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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 October issue (odd-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$31.00 per year for surface-mail delivery (price includes the annual *Comet Handbook*; the price without the *Handbook* is US$23.00 per year). Subscribers who do not wish to be billed may subscribe at the special rate of US$23.00 per year for surface-mail delivery (rate is $15.00 without *Handbook*). Add $15.00/year to each of these rates for airmail delivery outside of the United States or for first-class delivery within the U.S. [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 $6.00 each — *except* for "current" *Comet Handbooks*, which are available for $15.00 ($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.

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 observational data (or manuscripts) in machine-readable form are encouraged to do so [especially through e-mail via the computer networks *SPAN* (6700::DAN), *BITNET* (GREEN@CFA), or Internet (GREEN@CFA.HARVARD.EDU), or via floppy disks that can be read on an IBM PC], and should contact the Editor for further information.

Among the Observation Coordinators (OCs) listed below, those with postal addresses have e-mail contacts with the *ICQ* Editor (or regularly send data to the Editor on IBM PC-compatible floppy disks); observers in the general area of such OCs who lack access to e-mail networks may send data to the OC for relay to the *ICQ* in electronic form.

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INDEX TO VOLUMES 16 AND 17

Note that an index to Volumes 16 and 17 of the *ICQ* is included with this issue (following page 220), so that libraries binding volumes will immediately have the index to include therein. In the past, we published indices for volumes in the immediately-following January issue. It is planned that future 2-year indices will be published and mailed with the October issues of odd-numbered years. — The Editor

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ICQ ARCHIVE

After 1996 January 1, we will no longer be able to produce 9-track magnetic tapes containing the *ICQ* Photometric Archive of Comets. It is therefore advised that interested parties contact the Editor immediately if such a tape is desired. It is anticipated that further details on accessing the *ICQ* Archive will be outlined in the January 1996 issue of the *ICQ*.

— The Editor

The Re-discovery of Comet 122P/de Vico

Daniel W. E. Green

In less than 24 hours on Sept. 17-18, at least five independent visual discoveries were made of a bright "binocular" comet in the morning sky. In the span of less than 50 minutes in Japan alone, independent discoveries were made by Yuji Nakamura (Suzuka, Mie), by Masaaki Tanaka (Iwaki, Fukushima), by Shougo Utsunomiya (Minamioguni, Kumamoto), and by Tsutomu Seki (Geisei). Among the additional independent discoveries reported in the following days were those by Don Machholz (Colfax, California), and by Xing-ming Zhou and D.-q. Zhang in China.

