time span.]

Other recent comet recoveries — all by Jim Gibson with the 60-inch (1.5-m) Cassegrain reflector (+ CCD) at Palomar — include P/Russell 3 (1989*d*), P/Pons-Winnecke (1989*g*), and P/Clark (1989*h*). P/Russell 3, making its first predicted return to perihelion following its 1983 discovery, was at $m_2 \sim 20$ with a faint 5″ coma and sharp central condensation when located on January 1 (cf. *IAUC* 4710); the indicated correction to the prediction in the *ICQ 1989 Comet Handbook* is $\Delta T = -0.36$ day. P/Pons-Winnecke, making its 20^{th} observed return to perihelion, appeared stellar at $m_2 \simeq 20.5$ (Gunn *r* filter used) on Jan. 17 and 18 (cf. *IAUC* 4736). P/Clark was around $m_1 \sim$ 19–20 when found on Jan. 2, 17, and 18; it then showed a 5″ coma with condensation and a short tail toward the west-northwest (cf. *IAUC* 4742). P/Clark has been observed at three previous apparitions.

P/Kopff and CRAF

E. M. Alvarez and others reported the recovery of P/Kopff (comet 1988*k*) from observations obtained in 1988 February and March at Mauna Kea in Hawaii; the observers' delay in reporting the recovery prevented the news from being announced until late August (on *IAUC* 4647). The object appeared basically stellar, of red magnitude $\simeq$ 21. A big piece of news for cometary astronomers — which involves P/Kopff — came in January, as out-going U.S. President Reagan released his 1990 budget, which included a new start for the *Comet Rendezvous/Asteroid Flyby (CRAF)* mission. The *CRAF* mission had been submitted each year during the last several years by NASA, and each time it had been turned down by the Reagan administration. New-President George Bush appears to be solidly behind NASA, and his revised 1990 budget also includes *CRAF* (cf. *Science* **243**, 881). It now goes to Congress for review; as Congress is not known for cutting NASA spacecraft when the President's proposed budget has included them, *CRAF*'s new start appears fairly sure. The new comet target will now be P/Kopff, as announced by Lennard A. Fisk (Associate Administrator for Space Science and Applications, NASA) at the Boston meeting of the American Astronomical Society on January 10. The idea is a 1995 August launch, a fly-by of the minor planet (449) Hamburga, and a rendezvous with P/Kopff near the comet's aphelion distance in 2000 July; *CRAF* would then remain in the comet's vicinity as the comet approaches perihelion more than two years later. P/Wild 2 has been designated the "backup comet" to P/Kopff. The Cassini spacecraft to Saturn was given a new start along with *CRAF*.

Other Comets under Observation

P/Tempel 2 was well observed in 1988 and early 1989, gaining a significant coma sometime in May or June 1988 and greatly increasing in brightness during July and August. Prior to *CRAF*'s cancellation last year, P/Tempel 2 was the planned spacecraft target, and this led to more observations than usual for a comet of this nature.

Richard M. West reported observations (cf. *IAUC* 4712) of P/Halley made in early January 1989 with the 1.5-m Danish telescope at the European Southern Observatory in Chile. Comet 1986 III still exhibited a "smooth, circular, outer coma" of diameter 1′, and had a nucleus of mag $V = 23.6$. He adds that "the inner coma seen last May is no longer present".

Comet Wilson 1987 VII still exhibits a double nucleus, with the secondary body being some 2 mag fainter than the primary nucleus, according to January observations by Steve Larson and David Levy in the Catalina Mountains of Arizona (cf. *IAUC* 4722).

P/Schwassmann-Wachmann 1 has continued to be much more active in the last year than it had been for several years preceding, likely due to greatly increased solar activity as the sun approaches the maximum point in its 11-year cycle much earlier than usual.

Other News

The unusual minor planet (2060) Chiron has been reported as anomalously bright in 1988 by $\sim$ 1 magnitude (cf. *IAUC* 4653). This object is in an unusual orbit between Saturn and Uranus, and — like Pluto — could be cometary in nature. However, no discernable coma and no detectable emission features could be found.

In other spacecraft news, Japan's *Sakigake* (a plasma probe that obtained data on P/Halley in 1986) is now scheduled for a 1996 February 3 flyby of P/Honda-Mrkos-Pajdušáková following four Earth swing-bys, and the European Space Agency is considering sending *Giotto* to this same comet for a flyby some four days earlier.

The third edition of the *ICQ* Cometary Photometric Archive on 9-track magnetic tape is now available, containing all data published in the *ICQ* from the 1970s through the October 1988 issue. The Archive also contains $\sim$ 600-700 observations of P/Halley from 1909-11 and 1981-85 that were published previously in non-*ICQ* sources. The tape contains 5323 m_1 estimates of P/Halley (plus 19 "negative" estimates, where the comet was not seen and an "upper" limit was given). The next "top-ten" short-period comets, with the most observations in the Third-Edition Archive (with number of 1-line observations given parenthetically) are: P/Giacobini-Zinner (916), P/Borrelly (641), P/Kopff (575), P/Stephan-Oterma (511), P/Churyumov-Gerasimenko (425), P/Encke (396), P/Schwassmann-Wachmann 1 (347), P/Tempel 2 (346), P/d'Arrest (343), and P/Tempel 1 (341). Note that many observations of P/Schwassmann-Wachmann 1 are negative ones.

The similar list of top-ten long-period comets in the Third-Edition *ICQ* Archive follows: Bradfield 1987*s* (1560), Kohler 1977 XIV (1116), Austin 1982 VI (874), Liller 1988*a* (725), Wilson 1986*l* (698), Kobayashi-Berger-Milon 1975 IX (671), Bradfield 1979 X (635), Panther 1981 II (507), Kohoutek 1973 XII (497), Sorrells 1986*n* (455). (Comet West 1976 VI has 426 observations, and Comet IRAS-Araki-Alcock 1983 VII has 342 observations.) For further information concerning the Archive on magnetic tape, contact the Editor.

— *Daniel W. E. Green (1989 March 4)*

TABULATION OF COMET OBSERVATIONS

In this issue and the October 1988 issue, we have again been publishing observations from the files of the Comets Section of the Association of Lunar and Planetary Observers (ALPO), dating back to the 1960s and 1970s. Most of these observations have never been published anywhere until now, and we are working toward finishing publication of the ALPO data during the next year. Due to the large number of observations, it has been decided to publish descriptive information (that is, in text form, as below) only for observations made by John E. Bortle (BOR), the leading active observer of the past three decades, as his carefully-made observations have consistency that allows one comet's appearance to be compared readily with another. Also published among the descriptive information below are remarks relating to tabulated data from the October 1988 issue. A new addition to the Magnitude Method Key is: v = photoelectric with filters to match visual.

Descriptive Information (to complement the Tabulated Data):

◇ *Comet Honda* 1968 *VI* (all notes by BOR; complements tabulated data on page 83 of October 1982 issue) ⟹ 1968 July 7.34: in 12.7-cm *f*/4 R (20×), coma is small and apparently circular with poorly defined boundaries; coma may be somewhat condensed (unsure). July 22.34: in 15.2-cm *f*/4 L and 16×50 B, coma much more condensed than on the 7th or 8th but of similar diameter; a small central cond. (< 20″) was vaguely apparent at low powers but not higher ones; at maximum power (150×), an extremely faint stellar nucleus was noted (mag 11-12), which was eccentrically placed toward the sunward side of the coma (p.a. ~ 90°) — this was also the case with the central cond. July 24.34: circular coma has undefined boundaries, and is well condensed with a strong central or nuclear cond. of very small diameter — the cond. is almost stellar at low powers (15.2-cm L, 33×, 29×), but vague at 90× and invisible above ~ 100×. July 26.34: an apparent stellar nucleus of mag ~ 10 is visible at intermediate powers (15.2-cm L, 71×, 90×) but becomes very faint and difficult at high ones (up to 215×), giving doubts as to its reality; it is possibly offset toward the sunward side of the coma (p.a. ~ 90°). July 29.34: in 15.2-cm *f*/4 L, a narrow, straight tail was seen extending ~ 13′ toward p.a. 315° (this was not visible in binoculars: correction to *ICQ* No. 44, p. 83); tail was faint with its maximum width near its beginning (possibly 3′-4′), tapering as it advanced. The coma is well condensed, but without central cond.; an apparent stellar nucleus (fairly bright) was noted at low power but became increasingly fainter with increasing magnification until at maximum power (215×) it was extremely faint; coma still appears circular with poorly defined boundaries.

Aug. 3.33: in 15.2-cm *f*/4 L, an extremely faint tail of width 3′-4′ and length 15′ was seen; the tail was not seen in binoculars (correction to *ICQ* No. 44, p. 83). A stellar nucleus of mag 11.5 was visible, centrally located; it was also stellar in a 25.4-cm L at medium power. Aug. 4.33: Tail in direction of p.a. 285° was long (certain to 25′ length, suggested out to 40′) and very faint; it was straight and narrow with ill-defined boundaries. The second tail (toward p.a. 300°) was more difficult but seemed to extend for 20′ to 25′; the two tails were never seen simultaneously. There was also a suggestion of a diffuse glow extending from the rear of the coma in the anti-sun direction. Aug. 8.34: "no tail apparent, undoubtedly due to moonlight"; coma appears circular with a nucleus or nuclear cond. which is centrally located; in 15.2-cm L, no nucleus seen at 100×; probable small, diffuse central cond. noted with averted vision at 50×. Aug. 12.35: vague suggestion of two tails, one pointing somewhat north of west, the other almost due NW; the former seemed to be the brighter; suggested lengths possibly 0.5 deg. There was a diffuse "stellar" nucleus, like a very faint star viewed through a mist; this was possibly surrounded by a very vague central cond. < 1′, which was suggested with averted vision at 100× (15.2-cm *f*/8 L). Aug. 16.35: in 15.2-cm *f*/8 L, a possible very faint, straight tail of length ~ 10′ and width ~ 2′ was suggested extending toward p.a. 280° (correction to *ICQ* No. 44, p. 83: tail not seen in binoculars). The coma is strongly condensed, w/ a probable nuclear cond. of small diameter somewhat offset toward the east; coma appeared to be elliptical w/ the axis almost E-W (~ 10° off the p.a. of tail's axis). Aug. 19.21: tail is difficult and quite narrow; a nuclear cond. was offset (perhaps ~ 1′ to the E side of the coma. Aug. 27.11: In 15.2-cm *f*/8 L (50×), there seemed to be a stellar nucleus (mag ~ 10); in 16×50 B, coma somewhat more condensed, and no indication of tail (correction to *ICQ* No. 44, p. 83). Aug. 28.11: in 15.2-cm *f*/8 L, a nucleus or nuclear cond. seems present — either centrally located or slightly offset toward E side of the coma — but is better seen at 50× than 100×. Aug. 30.08: tail narrow (width probably no more than 2′), straight, and visible in 15.2-cm L and 10-cm R, but not in binoculars; comet faintly seen with naked eye as a glow ($m_1 \simeq 6.0$) in later hours; in the telescopes, an apparent stellar nucleus (mag 9-10) was offset in the coma opposite the main tail. Aug. 31.11: coma well condensed and apparently circular; the nucleus and the area of greatest cond. are offset toward p.a. 250°; $m_2 \simeq 8.5$-9 most probably.

Sept. 4.08: no tail apparent, probably due to strong moonlight; coma is strongly condensed and there is a strong suggestion of a stellar nucleus at 50× but almost none at 100× (15.2-cm *f*/8 L). Sept. 8.08: in 15-cm *f*/8 L, area of greatest coma cond. and the nucleus are offset toward p.a. 240°; at both 50× and 100×, there is a stellar nucleus vaguely apparent; coma's boundaries and shape completely undefinable; very strong moonlight. Sept. 13.10: in 15.2-cm *f*/8 L, faint, indistinct nucleus that is probably stellar, offset toward p.a. 300° by a slight amount, and not brighter than mag 10-11; no tail apparent. Sept. 14.10: stellar nucleus noted, offset slightly toward p.a. ~ 285°; the coma was fairly condensed in the 15.2-cm *f*/8 L, but not so in 16×50 B; suggestions of multiple tail toward E. Sept. 15.05: narrow, difficult tail; coma strongly elliptical with its main axis running p.a. 70°-250° but does not appear very condensed in 25.4-cm *f*/6 L; very small nuclear cond. visible, offset roughly toward p.a. 250°. Sept. 16.09: reasonably condensed coma surrounds a stellar nucleus of mag 11.5; nucleus and area of greatest cond. are offset toward p.a. ~ 30°. Sept. 19.06: "apparently a long, fairly narrow tail extends toward p.a. 25° and may be upwards of 20′ long, but it was never more than glimpsed"; in 15.2-cm *f*/8 L, nucleus of mag 11.5 noted, offset opposite the long tail. Sept. 28.04: no tail apparent; in 15.2-cm *f*/8 L, only slightest suggestion of a nucleus; coma's boundaries totally undefined. Sept. 29.07: in 15.2-cm *f*/8 L, area of greatest cond. and a weak nucleus appeared offset toward the southern part of the coma.

◇ *Comet Bally-Clayton* 1968 *VII* (all notes by BOR; complements tabulated data on page 84 of October 1982 issue) ⟹ 1968 Sept. 14.07: comet only barely above the sky background; once a nucleus or central cond. was suggested. Sept. 15.16: a nucleus — possibly stellar — was strongly apparent. Sept. 29.11: a faint nucleus — possibly of mag 13-13.5 — was seen and appeared irregular and possibly elongated or double with its axis running from p.a. ~ 160° to 340°; coma diffuse w/ little cond.

◇ *Comet Tago-Sato-Kosaka* 1969 *IX* (all notes by BOR; complements tabulated data on page 84 of October 1982 issue) ⟹ 1970 Jan. 20.02: "a thin, very faint tail up to 1° long was noted in both a 10.2-cm R and 56-cm M; coma strongly condensed w/ possible stellar nucleus glimpsed in each telescope but faint in both, probably not real." Jan. 22.01: strongly condensed coma, sharply condensed near the center; no nucleus or central cond. pronounced enough to be visible in binoculars; coma circular w/ ill-defined edges. Jan. 31.03: tail is quite straight and ~ $1\frac{1}{2}'$ wide; in 15.2-cm L, there is an apparent stellar nucleus seen at 50× (but weak at 100×) that is centrally located or slightly sunward; possible, very vague, round cond. located ~ 10′ tailward from the nucleus and 5′ to 7′ in diameter; m_1 estimate difficult because coma is large and strongly condensed. Feb. 2.00: tail straight and narrow, visible only in 15.2-cm L (correction to tabulated data on page 84 of *ICQ* No. 44); nucleus possibly surrounded by a weak central cond. only a few arcmin in diameter (m_2 = 10.5). Feb. 8.01: in 15.2-cm L, a probable tail up to $\frac{1}{2}°$ long toward p.a. ~ 80° was glimpsed; circular coma w/ outer edges diffuse but suddenly sharply condensed near the center: nucleus centrally located by probably not stellar at 100× (m_2 = 10.5). In binoculars, 8th-mag "nucleus". Feb. 13.02: a faint, straight, narrow tail projected possibly 20′ toward p.a. 75°-80°, its width not more than 2′; in 15.2-cm L, circular coma has weak central cond. $1\frac{1}{2}'$-2′ in dia. w/in which is an apparently stellar nucleus (visible only at 50×) offset toward the tail (m_2 = 10.8). Feb. 18.01: strong moonlight; coma probably circular, diffuse w/ totally undefined boundaries; no nucleus, but a possible vague central cond. ~ 2′-3′ in dia., centrally located. Feb. 20.05: strong moonlight; no m_1 estimate made; in 56-cm *f*/15 M, a bright, condensed nebula with a nucleus (mag perhaps 12.5-13) located in the western part of a small central cond., which itself is possibly 15″ to 20″ in dia. and is also slightly eccentric to the W side of the coma. Feb. 21.04: in 15.2-cm *f*/8 L, occasional suggestion of a nucleus. Feb. 24.02: in 15.2-cm *f*/8 L, nucleus of mag 11.5 occasionally glimpsed (but more often at 50× than at 100×), appearing offset toward p.a. 20° relative to the coma's center and also to a possible large (~ 2′), poorly-defined central cond. Mar. 10.03: in 15.2-cm *f*/8 L, coma circular w/o central cond. or nucleus.