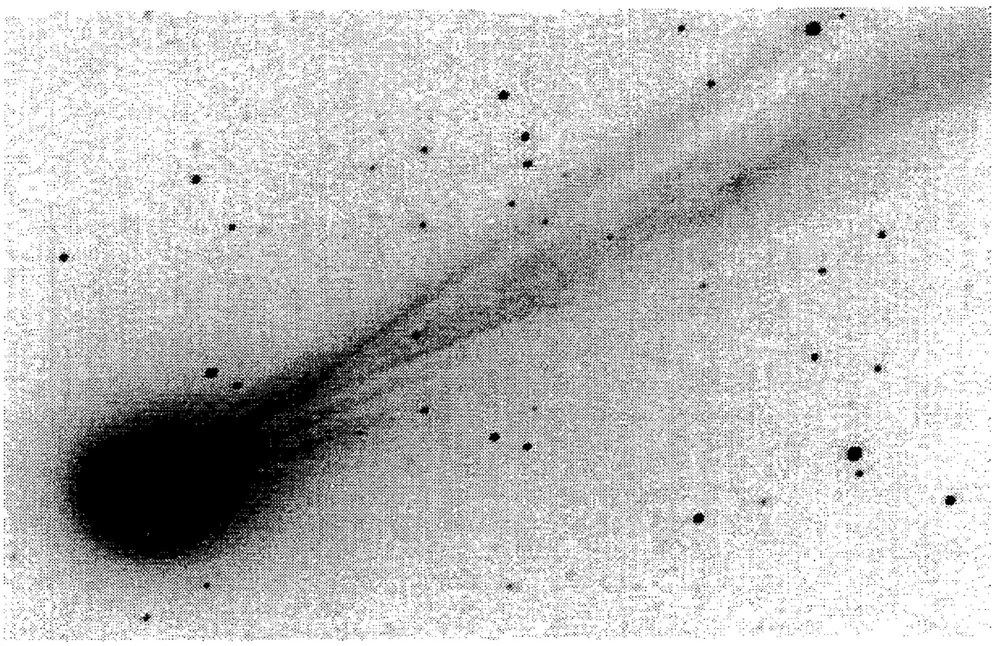

Image of 122P/de Vico taken on 1995 Oct. 6.81 UT by Kazuyuki Ito (Sangamine Obs., Hyogo, Japan; 20-cm f/6 reflector + ST-6 CCD; 60-sec exposure)

However, as soon as three nights of astrometric positions had been reported, my first preliminary parabolic orbital calculations showed an inclination near 85°, which — as a result of my extensive work on the orbit of D/1846 D1 (de Vico) in the past year — immediately made me think of that comet which had been missed at its previous return (Green 1995a, b). This article is an extensively revised version of a paper that had been in preparation over the past year by the author in close collaboration with Gareth V. Williams and Brian G. Marsden (as co-authors),* a paper that intended to look at the 1846 data and give a "best assessment" of when the comet might return again.

I. The 1846 Apparition

Father Francesco de Vico‡ discovered a comet near the star 36 Ceti on 1846 February 20. The year 1846 was a then-record year for new comet discoveries, and in reporting his find to Editor Schumacher of the *Astronomische Nachrichten* (*A.N.*; the world's most influential astronomical journal in the 19th century) de Vico (1846) asked "What is this overabundance of comets we're having?" (having himself discovered C/1846 B1 less than a month earlier). The Roman Catholic priest noted his latest fast-moving comet as being small with a short tail; de Vico's comet was not far from another comet reported on Feb. 26 by Brorsen at Kiel, causing some initial confusion (with Brorsen apparently looking for de Vico's comet when he found *his* new one).⋈

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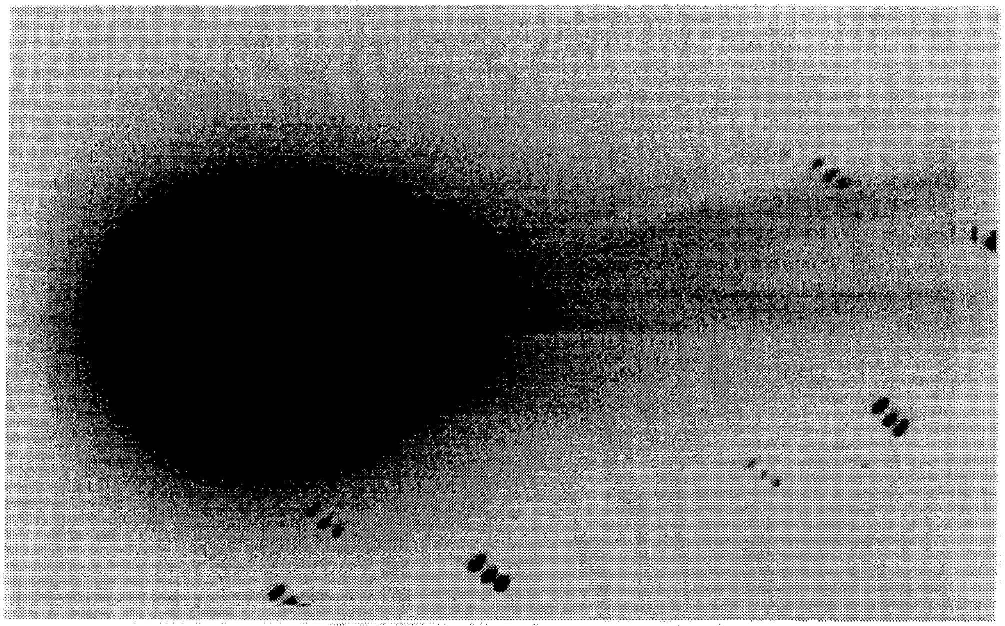
* and to whom I am grateful for contributions to this paper and for critical readings of the manuscript prior to publication.