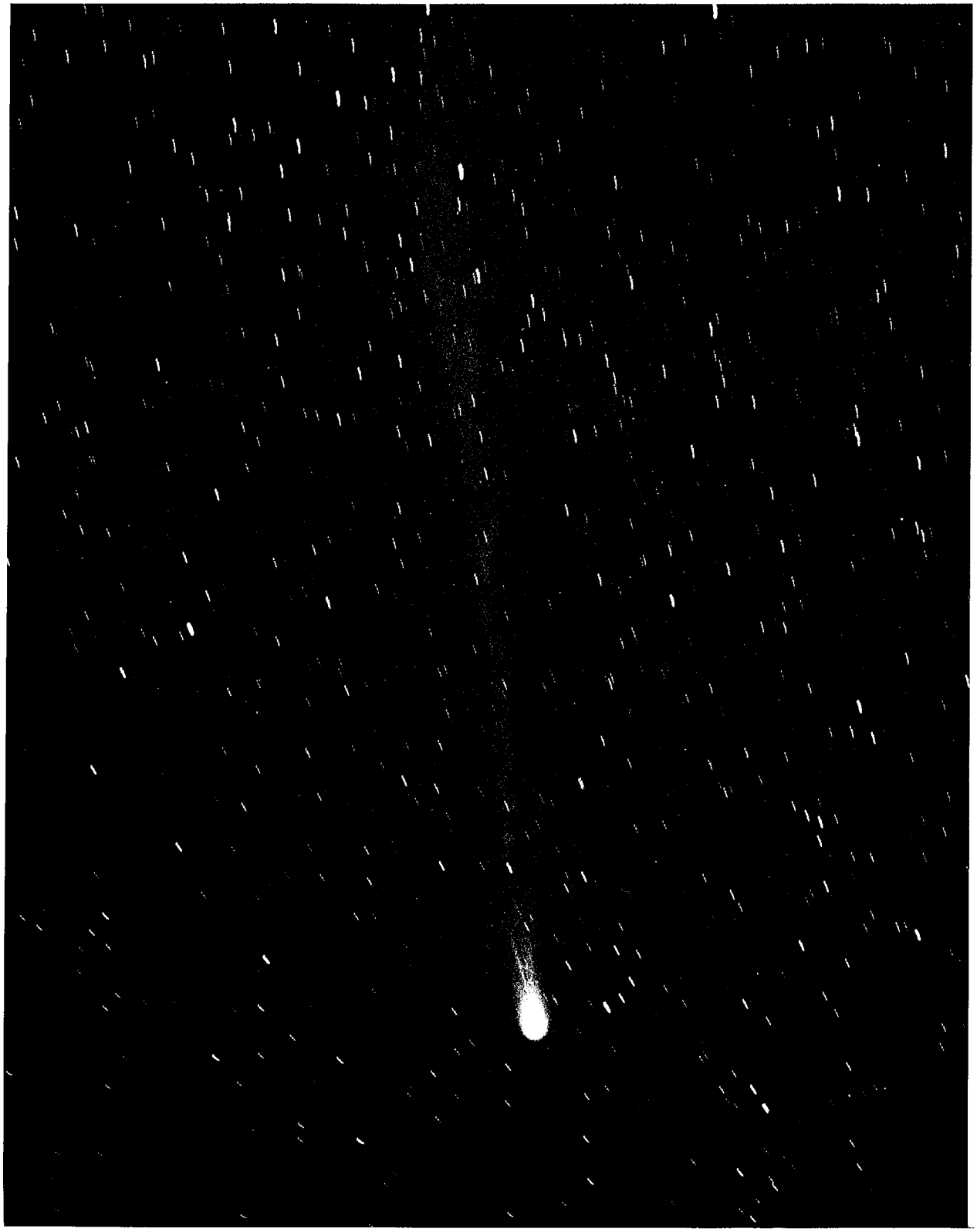
◇ *Comet Bradfield* 1987 *XXIX* ⟹ 1987 Dec. 17.04: in 25-cm *f*/4.5 L (179×), coma dia. 6.5′, DC = 6; 4.8-deg "ion" tail in p.a. 49°, also 3.8-deg tail in p.a. 60°; knot of material in "ion tail" 3.1° from head; faint central spine in dust tail also visible; cond. intense and surrounded by bright material. [JAC01]. 1988 Jan. 13.18: "there was a faint dust fan extending from the anti-tail, passing through N and connecting with the main tail; in 25.6-cm *f*/4.5 L (156×), there were indications of nuclear activity [*i.e.*, jets and hood(s)]" [MOR]. Feb. 8.17: tail was straight, narrow, and very faint [MOR]. Feb. 10.15: tail was much less obvious [MOR].

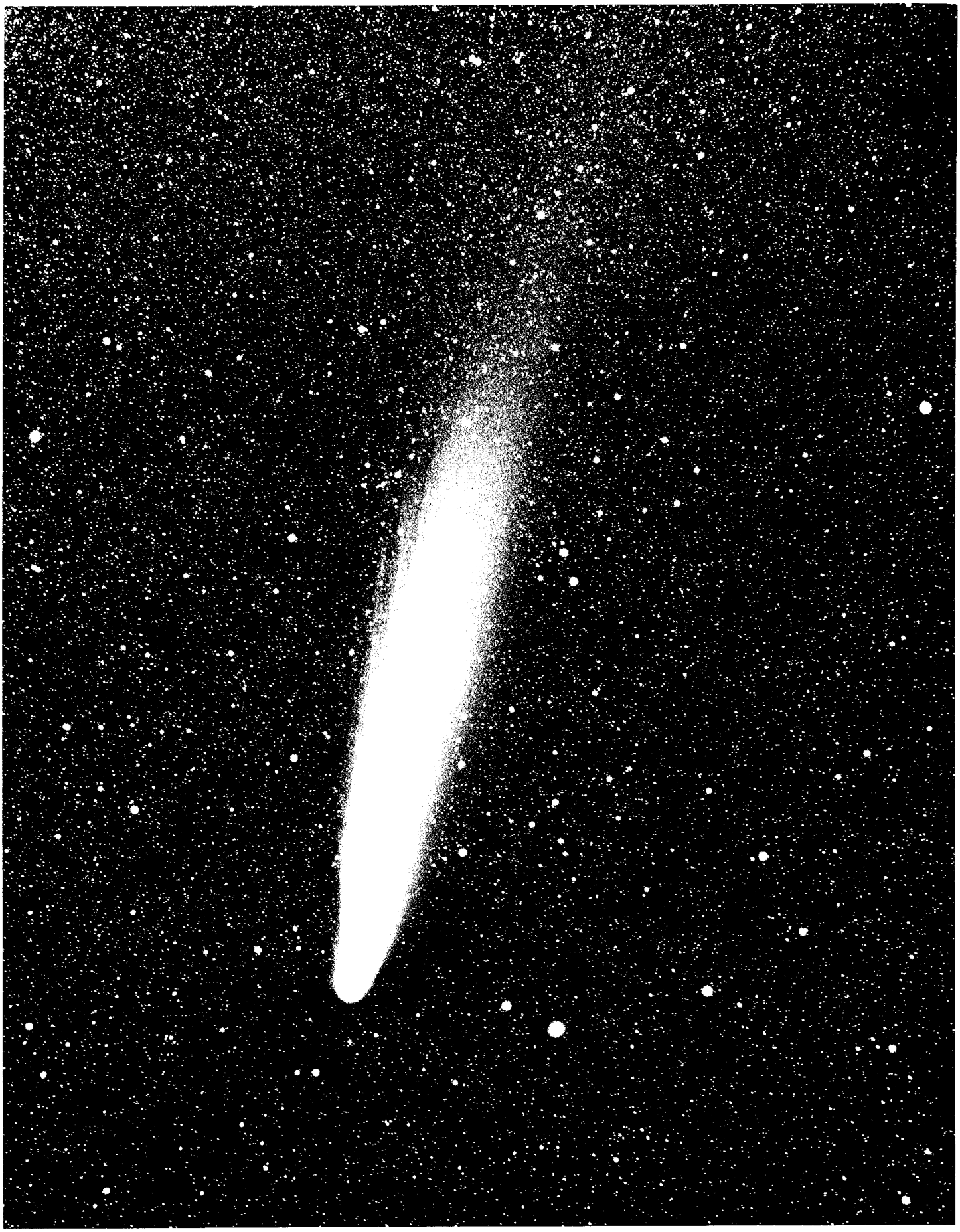
◇ *Comet McNaught* 1987 *XXXII* ⟹ 1988 Feb. 22.53: comet involved with star — may have affected m_1 and coma dia. estimates [MOR].

◇ *Comet Liller 1988a* ⟹ 1988 Apr. 6.11: in 6-cm R, "dust tail" spanning p.a. 356°-3° [JAC01]. Apr. 11.14: in 25-cm *f*/4.5 L (82×), 30′ "dust tail" spanning p.a. 347°-355°; coma well condensed, cond. ill-defined; "possible ion tail visible behind dust tail" [JAC01]. Apr. 11.84: in 9×63 B, narrow "type-I" 24′ tail w/ very conspicuous, starlike central cond.; in 20.3-cm *f*/10 T (100×), coma dia. 2′.0, DC = 7, broad "type-II" 6′ tail in p.a. ≃ 0° [KAM01]. Apr. 12.13: in 25-cm L, 0°.58 wispy, broad tail spanning 338°-355°; cond. very bright and nearly stellar, m_2 = 6.9 (ref. AA); cond. near tip of parabolic coma, nearly ⊥ to envelope visible at edge of coma [JAC01]. Apr. 15.81: 2°.5 tail is "ion" tail; also 1°.2 "dust" tail in p.a. 335° [PLE01]. Apr. 18.13: in 10×50 B, "dust tail" spanning p.a. 320°-340°; edges of tail quite faint while center of tail is quite bright [JAC01]. Apr. 18.83: 0°.25 tail is "ion" tail; also 0°.66 "dust" tail in p.a. 340° [PLE01]. Apr. 24.45: comet was small and condensed with narrow, straight tail [MOR]. Apr. 24.98: in 20.3-cm *f*/10 T (80×), coma dia. 2′.8, "no trace of expected anti-tail; central cond. still very conspicuous and starlike" [KAM01] May 6.95: in 20.3-cm *f*/10 T (50×), coma dia. 3′.5, well-defined coma; central ~ 20″ is considerably brighter, but no stellar central cond. [KAM01]. May 6.96: 0°.75 tail is "ion" tail; also 30′ "dust" tail in p.a. 0° [PLE01]. May 10.19: fan-shaped tail with the eastern edge being longest [MOR]. May 11.93: in 20.3-cm *f*/10 T (50×), coma dia. 3′.7, DC = 6, bright inner coma w/ stellar central cond.; streamer ~ 10′ long within tail [KAM01]. May 12.89: 0°.83 tail is "dust" tail; also 45′ "ion" tail in p.a. 45° [PLE01]. May 15.23: fan-shaped tail extending between p.a. 20° and 52°, longest in p.a. 45° [MOR]. May 22.92: fan tail spanning p.a. 30°-70°, the tail being long towards p.a. 60° [PER01]. June 2.88: with 20-cm *f*/2 Baker-Schmidt camera and TP 2415 gas-hypered film (10-min exposure), comet shows fan-shaped tail 36′ long spanning p.a. 8°-92° [MIK]. June 4.24 and 9.23: faint dust fan was visible between the two tails [MOR]. July 17.22: stellar cond. seen; possible tail [MOR]. Aug. 9.20 and 12.18: comet very low [MOR].

◇ *Comet Machholz 1988j* ⟹ 1988 Aug. 11.11: photograph with 20-cm *f*/2 Baker-Schmidt camera (+ TP 2415 gas-hypered film) shows 2′ diffuse coma w/ central cond. (DC = 5); no tail detected; mag ~ 9 [MIK]. Aug. 12.16: central cond. of mag 10; coma elongated in westward direction [KOR]. Aug. 15.11: photograph with 20-cm *f*/2 Baker-Schmidt camera (+ TP 2415 gas-hypered film) shows 1′.5 diffuse coma w/ central cond., DC = 5; looks somewhat fainter than on Aug. 10-11 [MIK]. Aug. 17.36: in 31.7-cm *f*/5.6 L (68×), coma dia. 2′.5 and DC = 3 [BOR]. Aug. 16.73: in 15.2-cm *f*/5 L (76×), broad tail ~ 0°.17 long in p.a. 285° [SEA]. Sept. 2.79: broad tail w/ central spine visible in 25.4-cm L [SEA]. Sept. 6.79: in 25.4-cm *f*/4.5 L (114×), 12′ tail in p.a. 248°; at 190×, no discrete central cond. or nucleus visible (DC = 5) [SEA]. Oct. 7.18: searches conducted both at 83× and 183×, w/ and w/o Swan Band filter; despite fairly low altitude, the faintest stars on the Vehrenberg Falkauer chart were seen without difficulty [HAL].

Below is a photograph of Comet Tomita-Gerber-Honda 1964 VI, taken by Alan McClure at Mt. Piños, California, with a 7-inch *f*/7 Fecker triplet and a blue plate; the 25-min exposure began at 4^h48^m UT on 1964 July 6. On page 8 is another photograph by McClure, this time a 9.5-min exposure of Comet Bennett 1970 II beginning at 12^h11^m UT on 1970 April 12, for which he used a 5.5-inch *f*/5 Zeiss triplet aerial lens and a blue-sensitive plate; compare this photo with the one on the cover of the July 1985 *ICQ*.





◇ *Comet Shoemaker-Holt-Rodriquez 1988h* ⟹ 1988 Aug. 13.25: comet small and very condensed, appearance quite stellar at low power; the appearance was similar during subsequent observations during August and September [HAL]. Sept. 7.08: "strong cond." [BOR]. Oct. 2.20: comet somewhat more diffuse than during previous observations; the surrounding star field was very rich [HAL]. Oct. 14.19: candidate observed, but no motion detected after half an hour [HAL]. Nov. 5.09: candidate observed, but was shown on the *Palomar Sky Survey* (POSS) to be a pair of faint stars [HAL]. Nov. 12.10: estimate is of candidate; this was shown on POSS prints to be a tight group of 4 or 5 stars; there was no change in the appearance of the group when observed the following evening [HAL].

◇ *Comet 1988n (SMM 5)* [all observations by HAL w/ 41-cm *f*/4 L] ⟹ 1988 Oct. 26.51: at 83×, $m_1 > 10$: (method: I); low altitude, bright moonlight. Nov. 13.49: at 183×, $m_1 > 12.5$ (method: I).

◇ *Comet Yanaka 1988r* ⟹ 1988 Dec. 31.53: observed during moonlight; at times there were indications the tail might be about twice as long as reported; this tail was sharp along its northern edge and diffuse along its southern edge [HAL]. 1989 Jan. 4.21: in 19-cm *f*/4 T (38×), coma dia. 3.5′, DC = 7, visually; with 20-cm *f*/2 Baker-Schmidt camera and TP 2415 gas-hypered film (4-min exposures), coma appears very dense and shart-edged (dia. ∼ 1′), so that the comet head looks like a star; tail 20′ long in p.a. 300° [MIK]. Jan. 5.20: in 19-cm *f*/4 T (38×), coma dia. 2.5′, DC = 7, visually; photographically (same procedure as Jan. 4.21), "it looks more fuzzy", central cond. clearly visible, tail ∼ 10′ long in p.a. 320° [MIK]. Jan. 5.53: observed during breaks between rapidly forming clouds; some tail material was observed towards the W — this was again sharp along its northern edge [HAL]. Jan. 10.53: faint, amorphous outer coma seen; some tail material was again observed towards the west — again, this was sharp along its northern edge [HAL].

◇ *Comet Shoemaker 1989e* ⟹ 1989 Feb. 1.81: in 20.3-cm *f*/6 A, a 5-min exposure on TMax 3200 film shows $m_1 \sim$ 13.0: and a 9′ tail in p.a. 200° [HAS02].

◇ *P/Shoemaker-Holt (1987z)* [all by HAL] ⟹ 1988 Nov. 13.48: extremely good conditions. 1989 Jan. 1.22: extremely good conditions; rich star field; stars down to mag 15-16 on POSS prints were seen.

◇ *P/Borrelly (1987 XXXIII)* ⟹ 1988 Jan. 13.23: Coma was elongated toward PA 70 [MOR].

◇ *P/Tempel 2 (1987g)* ⟹ 1988 July 31.52: very diffuse [PEA]. Aug. 4.53: "becoming easier" to see [PEA]. Aug. 10.52: "a lot more condensed and smaller" [PEA]. Aug. 19.08: coma suggested to ∼ 4′ [BOR]. Sept. 8.15: in 41-cm L (83×), coma quite large and diffuse, DC ∼ 1 [HAL]. Oct. 9.14-Nov. 5.11: broad sunward fan toward NW [MOR]. Dec. 3.11: two faint stars involved in coma [HAL]. Dec. 12.09: atmosphere saturated with moisture; comet is large and very diffuse [HAL]. Dec. 28.09: comet is extremely diffuse [HAL]. 1989 Jan. 1.10: comet seems to have a little more "substance" than during previous observation [HAL].

◇ *P/Gunn* [all by HAL] ⟹ 1988 Nov. 13.50: low altitude, onset of twilight. Dec. 14.53: the nearby galaxy MCG -01-36-001 was faintly visible.

◇ *P/Schwassmann-Wachmann 1* ⟹ 1988 Aug. 12.46: stellar [SEA]. Aug. 16.46: "no longer stellar, but very marginal" [SEA]. below all by HAL: Dec. 12.12: atmosphere saturated with moisture; the comet's position was close to a 12th-magnitude star. An extremely faint candidate was suspected [HAL]. Dec. 13.07: "good conditions; the candidate suspected the previous evening was not seen" [HAL]. Dec. 30.10: "poor seeing, good transparency" [HAL]. 1989 Jan. 8.11: "altitude fairly low; poor transparency; a candidate was suspected, but was determined to be stellar; however, since the comet was detected the following evening under better conditions it is possible that what was seen was the comet superimposed upon a star (the star in question was detected the following evening)" [HAL]. Jan. 9.11: "altitude fairly low; appearance suggests outburst is ∼ 1 week old" [HAL]. Jan. 10.10: "altitude fairly low, plus some interference from zodiacal light; the comet is perhaps slightly more diffuse than during the previous evening" [HAL].

◇ ◇ ◇

OBSERVATIONS OF COMETS

The headings for the tabulated data are as follows: "DATE (UT)" = Date and time to hundredths of a day in Universal Time; "MM" = the method employed for estimating the total visual magnitude (B = Bobrovnikoff, M = Morris, S = Sidgwick/In-out, etc.; also, P stands for photographic magnitude, and photoelectrically-determined values fall under L, U, and V for the standard *U*, *B*, and *V*, respectively). "MAG." = total visual magnitude estimate; a colon indicates that the observation is only approximate, due to bad weather conditions, *etc.* (A left bracket, [, indicates limiting magnitude, comet not seen.) "RF" = reference for magnitude estimates (see Key above). "AP." = aperture in centimeters of the instrument used for the observations, usually given to tenths. "T" = type of instrument used for the observation (R = refractor, L = Newtonian reflector, B = binoculars, C = Cassegrain reflector, A = camera, T = Schmidt-Cassegrain reflector, S = Schmidt-Newtonian reflector, E = naked eye, *etc.*). "F/" and "PWR" are the focal ratio and power or magnification, respectively, of the instrument used for the observation.

"COMA" = estimated coma diameter of the comet in minutes of arc. An ampersand (&) indicates an approximate estimate. An exclamation mark (!) precedes a coma diameter when the comet was not seen (*i.e.*, was too faint) and where a limiting magnitude estimate is provided based on an "assumed" coma diameter (a default size of 1′ or 30″ is recommended; cf. *ICQ* **9**, 100). "DC" = degree of condensation on a scale where 9 = stellar and 0 = diffuse; a slash (/) indicates a value midway between the given number and the next-higher integer. "TAIL" = estimated tail length in degrees; again, an ampersand indicates a rough estimate. "PA" = estimated measured position angle of the tail in degrees (north = 0°, east = 90°). "OBS" = the observer who made the observation (given as a 3-letter, 2-digit code). An asterisk between the DATE and MM columns indicates that the observation is an updated version of one already published in a previous issue of the *ICQ*, *The Comet Quarterly*, or *The Comet*. (An exclamation mark in this same location indicates that the observer has corrected his estimate in some manner for atmospheric extinction.)

Key to observers with observations published in this issue, with 2-digit numbers between Observer Code and Observer's Name indicating source [05 = A.L.P.O. Comets Section; 17 = Kiev Komet. Tsirk.; 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
AMO		Mauro Amoretti, Italy
*AND02	05	C. A. Anderson, NH, U.S.A.
*BAR03		Ricardo Barbosa, Portugal
BOA		Andrea Boattini, Italy
BOE	05	Leo Boethin, The Philippines
BOR		John E. Bortle, NY, U.S.A.
*BRA02		Jorge Bras, Portugal
CHE		G. R. Chester, VA, U.S.A.
*CHM	18	Wladyslaw Chmielewski, Poland
CLA	14	Maurice L. Clark, Australia
CON	05	Darrell Conger, WV, U.S.A.
*COU	05	Elias P. Coulouras, MA, U.S.A.
DEL	05	Kenneth J. Delano, MA, U.S.A.
*EDR	05	Harold P. Edris, FL, U.S.A.
*EPP	05	Chet Eppert, PA, U.S.A.
FIL02	17	V. S. Filonenko, Ukraine, U.S.S.R.
GOR01	18	Dariusz Gora, Poland
GRA03	05	Bill Grady, WV, U.S.A.
*GRE02	05	Jerome Green, FL, U.S.A.
HAL		Alan Hale, U.S.A.
HAR	05	Daniel B. Harris, AZ, U.S.A.
HAS02		Werner Hasubick, West Germany
HAS03		Hisaya Hasegawa, Japan
*HOU	05	Walter Scott Houston, CT, U.S.A.
HUR		Guy M. Hurst, England
ICH	16	Kazuhiko Ichikawa, Japan
ISH02	16	Akiyoshi Ishikawa, Japan
JAC01		Eric A. Jacobson, MN, U.S.A.
*JAR	18	Krzysztof Jaroszewski, Poland
JON01		Merv V. Jones, Australia
KAN	16	Kiyotaka Kanai, Japan
KEE		Richard A. Keen, CO, U.S.A.
KOR		Stefan Korth, West Germany
LAM	05	Randy Lambert, TX, U.S.A.
LEV		David Levy, AZ, U.S.A.
LUK	05	Rainer Lukas, West Germany
MAC		Donald E. Machholz, CA, U.S.A.
MAR01		Joseph N. Marcus, OH, U.S.A.

CODE	S	OBSERVER, LOCATION
MAT01	05	Vic L. Matchett, Australia
MCC03	05	Michael McCants, TX, U.S.A.
*MCC04	05	Richard McClowry, PA, U.S.A.
MCM	05	Simon C. McMillan, Australia
MCN		Robert Houston McNaught, Australia
MID	05	Tom Middlebrook, TX, U.S.A.
MIK		Herman Mikuz, Yugoslavia
MIL	05	Dennis Milon, MA, U.S.A.
MIL03	05	Martin P. Miller, CA, U.S.A.
MIN	05	R. B. Minton, AZ, U.S.A.
MOR		Charles S. Morris, U.S.A.
NAK01	16	Akimasa Nakamura, Japan
OHT	16	Tadao Ohtsuka, Japan
PAC01	05	Walter D. Pacholka, CA, U.S.A.
PAR03	18	Mieczyslaw Paradowski, Poland
PEA	14	Andrew R. Pearce, Australia
PER01		Alfredo Jose Serra Pereira, Portugal
PLE01	18	Janusz Pleszka, Poland
PRY		Jim Pryal, WA, U.S.A.
RAF	18	Jerzy Rafalski, Poland
RIC	05	Charles L. Ricker, MI, U.S.A.
RIM	05	Logan Rimes, TX, U.S.A.
RIP		Jose Ripero, Spain
SCI	18	Tomasz Sciezor, Poland
SEA	14	David A. J. Seargent, Australia
SHA02		Jonathan D. Shanklin, England
SIM	05	Karl Simmons, FL, U.S.A.
*SLU	18	Janusz Slusarczyk, Poland
SMI	05	Horace A. Smith, CT, U.S.A.
SPE01	18	Jerzy Speil, Poland
SUT	05	David A. Sutherland, VA, U.S.A.
SWE	05	Richard A. Sweetsir, FL, U.S.A.
TAN01	16	Kunihiko Taniguchi, Japan
*WER	05	William G. Werner, OH, U.S.A.
WIL01	05	Thomas R. Williams, TX, U.S.A.
*WIS01	18	Witold Wisniewski, Poland
WOO01	05	Wayne Wooten, FL, U.S.A.
*WOO02	05	Gary Wood, IL, U.S.A.

Comet Honda 1968 VI

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1968 07 07.29		8.3	S	15.2	L			3				MIL
1968 07 07.38		8.1	AC	20.3	L		40	3	6			SIM
1968 07 21.53		7.6	S	5.0	R		8	1	3			PAC01
1968 07 25.39		7.9	AC	5.0	B		7					SIM
1968 07 26.54	O	7.0	S	3.5	R		8	1.2	5			PAC01
1968 07 27.35		7.7	AC	5.0	B		7					SIM
1968 07 28.33		7.5	AC	5.0	B		7					SIM
1968 07 29.40		7.5	AC	5.0	B		7					SIM
1968 08 02.44		6.9	S	15.2	L		52	3	7			MIL03
1968 08 03.44		7.2	S	15.2	L		52	5	5			MIL03
1968 08 04.38		7.1	S	15.2	L		52	3	5			MIL03
1968 08 07.45		7.0:	S	25.4	L			& 4				MCC03
1968 08 09.51		7.1	AC	5.0	R		8		6			PAC01
1968 08 17.16	O	6.8	S	5.0	B		7					CON
1968 08 18.15	O	6.7	S	5.0	B		7					CON
1968 08 18.27		6.7	AC	20.3	L		55	7	6		68	MID
1968 08 20.16	O	6.8	S	5.0	B		7	& 3.5	5			CON
1968 08 21.15	O	6.5	S	5.0	B		7					CON
1968 08 23.20		6.7	S	15.2	L		52	9	5	?	315	MIL03
1968 08 24.17		7.0	AC	5.0	B		7	& 1.5	2			WER
1968 08 24.19		6.2	AC	5.0	B		7					SIM
1968 08 24.22		6.6	S	15.2	L		52	8	6	?	315	MIL03
1968 08 24.25		6.6	AC	3.5	B		7					MID
1968 08 25.11		6.1	AC	5.0	B		7					SIM
1968 08 25.15		6.9	AC	5.0	B		7	& 1.5	2			WER
1968 08 25.22		6.3	S	15.2	L		52	9	5			MIL03
1968 08 26.10	O	6.6	S	5.0	B		7					CON
1968 08 26.26		6.3	S	15.2	L		52	8	5			MIL03
1968 08 27.14		6.1	AC	5.0	R		7					MID
1968 08 27.15		6.8	AC	5.0	B		7	& 3	3			WER
1968 08 27.30		6.4	S	3.5	B		7					MIL
1968 08 28.10	O	6.3	S	5.0	B		7	& 7.5				CON
1968 08 28.12		6.4	AC	5.0	B		7					WER

Comet Honda 1968 VI [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1968 08 29.10		6.6	AC	5.0	B		7					WER
1968 08 29.14		6.0	AC	20.3	L		45	10	6/	1.5	200	MID
1968 08 29.18		7.5	S	31.8	L	6	60	10	9	1	183	RIM
1968 08 30.08		6.4	AC	5.0	B		7	& 1.5	5			WER
1968 08 31.06		6.6	AC	3.5	B		7	& 1.5	7			WER
1968 08 31.10	O	6.2	S	5.0	B		7	& 7.5	5/			CON
1968 08 31.11		6.3	SP	5.0	B		7					RIC
1968 08 31.19		6.6	S	5.0	B		7					MCC04
1968 09 01.09		5.9	Y	5.0	B		7	> 2	6			MCC04
1968 09 01.19		6.1	AC	5.0	B		7					SIM
1968 09 02.09		6.8:	S	5.0	B		7	> 1.5	6			MCC04
1968 09 03.05		6.8	AC	5.0	B		7					SIM
1968 09 03.08		6.1	S	5.0	B		7					MCC04
1968 09 03.10		6.6:	AC	5.0	B		7		2			WER
1968 09 03.14		6.6	S	5.0	B		7	8	7			GRA03
1968 09 04.03		6.9	AC	5.0	B		7					SIM
1968 09 04.06	O	6.0	S	5.0	B		7	& 9	6			CON
1968 09 04.11		6.6	S	5.0	B		7					MCC04
1968 09 04.14		6.4	S	5.0	B		7					GRA03
1968 09 05.06		6.6	AC	5.0	B		7					SIM
1968 09 06.03		6.6	AC	5.0	B		7					SIM
1968 09 07.15		6.4	S	5.0	B		7	8	4			GRA03
1968 09 08.43	O	6.3	AC	5.0	R		8		4			PAC01
1968 09 09.03	O	6.2	AC	4.0	B		10					DEL
1968 09 09.39	O	6.2	AC	20.3	L			2	4			PAC01
1968 09 10.16		6.3	S	15.2	L		52	10	4			MIL03
1968 09 10.39	O	6.2	AC	5.0	R		8	2	4			PAC01
1968 09 11.05	O	6.4	S	5.0	B		7	&11	6/			CON
1968 09 11.08		6.8:	AC	5.0	B		7	& 1.5	6			WER
1968 09 11.10		6.2	AC	5.0	R		7					MID
1968 09 11.33	O	6.2	AC	5.0	R		8					PAC01
1968 09 12.06	O	6.3	AC	4.0	B		10					DEL
1968 09 12.12				20.3	L		40	& 6.5	6	1.25	45	MID
1968 09 12.12		6.1	AC	5.0	R		7					MID
1968 09 12.18		6.6	S	15.2	L		52	9	5			MIL03
1968 09 12.38		6.3	S	5.0	B		7					MAT01
1968 09 13.06	O	6.7	S	6.1	R		20		6/			CON
1968 09 13.12		6.3	AC	5.0	R		7					MID
1968 09 13.19		6.4	S	15.2	L		52	10	4			MIL03
1968 09 13.38	O	6.3	AC	5.0	R		8					PAC01
1968 09 13.39		6.4	S	5.0	B		7					MAT01
1968 09 14.05		7.0	AC	5.0	B		7					SIM
1968 09 14.06	O	6.6	S	5.0	B		7	10	5	0.25	75	CON
1968 09 14.12		6.8	AC	5.0	B		7		7			MCC04
1968 09 14.18		6.3	S	15.2	L		52	11	4/			MIL03
1968 09 15.07	O	6.5	S	5.0	B		7	10	4/			CON
1968 09 15.08	O	6.8	AC	4.0	B		10					DEL
1968 09 15.1		6.4	AC	5.0	B		7					MCC04
1968 09 15.17		6.5	S	15.2	L		52	10	4			MIL03
1968 09 15.43		5.9	SP	30.5	L							MAT01
1968 09 16.05	O	7.0	AC	4.0	B		10					DEL
1968 09 16.06	O	7.1	S	6.1	R		20	7	4/			CON
1968 09 16.10		7.3	AC	6.0	R		45	4	6			GRA03
1968 09 16.16		6.7	S	15.2	L		52	10	4			MIL03
1968 09 17.17		6.7	S	15.2	L		52	8	4			MIL03
1968 09 18.26	O	6.7	AC	5.0	R		8		2			PAC01
1968 09 18.41		8.8	S	30.5	L							MAT01
1968 09 19.07	O	7.2	AC	4.0	B		10					DEL

Comet Honda 1968 VI [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1968 09 19.09		6.7	AC	15.2	L	8	43		7	0.33	40	AND02
1968 09 19.38		8.0	S	30.5	L			2.36				MAT01
1968 09 20.12	O	7.8	S	6.1	R		20		4			CON
1968 09 21.05	O	7.5	S	5.0	B		7	& 7.5	4/			CON
1968 09 21.10		7.2	AC	5.0	B		7					SIM
1968 09 21.11		6.3	AC	5.0	B		7	3.5	8			MCC04
1968 09 22.05		7.6	AC	5.0	B		7					SIM
1968 09 22.15	O	7.4	S	5.0	B		7	8	4			CON
1968 09 22.41		8.3	S	20.3	L							JON01
1968 09 22.41		8.3	S	30.5	L							MAT01
1968 09 23.06	O	7.4	S	5.0	B		7	8	4/			CON
1968 09 24.05	O	7.4	AC	4.0	B		10					DEL
1968 09 25.25	O	7.5	S	5.0	R		8	3	3			PAC01
1968 09 27.08	O	7.6	S	5.0	B		7	& 4.5	5			CON

Comet Bally-Clayton 1968 VII

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1968 09 01.18		12.4	AC	20.3	L		40		3			SIM
1968 09 02.19		12.3	AC	20.3	L		40	1.5	3			SIM
1968 09 03.06		12.2	AC	20.3	L		40	< 0.8	0			SIM
1968 09 04.05		12.2	AC	25.4	L			& 1	1			SIM
1968 09 05.05		11.2	AC	20.3	L		40	1.0	0			SIM
1968 09 11.17		10.2	AC	15.2	L		52	2	2			MIL03
1968 09 14.07		12.4	AC	20.3	L		40	< 1	1			SIM
1968 09 16.06	O	11.3	AC	31.8	L		150	& 2				DEL
1968 09 19.10		11.2	AC	31.8	L	6	40	0.67	9			RIM
1968 09 20.09		11.2	AC	31.8	L	6	40	0.67	9			RIM
1968 09 25.32	O	11.0	AC	20.3	L			1.5	1			PAC01

Comet Tago-Sato-Kosaka 1969 IX

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1969 10 15.99		9.0	S	15.2	L			2	0			MIL
1969 10 30.00		8.4	S	20.3	L	4	29					SUT
1969 11 01.04		8.5	S	5.0	R		8	& 3.5	5			MCC03
1969 11 08.00		8.0	AC	20.3	L		40	2.5	1			SIM
1969 12 20.40		4.4	SP	5.0	B		7					MCM
1969 12 25.40		5.0	SP	5.0	B		7			0.5	150	MAT01
1969 12 25.41		4.9	SP	5.0	B		7					MCM
1969 12 26.41		4.8	SP	5.0	B		7					MCM
1969 12 26.41		4.9	SP	5.0	B		7			0.5	150	MAT01
1969 12 27.42		4.7	SP	5.0	B		7					MCM
1969 12 31.41		4.8	Y	5.0	B		7			7	165	JON01
1969 12 31.41		5.3	SP	5.0	B		7					MCM
1969 12 31.43		4.3	SP	5.0	B		7			4	152	MAT01
1970 01 05.41		4.3	Y	5.0	B		7	4		7	140	JON01
1970 01 06.44		4.3	Y	5.0	B		7	5		7	140	JON01
1970 01 08.42		3.6	Y	5.0	B		7			6	134	MAT01
1970 01 09.42		3.8:	Y	20	L		40			7	140	JON01
1970 01 10.41		4.4	Y	5.0	B		7			3.5		MCM
1970 01 10.43		4.0	Y	5.0	B		7					MAT01
1970 01 10.43		4.2	SP	5.0	B		7			6	115	MAT01
1970 01 10.45		4.5	Y	20	L		40	6		7	130	JON01
1970 01 11.42		4.3	Y	20	L		40	7		6	130	JON01
1970 01 12.42		4.2	Y	20	L		40	7		2.5	127	JON01
1970 01 13.41		4.2	Y	5.0	B		7					MCM
1970 01 15.44		4.4	AT	5.0	B		7					MCM

Comet Tago-Sato-Kosaka 1969 IX [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1970 01 18.1		3.6	S	5.0	B		7	12	2/	1.5	110	MCC03
1970 01 18.42		4.3	AT	5.0	B		7			0.75	92	MAT01
1970 01 18.42		4.4	AT	5.0	B		7					MCM
1970 01 19.99	O	3.5	AT	3.5	B		7	&23	5			EPP
1970 01 20.00		4.4	SP	5.0	B		7					SIM
1970 01 20.00		4.5	Y	5.0	B		7	&10	6			WOO01
1970 01 20.00		4.6	SP	3.5	B		7					EDR
1970 01 20.00	O	3.7	AT	5.0	B		10		0			SWE
1970 01 20.03	O	4.1	AC	3.0	B		6					LAM
1970 01 20.10	v	4.24		15.2	L	5		11.5				MIN
1970 01 21.03	O	4.3	AC	3.0	B		6					LAM
1970 01 21.96	O	3.6	AT	3.5	B		7	&12	5/	&0.02	140	SMI
1970 01 21.97		4.4	AT	3.5	B		7					MIL
1970 01 21.99		4.5	SP	5.0	B		7			3	75	SIM
1970 01 22.96		4.5	SP	5.0	B		7					COU
1970 01 22.97	O	3.6	AT	3.5	B		7					SMI
1970 01 22.99	O	3.8	AT	3.5	B		7	&25	5/			EPP
1970 01 23.03		5.0	SP	5.0	B		7					SIM
1970 01 23.07		4.4	AT	5.0	B		10		0			SWE
1970 01 23.96		4.6	SP	5.0	B		7					COU
1970 01 24.04	O	4.4	AT	3.0	B		6					LAM
1970 01 24.06	O	4.4	AT	20.3	L		55	10	7	1	75	MID
1970 01 24.97	O	3.6	AT	3.5	B		7	&15	7	&0.33		SMI
1970 01 24.97	O	4.3	AT	4.0	B		10					DEL
1970 01 24.98		4.3	SP	0.0	E		1					GRE02
1970 01 25.03		4.3	AT	5.0	B		10					SWE
1970 01 25.03		4.7	SP	5.0	B		7					COU
1970 01 25.10		4.5	S	0.0	E		1					MIL03
1970 01 25.42		4.4		5.0	B		7					MAT01
1970 01 26.00	O	4.6	SP	5.0	B		7					GRE02
1970 01 26.04	O	4.4	AT	3.0	B		6					LAM
1970 01 26.05		4.5	AT	5.0	B		10	& 8	1	2	80	SWE
1970 01 26.11		4.4	S	0.0	E		1					MIL03
1970 01 26.97	O	4.3	AT	4.0	B		10					DEL
1970 01 27.04		4.4	AT	0.0	E		1					RIM
1970 01 27.04		5.1	SP	5.0	B		7					SIM
1970 01 27.06		4.6	AT	5.0	B		10		1			SWE
1970 01 27.06	O	4.5	AT	3.0	B		6					LAM
1970 01 27.08		4.9	SP	5.0	B		7					COU
1970 01 27.10		4.8	S	0.0	E		1					MIL03
1970 01 27.12	v	4.92	AT	15.2	L	5		10.5				MIN
1970 01 27.18	O	4.8	Y	5.0	B		7	10		3.8		HAR
1970 01 28.17		4.9	S	0.0	E		1					MIL03
1970 01 29.00		5.0	AT	5.0	B		10	& 6.5	2			SWE
1970 01 29.02		5.8	SP	5.0	B		7		0			SIM
1970 01 29.12		4.6	S	0.0	E		1					MIL03
1970 01 29.84	O	5.4	S	7.0	B		20					LUK
1970 01 30.02		5.3	SP	5.0	B		7			&1	90	SIM
1970 01 30.04	O	4.9	AT	3.0	B		6					LAM
1970 01 30.09		5.1	Y	20.3	L		55	10	6	0.75	291	MID
1970 01 30.14		5.1	AT	5.0	B		10		2			SWE
1970 01 30.23		4.5	AC	3.5	B		7					PAC01
1970 01 30.98		5.6	Y	6.5	B		15					HOU
1970 01 31.03	O	5.5	AT	3.0	B		6					LAM
1970 01 31.04		5.0	SP	5.0	B		7					COU
1970 01 31.04		5.8	SP	5.0	B		7					SIM
1970 01 31.04	O	5.4	SP	5.0	B		7					GRE02
1970 01 31.98		5.8	Y	6.5	B		15	17				HOU
1970 01 31.98		6.1	Y	10.2	R							HOU

Comet Tago-Sato-Kosaka 1969 IX [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1970 02 01.00		5.2	SP	15.2	L		150					COU
1970 02 01.01	O	4.9	AT	3.5	B		7					SMI
1970 02 01.01	O	5.3	S	5.0	B		7	&14	4/	1	70	CON
1970 02 01.03		5.8	SP	5.0	B		7					GRE02
1970 02 01.04	O	5.1	AT	4.0	B		10					DEL
1970 02 01.12		4.9	AT	5.0	B		7	20	9	2	71	RIM
1970 02 01.98		5.4	S	5.0	B		7	& 8.8				WIL01
1970 02 01.98		5.5	Y	0.0	E		1	20				HOU
1970 02 01.98		6.1	Y	6.5	B		15					HOU
1970 02 01.98		6.7	Y	10.2	R							HOU
1970 02 02.23		5.5	S	3.5	B		7		3			PAC01
1970 02 03.10		5.5	S	20.3	L	4	26	12	2	0.25	75	MIL03
1970 02 03.21		5.7	S	3.5	B		7		3			PAC01
1970 02 04.02		6.8	AC	5.0	B		7					SIM
1970 02 04.99		7.1	Y	10.2	R			4				HOU
1970 02 05.00	O	5.5	AT	3.5	B		7					SMI
1970 02 05.15		5.6	AC	5.0	B		7	&17.5	9	0.75	56	RIM
1970 02 05.52	O	6.0	S	7.0	B		20	15	0			LUK
1970 02 07.02	O	5.7	SP	5.0	B		10					WOO02
1970 02 07.04	O	5.5	S	5.0	B		7					CON
1970 02 07.97		5.3	S	5.0	B		7	&10.3				WIL01
1970 02 08.02		5.2	AC	4.0	B		10	10	6			DEL
1970 02 08.40		5.7	Y	5.0	B		7					MCM
1970 02 08.42		5.8	S	5.0	B		7					MAT01
1970 02 08.52		5.5	S	8.0	B		15	16		2		BOE
1970 02 09.00		5.5	AC	4.0	B		10					DEL
1970 02 09.05	O	5.8	AC	3.0	B		6					LAM
1970 02 09.41		5.8	Y	5.0	B		7					MCM
1970 02 09.42		5.4	Y	5.0	B		7					MAT01
1970 02 09.59		5.7	S	8.0	B		15					BOE
1970 02 10.06		5.2	SP	5.0	B		7					SIM
1970 02 10.41		5.4	Y	5.0	B		7					MAT01
1970 02 10.41		6.3	S	5.0	B		7					MCM
1970 02 10.57		5.3	S	8.0	B		15	15		0.48		BOE
1970 02 11.04		5.6	SP	5.0	B		7					SIM
1970 02 11.41		5.8	Y	5.0	B		7					MAT01
1970 02 11.57		5.5	S	8.0	B		15	14		0.5		BOE
1970 02 12.57		5.7	S	8.0	B		15					BOE
1970 02 13.02	O	6.1	AC	4.0	B		10					DEL
1970 02 13.04	E	6.4	S	5.0	B		7	& 9	7/			CON
1970 02 13.06		6.0	AC	5.0	B		7					SIM
1970 02 14.08		6.2	AC	4.0	B		10					DEL
1970 02 15.77		6.6	S	7.0	B		20	5	0			LUK
1970 02 17.05	O	7.1	AC	3.0	B		6					LAM
1970 02 20.01	O	3.0	AT	3.5	B		7	&15		?	155	SMI
1970 02 20.09		6.8	AC	5.0	B		7					SIM
1970 02 21.02	O	7.4	AC	15.2	L	8	48	& 4	3			SMI
1970 02 21.07		7.8	AC	20.3	L		40	& 3	1			SIM
1970 02 24.02	O	7.7	S	5.0	B		7					CON
1970 02 24.06		8.3	S	5.0	B		7	& 9.3				WIL01
1970 02 24.52		8.1	S	8.0	B		15	&10		&0.2		BOE
1970 02 25.07	I	7.8:	S	5.0	B		7	& 5				CON
1970 02 25.52		8.2	S	8.0	B		15					BOE
1970 02 27.10	O	8.1:	S	6.1	R		20	5	3			CON
1970 02 28.08	O	8.3	S	6.1	R		20	4	2			CON
1970 02 28.54		8.6	S	8.0	B		15	& 8				BOE
1970 03 02.58		8.8	S	8.0	B		15	& 8				BOE
1970 03 06.53		9.0	S	8.0	B		15	8				BOE

Comet Tago-Sato-Kosaka 1969 IX [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1970 03 24.03		9.4	AC	20.3	L		40	1	0			SIM
1970 04 07.06		10.4	AC	20.3	L		40	< 1	1	?0.12	100	SIM

Comet Nishikawa-Takamizawa-Tago 1987 III

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1987 02 17.14	S	8.4	S	12.5	R	7	27	4	2			MAC

Comet Wilson 1987 VII

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 02 07.17	S	11.8	AC	31.8	L	4	150	1.2	1			KEE

Comet Bradfield 1987 XXIX

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1987 11 22.08	S	5.2	AA	5.0	B		10					MAR01
1988 01 07.83	S	6.8	AA	8.0	B		15	14	5	0.5	50	HUR
1988 01 08.09	K	7.0	S	4.0	B		8	10	3	1	60	KEE
1988 01 20.80	S	8.1	AA	8.0	B		15	8	4			HUR
1988 01 22.79	S	8.1	AA	8.0	B		15	9	4			HUR
1988 02 07.12	M	8.4	AA	31.8	L	4	33	9	2			KEE
1988 02 15.14	M	8.8	AA	15.2	L	3	16					KEE
1988 02 15.14	S	8.9	S	15.2	L	3	16	8	1			KEE

Comet McNaught 1987 XXXII

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 02 12.50	M	7.9	AA	15.2	L	3	16	7	3			KEE
1988 04 11.14	! S	10.4	AC	31.8	L	4	63	3.5	1			KEE

Comet Furuyama 1987f1

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 02 07.10	M	8.8	S	31.8	L	4	33	7	2			KEE

Comet Liller 1988a

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 02 07.09	M	8.6	S	31.8	L	4	33	5	3			KEE
1988 02 15.08	S	8.0	S	15.2	L	3	16	6	1			KEE
1988 04 06.77	B	6.5	S	6.0	B	5	20		4			PAR03
1988 04 06.8	B	6.0:	AA	8.0	B		20	& 3	7			SPE01
1988 04 06.80	B	6.3	S	6.4	L	6	30		6			GOR01
1988 04 07.78	B	6.3	S	10.0	R	10	25		4			PAR03
1988 04 10.78	B	5.6	S	5.0	B		10	3	7			PLE01
1988 04 10.79	B	5.6	S	6.8	R	6	13		4			PAR03
1988 04 10.81	B	5.5:	AA	8.0	B		20	3	6	0.4	6	SPE01
1988 04 10.81	B	6.3	S	5.0	B		10	4	5			SCI
1988 04 10.82	B	5.8	S	6.4	L	6	30					GOR01
1988 04 11.86	B	5.3	S	5.0	B		7	5	5	0.17	345	CHM
1988 04 12.79	B	6.1	S	6.4	L	6	30					GOR01
1988 04 12.80	B	5.9	Y	5.0	B	5	10		4			SLU
1988 04 12.81	B	5.4	S	5.0	B		10	8	6	0.66	355	PLE01
1988 04 12.81	B	6.2:	AA	8.0	B		20	& 3	5			SPE01
1988 04 13.82	B	5.8	AA	8.0	B		20	4	6	0.4	354	SPE01
1988 04 13.84	B	5.5	S	5.0	B		7	6	7	0.26	345	CHM
1988 04 13.86	B	5.8	AA	5.0	B		7					SPE01
1988 04 14.79	B	6.0	S	5.0	B		10	4	5			SCI

Comet Liller 1988a [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 04 14.80	B	6.1	S	5.0	B		10	15	5	1.20	355	PLE01
1988 04 14.81	B	5.9	S	6.4	L	6	30					GOR01
1988 04 14.82	B	5.9	AA	8.0	B		20	4	6	0.4	351	SPE01
1988 04 14.83	B	5.6	Y	5.0	B	5	10		5	0.83		SLU
1988 04 14.84	B	5.8	AA	5.0	B		7		7			SPE01
1988 04 14.86	B	5.3	S	5.0	B		7	5	7	0.26	345	CHM
1988 04 15.05	B	5.9	AA	5.0	B		7		7	0.5	350	SPE01
1988 04 15.09	B	5.8	AA	8.0	B		20	3	7	0.5	350	SPE01
1988 04 15.11	B	5.6	Y	5.0	B	5	10		5			SLU
1988 04 15.79	B	6.4	S	5.0	B		10	4	5			SCI
1988 04 15.81	B	5.8	S	6.4	L	6	30					GOR01
1988 04 15.81	B	6.0	S	5.0	B		10	15	5	2.50	355	PLE01
1988 04 15.83	B	5.3	S	8.0	B		10			1.0		WIS01
1988 04 15.83	B	5.5	S	6.8	R	6	17		4	0.93	351	PAR03
1988 04 16.06	B	5.6	Y	5.0	B	5	10		5	1.0		SLU
1988 04 16.08	B	6.0	AA	8.0	B		20	3	6	0.5	355	SPE01
1988 04 16.75	E	6.2	S	6.5	L	8	33	1.5	6			FIL02
1988 04 16.79	B	6.0	S	5.0	B		10	4	5			SCI
1988 04 16.81	B	5.7	S	6.4	L	6	30					GOR01
1988 04 16.83	B	5.4	S	6.8	R	6	17		4	0.97	351	PAR03
1988 04 16.83	B	5.8	AA	8.0	B		20	4	6	0.4	352	SPE01
1988 04 16.83	B	5.8	S	5.0	B		10	12	6	2.0	325	PLE01
1988 04 16.86	B	5.7	AA	5.0	B		7		7			SPE01
1988 04 17.03	B	5.3	S	5.0	B	4	7		4	0.97	351	PAR03
1988 04 17.82	B	5.7	S	6.4	L	6	30					GOR01
1988 04 17.83	B	5.3	S	6.8	R	6	17		4	0.97	351	PAR03
1988 04 17.83	B	5.3	S	8.0	B	4	10		4	0.97	351	PAR03
1988 04 17.97	B	5.5	S	5.0	B		7	10	5	0.67	345	CHM
1988 04 18.05	B	6.0	AA	5.0	B		7		7	0.6	350	SPE01
1988 04 18.08	B	6.0	AA	8.0	B		20	4	7	0.7	350	SPE01
1988 04 18.81	B	5.7	S	6.4	L	6	30					GOR01
1988 04 18.83	B	6.2	S	5.0	B		10	10	6	0.25	355	PLE01
1988 04 18.85	B	5.6	Y	5.0	B	5	10		4	1.5		SLU
1988 04 18.89	B	5.3	S	5.0	B		7	8	7	0.85	345	CHM
1988 04 19.83	B	6.0:	AA	8.0	B		20	& 3	5			SPE01
1988 04 19.90	B	5.5	S	5.0	B		7	8	6	1.09	350	CHM
1988 04 19.97	B	5.7	Y	5.0	B	5	10		5			SLU
1988 04 20.75	E	6.6	S	11.0	L	7	32		5			FIL02
1988 04 20.81	B	5.8	S	6.4	L	6	30					GOR01
1988 04 20.81	B	5.9	S	5.0	B		10	10	7	0.5	350	PLE01
1988 04 20.83	B	5.5	S	10.0	R	10	25	2.8	4	0.48	350	PAR03
1988 04 23.81	B	5.5	S	5.0	B		10	4	5			SCI
1988 04 23.85	B	5.2	S	5.0	B	4	7		4	0.85	350	PAR03
1988 04 23.87	S	5.8	AA	8.0	B		15	5.1	7	0.6	5	HUR
1988 04 23.90	B	5.4	S	6.8	R	6	17	3.8	4	0.85	350	PAR03
1988 04 24.05	B	5.9	AA	5.0	B		7		6	0.7	350	SPE01
1988 04 24.06	B	5.9	AA	8.0	B		20	4	6	1.0	350	SPE01
1988 04 24.75	E	6.2	S	6.5	L	8	33	1.5	5			FIL02
1988 04 24.79	B	6.3	S	5.0	B		10	4	5			SCI
1988 04 24.86	S	5.9	AA	8.0	B		15	6	7	0.3	5	HUR
1988 04 24.98	B	5.3	S	5.0	B		7	10	5	0.80	0	CHM
1988 04 25.06	B	5.4	S	8.0	B	4	10		4			PAR03
1988 04 25.07	B	5.6	S	6.8	R	6	17		4			PAR03
1988 04 25.75	E	6.3	S	11.0	L	7	32		6	0.6	235	FIL02
1988 04 27.77	E	6.3	S	6.5	L	8	33		4			FIL02
1988 04 27.83	B	6.2	S	4.0	B		11	10	4			RAF
1988 04 28.81	B	6.0	S	6.7	R	4	12	3.3	5			PAR03
1988 04 28.82	B	6.2	S	4.0	B		11	10				JAR
1988 04 28.84	B	6.2	S	4.0	B		11	10	5			RAF

Comet Liller 1988a [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 04 29.80	E	6.3	S	6.5	L	8	33	& 2	6	0.5	0	FIL02
1988 04 29.84	B	6.0	S	8.0	B	4	10		3			PAR03
1988 04 29.88	B	6.0	S	6.8	R	6	17	4.6	4	1.10	355	PAR03
1988 04 30.83	B	6.3	S	4.0	B		11					RAF
1988 04 30.84	E	6.5	S	6.5	L	8	33	4	5			FIL02
1988 04 30.86	B	6.0	S	8.0	B	4	10		4			PAR03
1988 04 30.88	B	6.0	S	6.8	R	6	11	4.4	4			PAR03
1988 05 01.04	B	6.8	AA	8.0	B		20	3	3			SPE01
1988 05 01.82	B	6.4	S	5.0	B		10	4	5			SCI
1988 05 01.83	E	6.7	S	6.5	L	8	33	3	5	0.4	340	FIL02
1988 05 01.90	B	6.0	S	8.0	B	4	10		4			PAR03
1988 05 02.03	B	6.6	AA	5.0	B		7		4			SPE01
1988 05 02.04	B	6.7	AA	8.0	B		20	3	5			SPE01
1988 05 02.80	E	6.6	S	6.5	L	8	33	3	5	0.5	7	FIL02
1988 05 02.83	B	6.9	S	4.0	B		11					JAR
1988 05 02.85	B	6.9	S	4.0	B		11					RAF
1988 05 03.79	E	6.4	S	6.5	L	8	33	4.5	5	0.5	12	FIL02
1988 05 03.88	B	6.3	AA	8.0	B		20	4	6	0.5	5	SPE01
1988 05 03.90	B	6.3	AA	5.0	B		7	4	6			SPE01
1988 05 04.96	B	6.5	Y	5.0	B	5	10		4			SLU
1988 05 05.88	S	6.1	AA	8.0	B		15	6	6	0.66	18	HUR
1988 05 06.81	B	6.7	S	5.0	B		10	10	5			SCI
1988 05 06.88	B	6.1	S	8.0	B	4	10		5	0.97	0	PAR03
1988 05 06.88	B	6.8	AA	8.0	B		20	5	6	0.3	11	SPE01
1988 05 06.90	B	6.1	S	6.8	R	6	11	6.3	5	0.97	0	PAR03
1988 05 06.93	B	6.0	Y	5.0	B	5	10		5			SLU
1988 05 06.96	B	6.4	S	5.0	B		10	15	6	0.75	8	PLE01
1988 05 07.83	B	6.9	S	5.0	B		10	10	5			SCI
1988 05 07.85	B	6.7	S	4.0	B		11	10	5	0.65	350	JAR
1988 05 07.85	B	6.7	S	4.0	B		11	10	5	0.65	355	RAF
1988 05 07.90	B	6.2	S	8.0	B	4	10		5	1.02	0	PAR03
1988 05 07.91	B	6.2	S	6.8	R	6	11	5	5	1.02	0	PAR03
1988 05 07.93	B	6.0	S	5.0	B		10	20	5	0.75	22	PLE01
1988 05 07.95	B	6.7	AA	5.0	B		7	4	6	0.3	13	SPE01
1988 05 08.00	B	6.5	AA	8.0	B		20	4	6	0.5	13	SPE01
1988 05 08.07	B	6.7	Y	5.0	B	5	10		4	0.5		SLU
1988 05 08.83	B	6.5	S	5.0	B		10	10	5			SCI
1988 05 08.86	B	6.6	S	6.4	L	6	30					GOR01
1988 05 08.86	B	6.7	S	4.0	B		11	10	5	0.66	350	JAR
1988 05 08.87	B	6.3	S	6.8	R	6	11	4.8	5	1.13	10	PAR03
1988 05 08.87	B	6.6	S	4.0	B		11	10	4	0.65	350	RAF
1988 05 08.88	B	6.3	S	8.0	B	4	10		5	1.13	10	PAR03
1988 05 09.84	B	6.3	S	5.0	B		10	5	5			SCI
1988 05 09.85	B	6.8	S	4.0	B		11	7	4	0.30	450	RAF
1988 05 09.85	B	6.9	S	4.0	B		11	7	4	0.33	350	JAR
1988 05 09.90	B	6.0	S	5.0	B		10	12	4	0.83	30	PLE01
1988 05 09.92	B	6.8	Y	5.0	B	5	10		4	0.66		SLU
1988 05 10.85	B	6.4	S	5.0	B		10	5	5			SCI
1988 05 10.91	B	6.9	Y	5.0	B	5	10		4	0.83		SLU
1988 05 11.78	E	7.4	S	6.5	L	8	33	7	4	1.2	30	FIL02
1988 05 12.05	B	6.0	S	5.0	B		7		5		13	CHM
1988 05 12.86	B	7.0	S	6.4	L	6	30					GOR01
1988 05 12.88	B	6.8	S	4.0	B		11	7	3			RAF
1988 05 12.88	B	6.9	S	4.0	B		11	6	3			JAR
1988 05 12.89	B	6.9	S	10.0	B		25	10	4	0.83	25	PLE01
1988 05 12.96	B	6.7	Y	5.0	B	5	10		3			SLU
1988 05 12.97	B	6.7	AA	8.0	B		20	4	6	0.4	35	SPE01
1988 05 13.00	B	6.6	AA	5.0	B		7	5	6	0.3	35	SPE01
1988 05 13.85	B	6.7	S	5.0	B		10	5	4			SCI

Comet Liller 1988a [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 05 13.86	B	7.2	S	6.4	L	6	30					GOR01
1988 05 13.88	B	6.6	S	5.0	B		10	8	5	0.42	43	PLE01
1988 05 13.91	B	6.5	Y	5.0	B	5	10		3	0.5		SLU
1988 05 13.99	B	6.8	AA	5.0	B		7	4	5	0.3	39	SPE01
1988 05 14.01	B	6.8	AA	8.0	B		20	5	5	0.3	39	SPE01
1988 05 14.85	B	7.0	S	5.0	B		10	5	4			SCI
1988 05 14.85	B	7.1	S	4.0	B		11		3			RAF
1988 05 14.87	B	7.2	S	6.4	L	6	30					GOR01
1988 05 14.90	B	6.8	AA	8.0	B		20	5	6	0.3	48	SPE01
1988 05 14.90	B	6.9	S	4.0	B		11	8	3			JAR
1988 05 14.92	B	6.8	AA	5.0	B		7	4	6			SPE01
1988 05 14.99	B	6.6	Y	5.0	B	5	10		4			SLU
1988 05 15.80	E	7.1	S	6.5	L	8	33	7	4	0.7	55	FIL02
1988 05 15.85	B	7.1	S	4.0	B		11	7	3			RAF
1988 05 15.88	B	7.0	S	4.0	B		11	8	2			JAR
1988 05 16.01	B	7.0	Y	5.0	B	5	10		4	0.42		SLU
1988 05 16.02	B	5.8	S	5.0	B		7		5		15	CHM
1988 05 16.80	E	7.2	S	6.5	L	8	33	11	3	0.6	55	FIL02
1988 05 16.84	B	6.9	S	5.0	B		10	7	5	0.33	46	PLE01
1988 05 16.85	B	7.0	S	5.0	B		10	5	4			SCI
1988 05 17.02	B	5.5	S	5.0	B		7		6			CHM
1988 05 17.03	B	7.6	Y	5.0	B	5	10		4			SLU
1988 05 18.02	B	5.8	S	5.0	B		7		6			CHM
1988 05 18.92	S	6.2	AA	3.4	B		9		6			PER01
1988 05 19.91	S	6.3	AA	3.4	B		9	8	5	0.9	60	PER01
1988 05 20.82	E	7.6	S	11.0	L	7	32	5.5	4	0.8	70	FIL02
1988 05 22.92	S	6.3	AA	3.4	B		9	9	5	1.7	60	PER01
1988 05 25.01	B	7.5	AA	8.0	B		20	4	3			SPE01
1988 05 25.98	B	7.6	AA	8.0	B		20	3	2			SPE01
1988 05 27.82	E	8.0	S	6.5	L	8	33	7	3	0.4	85	FIL02
1988 05 27.87	B	7.2	S	5.0	B		10	5	3			SCI
1988 05 28.84	E	8.1	S	6.5	L	8	33	5	3		80	FIL02
1988 05 30.96	S	7.1	AA	15	L	4	26	5				PER01
1988 05 31.90	B	7.6	S	5.0	B		10	5	3			SCI
1988 05 31.93	S	7.0	AA	15	L	4	26	6	6			PER01
1988 05 31.97	B	8.0:	AA	8.0	B		20	4	3			SPE01
1988 06 01.95	S	7.1	AA	15	L	4	26	6	4			PER01
1988 06 02.91	S	7.8	AA	8.0	B		15	6	5	0.4		MIK
1988 06 03.87	B	7.7	S	5.0	B		10	8	4			PLE01
1988 06 03.88	M	8.0	AA	8.0	B		15	7	6			MIK
1988 06 03.91	S	8.3	S	6.7	R	12	53	4	3			SCI
1988 06 03.93	B	8.3	AA	8.0	B		20	5	4			SPE01
1988 06 04.60	M	8.4	AA	31.0	L	6	63	4.5	4	0.25		HAS03
1988 06 04.84	E	8.7	S	6.5	L	8	33	4.5	2	0.2	85	FIL02
1988 06 04.86	B	7.1	S	5.0	B		10	9	4	0.17	75	PLE01
1988 06 04.88	S	8.7	S	6.7	R	12	53	4	3			SCI
1988 06 05.96	S	6.7	AA	15	L	4	26	6	4			PER01
1988 06 05.96	S	7.6	AA	3.4	B		9	5.5	6			PER01
1988 06 06.97	S	7.4	AA	3.4	B		9	8	5			PER01
1988 06 06.97	S	7.4	AA	15	L	4	26	7.5	3			PER01
1988 06 12.97	B	8.6	AA	8.0	B		20	5	2			SPE01
1988 06 13.95	B	8.7	AA	8.0	B		20	4	2			SPE01
1988 06 14.96	B	9.0:	AA	8.0	B		20	& 2	1			SPE01
1988 06 15.89	B	8.4	S	5.0	B		10	12	3			PLE01
1988 07 01.98 !	S	10.4	VB	20.0	R	14	40	1.4	2			SHA02

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DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 08 06.47	S	8.6	S	12.5	R	7	27	3	3			MAC
1988 08 07.48	S	8.6	S	12.5	R	7	27	5	3			MAC
1988 08 08.48	S	8.6	S	12.5	R	7	27	5	4			MAC
1988 08 08.71	S	8.9	AA	6.3	B		9	6	2			MCN
1988 08 09.35	S	9.2	NO	31.7	L	6	68	3	2			BOR
1988 08 10.49	S	8.6	S	25.4	L	4	32	5	3			MAC
1988 08 11.87	S	8.9	AA	20	L	4	45	5	4/			PEA
1988 08 12.48	S	8.3	S	15.2	L	8	76	5	3			MAC
1988 08 13.45	S	8.8	S	31.8	L	4	33	6	2			KEE
1988 08 13.50	S	8.2	S	12.5	R	7	27	5	4			MAC
1988 08 13.71	S	8.0	AA	8.0	B		15	2	2			SEA
1988 08 14.45	S	8.8	S	15.2	L	3	16	10	2			KEE
1988 08 14.49	S	8.0	S	12.5	R	7	27	5	5			MAC
1988 08 16.73	S	7.6	AA	8.0	B		15	4	6			SEA
1988 08 17.36	S	7.9	NO	8.0	B		20	3.7	4			BOR
1988 08 17.50	S	7.6	S	12.5	R	7	27	5	4			MAC
1988 08 19.45	M	8.0	AA	15.2	L	3	16	8	2			KEE
1988 08 19.50	S	7.8	S	15.2	L	8	76	3.5	2			MAC
1988 08 19.74	M	6.8	AA	8.0	B		15	4	6			SEA
1988 08 20.36	S	6.9	NO	5.0	B		10	5	4			BOR
1988 08 20.36	S	7.0	NO	8.0	B		20	5.1	5			BOR
1988 08 20.49	S	7.9	S	15.2	L	8	76	6	3			MAC
1988 08 20.78	M	7.5	AA	31.0	L	6	63	6.0	4	0.2		HAS03
1988 08 20.86	S	7.1	AA	20	L	7	71	7	5	0.2	247	CLA
1988 08 20.87	B	7.8	AA	20	L	4	45					PEA
1988 08 20.87	S	7.7	AA	20	L	4	45	3.5	5	0.8	263	PEA
1988 08 21.35	S	6.9	NO	8.0	B		20	4.0	5			BOR
1988 08 21.49	S	7.1	SC	20	T	10	50	5	3			PRY
1988 08 21.85	S	7.8	AA	20	L	4	45	3.5	5	0.6	255	PEA
1988 08 22.36	S	6.9	NO	5.0	B		10	4.5	5			BOR
1988 08 22.36	S	7.0	NO	8.0	B		20	3.3	5			BOR
1988 08 22.50	S	7.6	S	12.5	R	7	27	5	4	0.17	256	MAC
1988 08 23.36	S	7.1	NO	8.0	B		20	3.6	4			BOR
1988 08 24.50	S	7.8	S	15.2	L	8	76	3	5			MAC
1988 08 24.78	S	6.4	AA	8.0	B		15	& 1	7	&0.07	290	SEA
1988 08 25.51	S	8.4	S	12.5	R	7	27	3	4	0.25	250	MAC
1988 08 27.51	S	7.8	S	12.5	R	7	27	4	3			MAC
1988 08 30.51	S	7.5	S	15.2	L	8	76	3	3			MAC
1988 08 31.88	S	7.5	AA	20	L	4	45		6	0.5		PEA
1988 09 01.52	S	7.5	S	15.2	L	8	76	3	3			MAC
1988 09 01.88	S	7.4	AA	20	L	4	45		6			PEA
1988 09 02.79	S	6.1	AA	8.0	B		15		7			SEA
1988 09 06.78	S	6.6	AA	8.0	B		15					SEA
1988 09 26.2	S[	7 :	S	15.2	L	8	76	! 3				MAC
1988 09 29.79	S[	6.3	SC	8.0	B		20					SHA02
1988 09 30.00	S[	8.0	S	8.0	B		20					BOR
1988 09 31.14	S[	8.0	AA	20	T	10	50					PRY
1988 10 01.2	S[	10 :	S	12.5	B	7	27	! 2				MAC
1988 10 03.2	S[	10.5:	S	15.2	L	8	76	! 1				MAC
1988 10 07.10	I[	12 :		41	L	4	183					HAL
1988 10 07.77	S[	12.0:	UM	20.3	T	10	51					HAS02
1988 10 11.12	S[	10.1	AA	20	T	10	50					PRY
1988 10 17.2	S[	13.5:	S	35.5	L	7	150	! 1				MAC

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DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 12 31.53	M	9.4	AC	41	L	4	83	1.5	6/	0.05	295	HAL
1989 01 04.19	S	9.0	S	8.0	B		20	1.3	4			HAS02

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DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 01 04.21	S	9.8	AA	8.0	B		15	3	5			MIK
1989 01 04.24	S	9.5:	AC	8.0	B		15	& 2	4			KOR
1989 01 05.20	S	9.9	AA	8.0	B		15	3	5			MIK
1989 01 05.53	M	9.8:	AC	41	L	4	83					HAL
1989 01 08.77	S	10.7	AC	25.4	L	4	44	1.5	5			SEA
1989 01 10.53	M	9.9	AC	41	L	4	83					HAL
1989 01 10.75	S	11.0	AC	25.4	L	4	44	& 1	5			SEA

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DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 01 04.17	S	11.2	AA	36	T	11	325	2	2/			KOR
1989 01 05.25	S	10.6	A	15	L	4	26	1.5	3			PER01
1989 01 05.49	M	11.0	AC	41	L	4	83					HAL
1989 01 10.15	S	10.5	AC	20.3	T	10	51	2.4	0			HAS02
1989 01 10.49	S	10.9	AC	41	L	4	83					HAL
1989 01 11.72	S	11.8:	V	25.4	L	4	114		1			SEA

Comet Shoemaker-Holt-Rodriquez 1988h

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 08 14.32	S	13.8	AC	31.8	L	4	150	0.7	1			KEE
1988 09 07.08	S	13.6	AC	50.0	L	5	157	0.4	6			BOR
1988 09 14.09	S	13.4	AC	50.0	L	5	157	0.5	5			BOR
1988 09 17.22	S	13.6	AC	31.8	L	4	150	1.2	1			KEE
1988 10 09.14	S	13.5	AC	31.8	L	4	150	0.9	0			KEE
1988 10 14.19	I[	13.5		41	L	4	244					HAL
1988 10 31.16	S	13.6	NP	25.6	L	4	156	0.8				MOR
1988 11 05.09	I[	13.5		41	L	4	244					HAL
1988 11 05.14	S	13.6	NP	25.6	L	4	156	0.6	2/			MOR
1988 11 12.10	S[	13.3	AC	41	L	4	183	! 0.5				HAL

Comet Shoemaker 1989e

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 01 29.92	S	13.1	AC	40	L	5	222	1.5		0.03	220	BOA
1989 02 06.95	B	13.1	AC	35	T	6	96		8			AMO
1989 02 08.96	B	13.2	AC	35	T	6	96		9			AMO

Periodic Comet Tempel 2 (1983 X)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1983 05 14.76	S	11.5	NP	15	L	6	50	3				KAN
1983 06 13.73	S	9.8	AC	15	L	6	50	4	4			NAK01
1983 06 13.75	S	10.3	AC	15	L	6	100	4	3			TAN01
1983 06 21.75	S	9.2	AC	15	L	6	28	5.1	1			KAN
1983 07 18.74	S	10.6	AC	15	L	6	50	2.5	2/			NAK01
1983 07 18.76	S	10.6	AC	15	L	6	100	2				TAN01
1983 08 05.71	S	10.2	AC	30	L	6	60	4.5	2			NAK01
1983 08 05.72	S	10.4	AC	30	L	6	60	3.2				TAN01
1983 08 05.73	M	10.3	AC	30	L	6	60					ICH
1983 08 05.73	S	10.2	AC	13	L	6	44	4.6	0			KAN
1983 08 11.73	S	9.5	AC	30	L	6	45	6.5	2/			OHT
1983 08 11.73	S	10.2	AC	15	L	6	50	5	1/			NAK01
1983 08 12.75	S	10.6	AC	15	L	6	50	3	3			NAK01
1983 08 13.70	S	10.3	AC	15	L	6	50	4	3			NAK01
1983 08 14.72	S	10.1	AC	15	L	6	50	6	2			NAK01
1983 08 18.70	S	9.5	AC	20	T	10	50	6	1			OHT
1983 08 19.73	S	10.7	AC	15	L	6	50	3.5	2			TAN01

Periodic Comet Tempel 2 (1983 X = 1987g) [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1983 08 19.74	S	10.4	AC	15	L	6	50	4.5	2			NAK01
1983 08 19.78	S	10.2	AC	13	L	6	44	4	2			ISH02
1983 09 16.69	S	10.6	AC	15	L	6	50	5	1			NAK01
1983 09 16.70	S	10.8	AC	15	L	6	50	3	2			TAN01
1983 10 11.66	S	10.3	AC	10	L	10	60	3				ICH
1988 07 05.98 !	S	11.1	VB	20.0	R	14	40	1.1	4			SHA02
1988 07 18.96 !	S[	11.9	VB	20.0	R	14	95					SHA02
1988 07 31.39	S	9.4	AA	8.0	B		15		1			SEA
1988 07 31.48	S	11.0	V	25	L	6	71	6	3			CLA
1988 07 31.52	S	11.4	VN	20	L	4	45	3.5	0/			PEA
1988 08 01.54	S	11.3	VN	20	L	4	45	3.5	0/			PEA
1988 08 02.43	S	9.4	AA	8.0	B		15	& 8	0/			SEA
1988 08 02.53	S	11.1	VN	20	L	4	45	3	1			PEA
1988 08 02.55	S	10.4	V	25	L	6	44	7	3			CLA
1988 08 04.53	S	10.8	VN	20	L	4	45	3.5	1			PEA
1988 08 05.44	S	9.3	AA	8.0	B		15					SEA
1988 08 06.90 !	S	11.5	VB	20.0	R	14	95	2.1	3			SHA02
1988 08 07.46	S	8.9	AA	8.0	B		15	& 6	1			SEA
1988 08 07.51	S	10.6	VN	20	L	4	45	4	1			PEA
1988 08 08.54	S	10.3	V	25	L	6	71	7	3			CLA
1988 08 10.52	S	10.0	VN	20	L	4	45	2.5	5			PEA
1988 08 11.10	B	10.4	AA	31.8	L	5	40	1.5	5			SIM
1988 08 12.89 !	S	11.5	VB	20.0	R	14	40	1.6	3			SHA02
1988 08 13.18	K	8.0	AA	4.0	B		8	15	1			KEE
1988 08 14.16	K	8.4	AA	4.0	B		8	13	1			KEE
1988 08 14.16	M	8.8	S	31.8	L	4	33	10	2			KEE
1988 08 14.40	S	8.2	AA	8.0	B		15	6	3			SEA
1988 08 16.06	S	10.0	AC	31.7	L	6	68	2.2	2			BOR
1988 08 17.07	S	9.9	AC	31.7	L	6	68	2.0	1			BOR
1988 08 17.46	S	8.1	AA	8.0	B		15	&10	4			SEA
1988 08 19.08	S	9.5	AC	31.7	L	6	68	2.7	1/			BOR
1988 08 29.41	S	8.7	AA	8.0	B		15	6	5			SEA
1988 08 30.42	S	8.5	AA	8.0	B		15	6	5			SEA
1988 08 30.52	S	9.3	VN	20	L	4	45	4.5	3/			PEA
1988 08 31.51	S	9.4	VN	20	L	4	45	4	3			PEA
1988 09 02.54	S	9.5	VN	20	L	4	45	4	3/			PEA
1988 09 03.22	S	8.8	S	12.5	R	7	27	5	3			MAC
1988 09 03.52	S	9.0	VN	8.0	B		20	8	3			PEA
1988 09 03.52	S	9.2	VN	20	L	4	45	5	4			PEA
1988 09 03.82	B	8.9	AC	35	T	6	96	0.03	3			AMO
1988 09 03.85 !	S	9.3	AA	20.0	R	14	40	1.9	3			SHA02
1988 09 04.15	S	8.1	AA	4.0	B		8	12	1			KEE
1988 09 04.45	S	8.4	AA	8.0	B		15					SEA
1988 09 05.53	S	9.3	VN	20	L	4	45	4	4			PEA
1988 09 07.04	S	8.7	AC	8.0	B		20	4.5				BOR
1988 09 07.04	S	9.2	AC	31.7	L	6	68	3.0	1/			BOR
1988 09 08.54	S	9.3	AA	25	L	6	71	9	3			CLA
1988 09 09.80	S	9.0:	S	20.5	L	4	48					HAS02
1988 09 10.53	S	9.2	AA	25	L	6	71	9	3			CLA
1988 09 11.53	S	8.6	VN	20	L	4	45	5	3			PEA
1988 09 12.43	S	8.4	AA	8.0	B		15	7	5			SEA
1988 09 12.53	S	8.8	VN	20	L	4	45	4.5	4			PEA
1988 09 15.52	S	8.8	VN	20	L	4	45	4	4			PEA
1988 09 16.87	O	10.0	AA	33.3	L	4	100	& 2.5	0			RIP
1988 09 17.14	K	8.0	S	4.0	B		8	10	1			KEE
1988 09 17.14	M	8.4	S	31.8	L	4	33	7	3			KEE
1988 09 28.42	S	8.7	AA	8.0	B		15					SEA
1988 10 05.53	S	8.5	AA	25	L	6	71	10	2			CLA
1988 10 06.43	S	8.8	AA	8.0	B		15					SEA

Periodic Comet Tempel 2 (1987g) [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 10 09.10	K	8.0	S	4.0	B		8	10	1			KEE
1988 10 09.10	M	8.4	S	31.8	L	4	33	8	2			KEE
1988 10 09.14	M	8.7	AA	8.0	B		20	6	2			MOR
1988 10 09.14	M	8.7	AA	25.6	L	4	45	4.0	2			MOR
1988 10 09.43	S	8.8	AA	8.0	B		15	4	5			SEA
1988 10 09.79	S	9.0:	S	8.0	B		20	2.2	2			HAS02
1988 10 10.12	M	8.8	AA	25.6	L	4	45	3.6	2			MOR
1988 10 10.54	S	8.7	AA	25	L	6	71	10	2			CLA
1988 10 13.11	S	8.8	AC	5.0	B		10					HAL
1988 10 14.08	S	9.1	S	20	L	6	92	10			210	CHE
1988 10 28.08	M	9.5	AC	41	L	4	83					HAL
1988 10 31.11	M	9.2	AA	25.6	L	4	45	5.2	2			MOR
1988 11 05.11	M	9.6	AA	25.6	L	4	45	4.1	3			MOR
1988 11 05.12	M	9.7	AC	41	L	4	83					HAL
1988 11 06.11	M	9.7	AA	25.6	L	4	45	4.1	2			MOR
1988 11 12.15	S	10.2	AC	41	L	4	83					HAL
1988 11 12.54	S	10.0	V	25	L	6	71	5	4			CLA
1988 11 13.11	M	10.0	AC	25.6	L	4	67	3.0	1/			MOR
1988 11 13.12	M	10.4	AC	50.8	L	4	73	2.0	1/			MOR
1988 11 13.56	S	10.1	V	25	L	6	71	4	3			CLA
1988 11 14.07	S	9.6	AA	31.8	L	4	33	6	1			KEE
1988 11 26.52	S	10.0	AA	20	L	4	45	3	3			PEA
1988 11 27.12	S	10.4	AC	41	L	4	83					HAL
1988 11 27.52	S	10.1	AA	20	L	4	45	4	2/			PEA
1988 11 28.53	S	10.1	AA	20	L	4	45	3	2/			PEA
1988 11 28.55	S	11.0	V	25	L	6	71	3	3			CLA
1988 12 03.11	S	10.6	AC	41	L	4	83		1/			HAL
1988 12 05.05	S	9.6	AA	31.8	L	4	33	7	0			KEE
1988 12 11.08	S	10.3	AA	31.8	L	4	33	6	0			KEE
1988 12 11.10	S	10.7	AC	25.6	L	4	67	2.8	1/			MOR
1988 12 12.09	S	11.4	AC	41	L	4	83		1			HAL
1988 12 28.09	S	11.3	AC	41	L	4	83		0/			HAL
1988 12 30.15	S	11.9	AC	25.6	L	4	45	1.6	1			MOR
1989 01 01.10	S	11.4	AC	41	L	4	83		1			HAL
1989 01 05.12	S	11.5	AC	41	L	4	83		1			HAL
1989 01 09.13	S	11.4	AC	41	L	4	83		1			HAL

Periodic Comet Kohoutek (1987 XXVII)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 02 18.30	S	12.6	AC	31.8	L	4	63	1.5	0			KEE

Periodic Comet Borrelly (1987 XXXIII)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1987 11 12.16	B	7.9	AA	25	L	4	46	8	2			JAC01
1987 11 14.18	B	7.8	AA	13	L	8	40	8	2/			JAC01
1987 11 14.19	B	7.8	AA	8.0	B		20	11	0/			JAC01
1987 11 24.15	B	7.6:	AA	5.0	B		10	13	0			JAC01
1987 11 24.16	M	7.6	AA	13	L	8	40	9	2	&0.13	0	JAC01
1987 12 10.18	M	7.3	AA	25	L	4	46					JAC01
1987 12 11.18	M	7.3	AA	8.0	B		20	10	3/			JAC01
1987 12 11.18	M	7.4	AA	13	L	8	40					JAC01
1987 12 17.05	M	7.2	AA	5.0	B		10	15	1			JAC01
1987 12 17.05	M	7.5	AA	13	L	8	40			0.17	34	JAC01
1987 12 19.08	M	7.2	AA	5.0	B		10					JAC01
1987 12 20.12	B	7.4:	AA	8.0	B		20					JAC01
1988 01 05.02	B	7.8	AA	13	L	8	40					JAC01
1988 01 06.04	S	7.3	AA	5.0	B		10					JAC01

Periodic Comet Borrelly (1987 XXXIII) [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 01 08.12	K	7.8	S	4.0	B		8	20	1			KEE
1988 01 09.24	M	7.5	AA	5.0	B		10	9	2			JAC01
1988 01 10.05	M	7.3	AA	5.0	B		10					JAC01
1988 02 07.15	M	9.2	AA	31.8	L	4	33	6	3			KEE
1988 02 15.17	S	10.1	AA	15.2	L	3	23	6	0			KEE
1988 02 22.11	S	10.8	AC	31.8	L	4	63	3	1			KEE
1988 02 25.08	S	9.8:	AA	25	L	4	82					JAC01
1988 03 09.23	S	10.2	A	25	L	4	82					JAC01
1988 04 06.13	S	12.5	A	25	L	4	179	1.4	1/			JAC01
1988 04 12.16	S	12.8:	L	25	L	4	179					JAC01
1988 04 12.17	S	11.8	AC	31.8	L	4	63	1.5	1			KEE

Periodic Comet Kopff (1983 XIII)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1983 04 20.76	B	12.0	AC	30	L	6	100					OHT
1983 04 20.76	S	11.9	AC	15	L	6	100	2.2	2			NAK01
1983 04 20.77	S	11.8	AC	15	L	6	100	2.5				TAN01
1983 05 04.54	S	10.7	AC	20	T	10	50	1.2	1			OHT
1983 05 04.65	S	11.5	AC	15	L	6	100	2	1			NAK01
1983 05 05.65	S	11.5	AC	15	L	6	100					TAN01
1983 05 07.58	S	10.6	AC	15	L	6	50	4	2			NAK01
1983 05 07.63	S	11.3	AC	15	L	6	50	3.5	2			TAN01
1983 05 07.68	S	10.7	AC	20	L	6	85	3.5	3			ISH02
1983 05 07.70	S	9.8	AC	30	L	6	45	2.5	3			OHT
1983 05 07.73	S	10.5	AC	13	L	6	25	2.0				ICH
1983 05 08.55	S	10.8	AC	15	L	6	50	3	2			NAK01
1983 05 08.59	S	11.1	AC	15	L	6	50	3.5				TAN01
1983 05 08.65	S	10.0	AC	30	L	6	45	2.5	2			OHT
1983 05 08.69	S	9.0	AC	15	L	6	28	9	1			KAN
1983 05 08.74	S	10.6	AC	10	L	10	30	3.4				ICH
1983 05 09.63	S	10.4	AC	15	L	6	50	4	2			NAK01
1983 05 09.64	S	10.9	AC	15	L	6	50	4				TAN01
1983 05 14.55	S	10.2	AC	15	L	6	50	3.5	2/			NAK01
1983 05 14.61	S	9.7	AC	20	T	10	50	5.0	3			OHT
1983 05 17.54	S	10.8	AC	10	L	10	30	1.9				ICH
1983 05 17.58	S	9.5	AC	20	L	6	48	6	4			ISH02
1983 05 17.59	S	8.8	AC	7.0	B		16	8	1			OHT
1983 05 17.61	S	9.7	AC	15	L	6	50	4.5	5			NAK01
1983 05 17.63	S	10.0	AC	15	L	6	50	4	5			TAN01
1983 05 18.66	S	10.1	AC	15	L	6	50	4				NAK01
1983 06 01.53	S	9.4	AC	20	T	10	50	7				OHT
1983 06 01.67	S	9.9	AC	15	L	6	50	5.5	4			NAK01
1983 06 01.69	S	9.5	AC	13	L	6	25	4	3			ISH02
1983 06 04.53	S	9.8	AC	15	L	6	50	5	4			NAK01
1983 06 07.58	S	9.7	AC	13	L	6	44	5	2			ISH02
1983 06 09.63	S	9.8	AC	20	T	10	50	7				OHT
1983 06 13.53	S	9.9	AC	7.0	B		16	9				OHT
1983 06 13.54	S	9.6	AC	15	L	6	50	4.5	5			NAK01
1983 06 13.55	S	9.9	AC	15	L	6	50	5.5	2/			TAN01
1983 06 14.54	S	9.3	AC	13	L	6	44	5	4			ISH02
1983 06 14.58	S	10.0	AC	10	L	10	30	1.5				ICH
1983 06 28.50	S	8.8	AC	15	L	6	28	7	4			NAK01
1983 06 28.51	S	9.0	AC	15	L	6	28	8	4			TAN01
1983 06 28.55	S	9.4	AC	30	L	6	100	2	3			OHT
1983 06 28.58	S	9.5	AC	10	L	10	30	4.3				ICH
1983 07 11.53	S	8.9	AC	15	L	6	28	6	3/			NAK01
1983 07 11.54	S	9.1	AC	15	L	6	50	5	3			TAN01
1983 07 29.48	S	8.2	AC	13	L	6	25	8.1	3/			KAN

Periodic Comet Kopff (1983 XIII) [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1983 07 29.49	S	8.1	AC	13	L	6	25	9.6	4			ISH02
1983 08 05.50	S	8.6	AC	13	L	6	44	5.5	3			NAK01
1983 08 05.51	S	8.3	AC	13	L	6	44	4.0				ISH02
1983 08 05.52	S	9.6	AC	30	L	6	45	4	2			TAN01
1983 08 05.54	M	9.5	AC	13	L	6	44	7				ICH
1983 08 05.55	S	8.4	AC	13	L	6	44	6.4	3			KAN
1983 08 14.55	S	8.9	AC	15	L	6	28	7.5	4			NAK01

Periodic Comet Gunn (1982 X)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 11 13.50	I[	12.0		41	L	4	244					HAL
1988 12 13.53	I[	13.0		41	L	4	183					HAL
1988 12 14.53	I[	13.5		41	L	4	244					HAL
1989 01 06.53	I[	14.0		41	L	4	244					HAL

Periodic Comet Helin-Roman-Crockett (1989b)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 01 06.46	I[	13.5		41	L	4	244					HAL
1989 01 10.40	S	14.7	AC	154.9	L	14	654	1	5	0.07	270	LEV

Periodic Comet Halley (1986 III)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1985 12 15.8	B	5.6	AA	5.0	B		8					BRA02
1985 12 17.8	B	5.6	AA	5.0	B		8					BRA02
1985 12 26.8	B	5.9	AA	5.0	B		8					BRA02
1985 12 29.8	B	5.6	AA	5.0	B		10					BAR03
1985 12 29.8	B	5.9	AA	5.0	B		8					BRA02
1986 01 02.8	B	5.6	AA	5.0	B		8					BRA02
1986 01 05.8	B	4.7	AA	5.0	B		10					BAR03
1986 01 11.8	B	4.8	AA	5.0	B		8					BRA02
1986 01 11.8	B	5.2	AA	5.0	B		10					BAR03
1986 01 12.8	B	5.0	AA	5.0	B		10					BAR03
1986 01 15.8	B	4.3	AA	5.0	B		8					BRA02
1986 01 16.8	B	4.3	AA	5.0	B		8					BRA02
1986 01 17.8	B	4.1	AA	5.0	B		10					BAR03
1986 03 10.2	B	4.5	AA	5.0	B		10					BAR03
1986 03 11.2	B	4.2	AA	5.0	B		10					BAR03
1986 03 13.2	B	3.3	AA	5.0	B		8					BRA02
1986 03 14.2	B	3.4	AA	5.0	B		10					BAR03
1986 03 15.2	B	3.3	AA	5.0	B		8					BRA02
1986 03 15.2	B	3.6	AA	5.0	B		10					BAR03
1986 03 17.2	B	3.8	AA	5.0	B		10					BAR03
1986 03 20.2	B	3.5	AA	5.0	B		10					BAR03
1986 03 21.2	B	3.3	AA	5.0	B		8					BRA02
1986 03 22.2	B	3.4	AA	5.0	B		10					BAR03
1986 03 30.2	B	3.8	AA	5.0	B		8					BRA02

Periodic Comet Schwassmann-Wachmann 1

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 08 12.46	I	13.7	AC	25.4	L	4	190		9			SEA
1988 08 16.46	S	13.7	AC	25.4	L	4	190		7			SEA
1988 10 14.20	I[	13.5		41	L	4	244					HAL
1988 10 31.18	S	13.4	NP	25.6	L	4	156	1.5	1			MOR
1988 11 05.14	I[	13.5		41	L	4	244					HAL
1988 11 05.17	S[	13.3	NP	25.6	L	4	156					MOR

Periodic Comet Schwassmann-Wachmann 1 [cont.]

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 11 12.20		I[13.5		41	L	4	244					HAL
1988 11 27.13		I[13.0		41	L	4	183					HAL
1988 12 03.12		I[13.5		41	L	4	244					HAL
1988 12 11.13		S[13.3	NP	25.6	L	4	156					MOR
1988 12 12.12		I[13.5		41	L	4	244					HAL
1988 12 13.07		I[14.0		41	L	4	244					HAL
1988 12 28.10		I[13.5		41	L	4	244					HAL
1988 12 30.10		I[13.5		41	L	4	183					HAL
1989 01 08.11		I[13.0		41	L	4	244					HAL
1989 01 09.11	!	S 13.2	AC	41	L	4	183		2/			HAL
1989 01 10.10	!	S 13.3	AC	41	L	4	183		2			HAL

Periodic Comet Shoemaker-Holt (1987z)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 10 19.44		I[14.0		41	L	4	244					HAL
1988 11 13.48		I[14.0		41	L	4	244					HAL
1989 01 01.22		I[14.0		41	L	4	244					HAL

Periodic Comet Ge-Wang (1988o)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1988 12 01.22		I[13.5		41	L	4	244					HAL

Periodic Comet Bradfield 2 (1989c)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 01 10.46		S 11.6	V	25.4	L	4	114	2	2			SEA

Φ Φ Φ

COMET LIGHT GRAPHS

Presented on the next three pages are two graphs each of Comets Wilson 1987 VII (= 1986*l*) and Bradfield 1987 XXIX (= 1987*s*), representing total visual magnitude data that have been published in the *ICQ*. One graph shows a plot of visual m_1 data *versus* time (in days) from perihelion (ΔT). The second graph for each comet gives the so-called "heliocentric magnitude" ($H_\Delta = m_1 - 5 \log \Delta$, where Δ is the comet's geocentric distance) as a function of ΔT, with different symbols used to show the difference between pre-perihelion and post-perihelion behavior.

The data chosen are those visual m_1 data reported by seven experienced observers who observed the comets over a long arc of time and over a wide range of brightness (down to mag 11 or fainter); the *ICQ* observer codes of the seven observers are BOR, BOU, GRE, HAL, MOR, PEA, and SEA. (Such choosing reveals a more meaningful light curve. As an example, compare the m_1 light curve here with the one on the cover of the July 1988 issue.)

While power-law magnitude formulae are inadequate for representing the light curve in detail over much of the comet's heliocentric distance (r), such formulae can be useful for a rough sketch of the comet's brightness behavior and for rough comparisons with the data of other comets. Some representative equations are provided for each of these two comets below, based on the same data sample used for plotting the graphs. Further information on use of visual m_1 data can be found in *20th ESLAB Symposium on the Exploration of Halley's Comet* (1986, European Space Agency SP-250), Vol. III, pp. 249-251. — Daniel W. E. Green

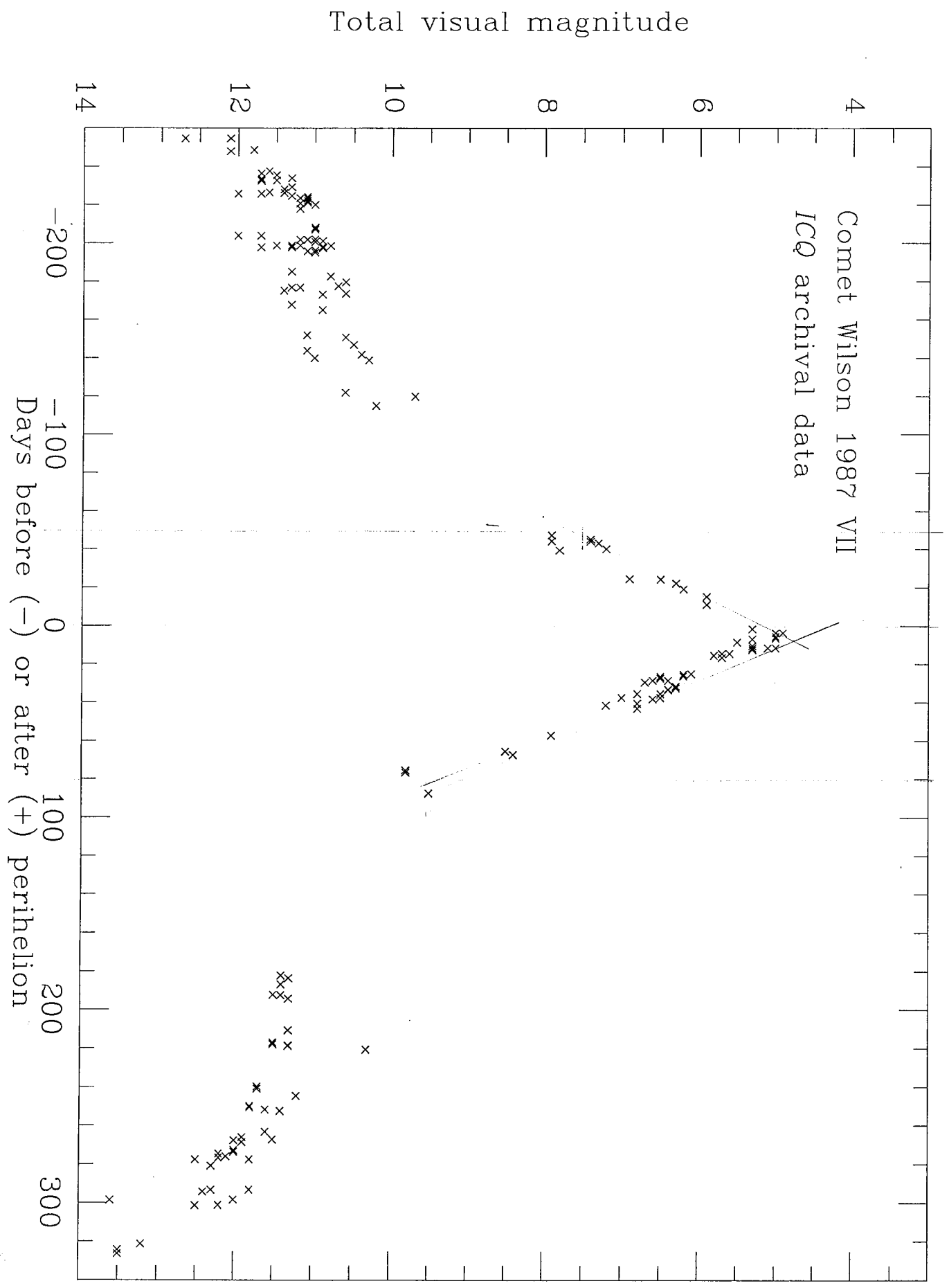
◇ **Comet Wilson 1987 VII.** The data included herein constitute 173 observations over the period 1986 Aug. 9-1988 Mar. 12 (range in r: 3.6 → 1.2 AU, pre-T; 1.2 → 4.3 AU, post-T).

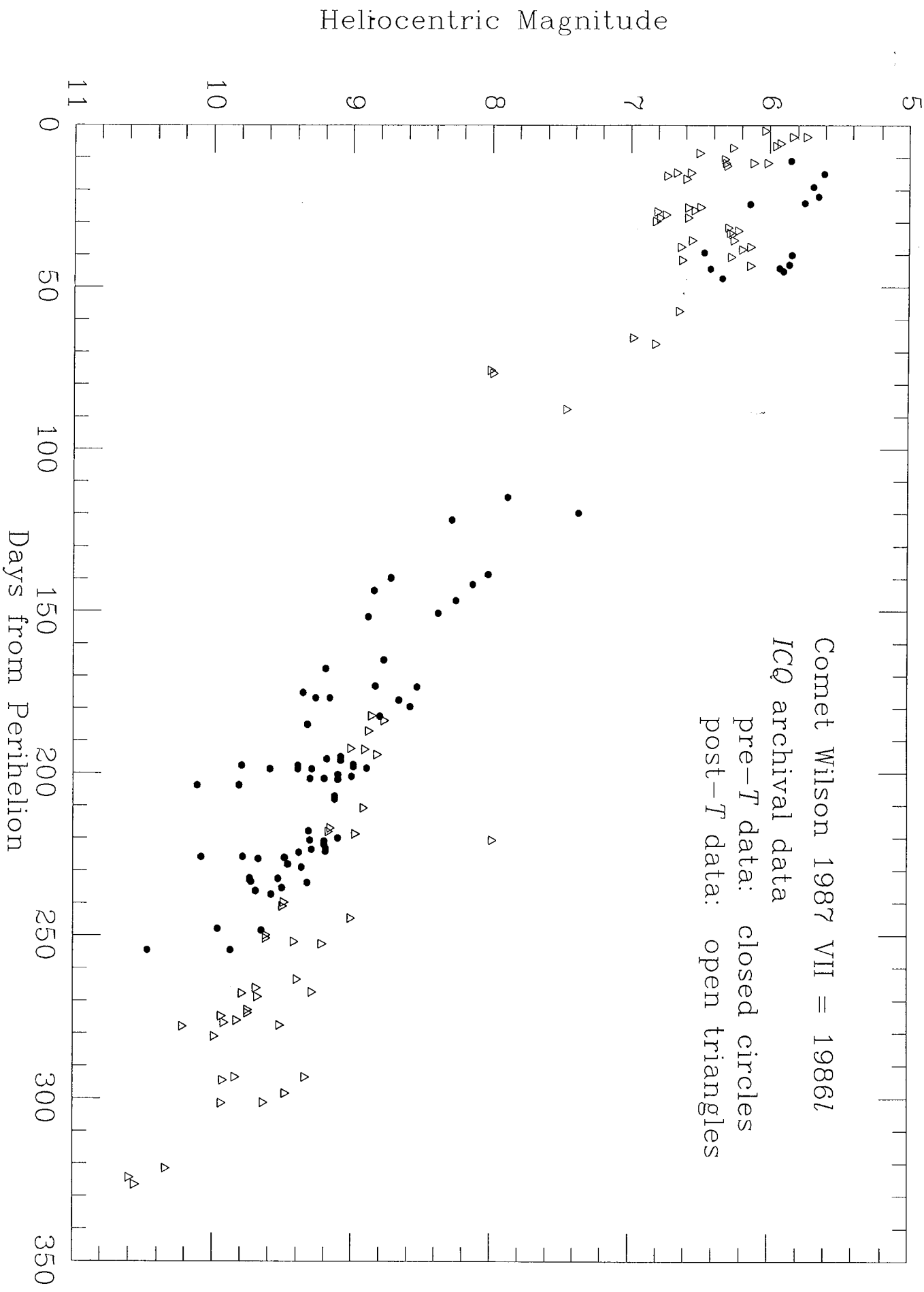
$m_1 = 5.3 + 5 \log \Delta + 7.5 \log r$ [for whole range of observed r, ± 0.5 mag]

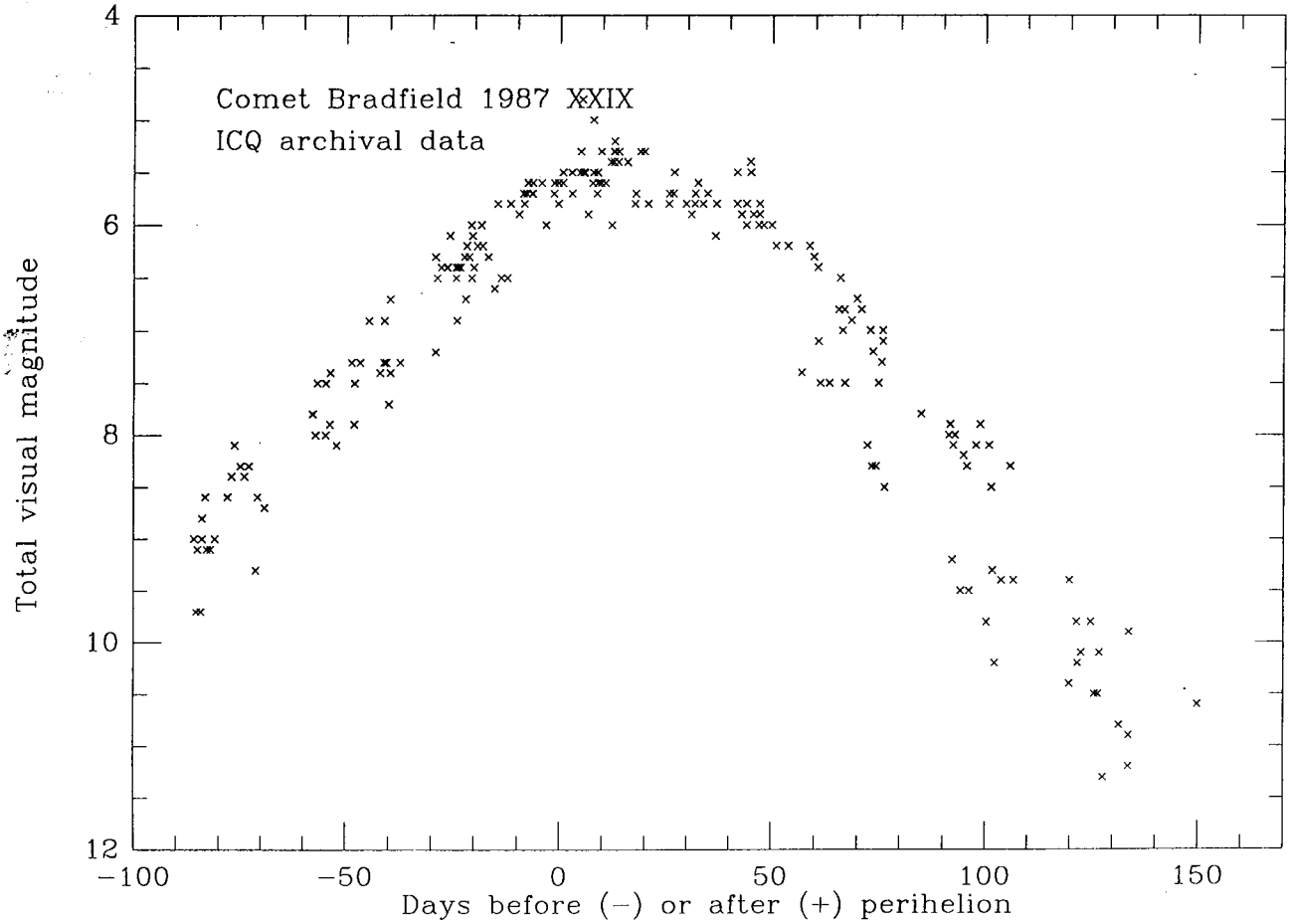
◇ **Comet Bradfield 1987 XXIX.** The data included herein constitute 208 observations over the period 1987 Aug. 13-1988 Apr. 5 (range in r: 1.7 → 0.87 AU, pre-T; 0.87 → 2.5 AU, post-T).

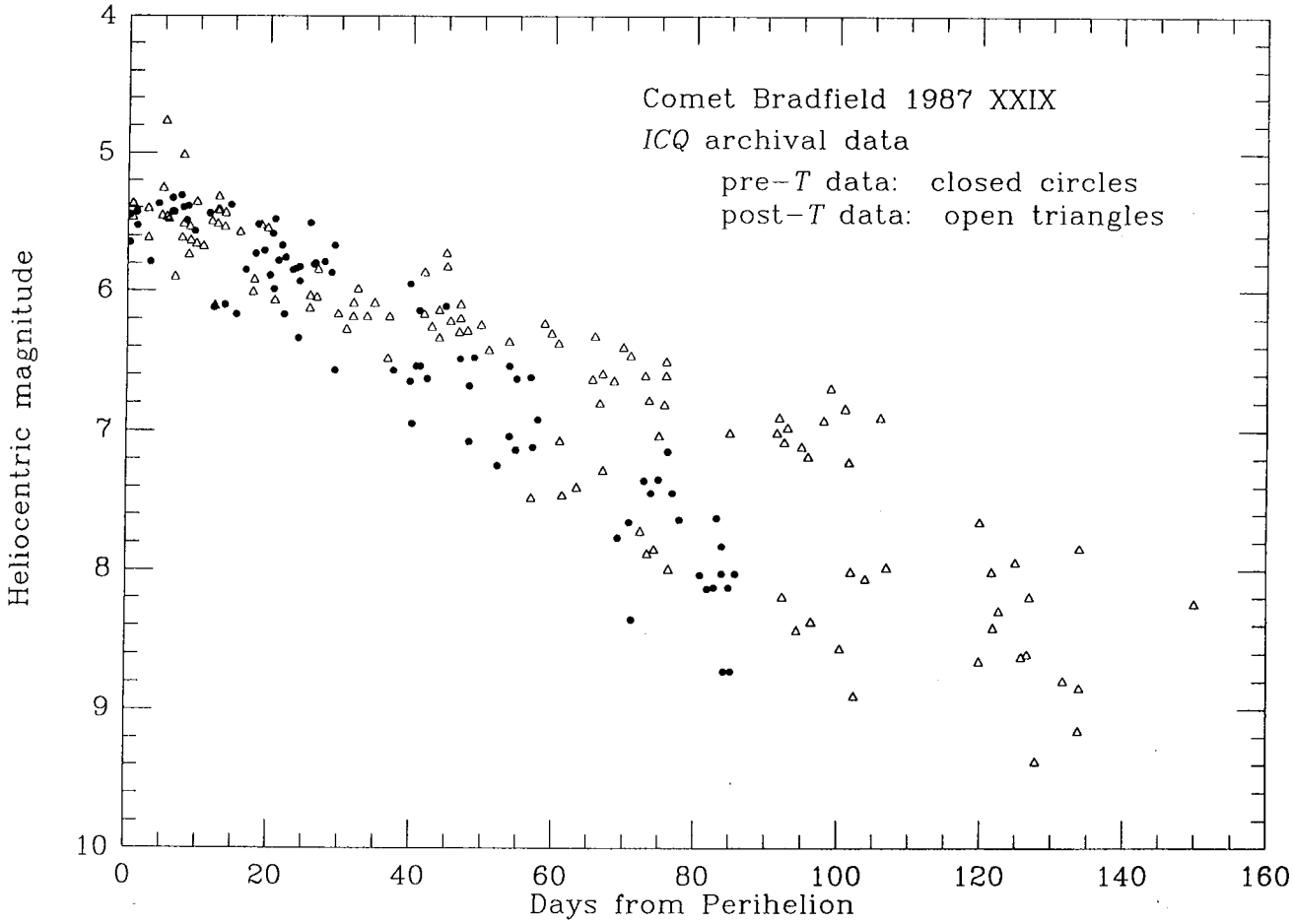
$m_1 = 6.0 + 5 \log \Delta + 8 \log r$ [pre-perihelion]

$m_1 = 5.7 + 5 \log \Delta + 6.2 \log r$ [post-T, and pre-T for $r < 1.4$ AU]


Total visual magnitude
14
12
10
8
6
4
Comet Wilson 1987 VII
ICQ archival data
−200
−100
0
100
200
300
Days before (−) or after (+) perihelion


Heliocentric Magnitude
5
6
7
8
9
10
11
0
50
100
150
200
250
300
350
Days from Perihelion
Comet Wilson 1987 VII = 1986l
ICQ archival data
pre-T data: closed circles
post-T data: open triangles


Comet Bradfield 1987 XXIX
ICQ archival data
Total visual magnitude
4
6
8
10
12
−100
−50
0
50
100
150
Days before (−) or after (+) perihelion


Comet Bradfield 1987 XXIX
ICQ archival data
pre−T data: closed circles
post−T data: open triangles
Heliocentric magnitude
4
5
6
7
8
9
10
0
20
40
60
80
100
120
140
160
Days from Perihelion