‡ The *A.N.* Editor usually printed names in contributed material in the same way that the authors wrote them; thus, while German authors generally spelled the discoverer's name "de Vico", the discoverer himself signed his name "Francesco De-Vico S.J.", and another Italian astronomer (G. Santini) referred to him as "P. [Padre] Vico" or simply "Vico". Nonetheless, over the years, the German custom of "de Vico" has been adopted for the comet's name, though many writers capitalized the "D" well into the 20th century.

⋈ e.g., cf. *MNRAS* 7(12), 218.



Above: *Composite of three 80-sec CCD images of 122P/de Vico, taken on Sept. 28.17 UT by Martin Mobberley (Galleywood Observatory, near Chelmsford, England) with a 49-cm f/4.5 Newtonian reflector (+ Starlite Xpress CCD). The images were co-added to allow for the 25″ northeastward motion of the comet over 5.75 minutes; the field measures 9′.7 × 6′.0. The tail is in p.a. 270°.*

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Francesco de Vico was born on 1805 May 19 at Macerata to a "noble Italian family of that name". Educated at the college of Urbino, he pursued theological studies and became associated in Rome with the Observatory of the Collegio Romano, becoming Director upon Dumouchel's death in 1839. During 1844-1846, de Vico discovered six comets that are named for him. De Vico received the King of Denmark's Gold Medal, "granted to the first discoverer of a telescopic comet", four times in 1846 alone. In 1848, he left Rome under religious persecution (as a member of the Society of Jesuits) and visited France, England, and the United States before being stricken with typhus, from which he died in London on 1848 Nov. 15 (RAS Council 1849; Poggendorff 1863).

De Vico's fourth comet was independently discovered by George P. Bond at Cambridge, Massachusetts, with a 2.75-inch refractor (40×) on 1846 February 26; Bond's father, William C. Bond (Director of the new Harvard Observatory), writes through the end of March that "the comet has at no time been visible to the naked eye; when near perihelion [Mar. 6], it exhibited a rapid condensation of light toward the center, but no definite nucleus; about the same time, a faint tail was perceptible, streaming off a degree or two, and diverging in a direction opposite to that of the sun: the tail was seen on two nights only" (Bond 1846a, b). This remark by Bond suggests that the comet was near naked-eye brightness in March, perhaps around 6th magnitude.

As was the custom then, comets were named for the first discoverer only, and this became known as "De Vico's Fourth Comet" or "Comet De Vico 1846 II" in the pages of Volume **24** of the *A.N.* A year or so later, the comet had became generally known as 1846 IV — the fourth comet known to have passed perihelion in 1846; later it was often called "P/de Vico". With the new IAU designation scheme in place this year, the comet received the designation D/1846 D1 (de Vico) — the "D/" indicating that the comet was considered lost because of the impossibility of accurately predicting its return. With the comet's re-discovery this year, it was assigned the preliminary designation "1995 S1", preceded by the sequential periodic comet number "122" after its identity with D/1846 D1 was proven.

The comet was observed at numerous observatories in Europe and the U.S. for three full months after de Vico's discovery. Using the estimate of 6 for the total visual magnitude (m_1) in March 1846, a possible power-law formula representative of the comet's brightness might be $m_1 = 8 + 5 \log \Delta + 15 \log r$, where Δ and r are the comet's geocentric and heliocentric distances (in AU), respectively. Indeed, this formula represents well the comet's brightness during Sept.-Oct. 1995. 122P/de Vico was some 41° from the sun when discovered. It moved rapidly northward into Pisces and then Andromeda in the third week of March (though then only 35° from the sun); on March 30, the comet skimmed by the eastern edge of M31. By April 7, the comet was in Cassiopeia and still moving steadily northward; when last reported seen in May, 122P/de Vico was in Cepheus near $\delta = +75°$ and ~ 1.4 AU from both the earth and the sun.

II. The Problematic 1846 Observations: Uncertainty in Orbital Period

Numerous orbital computations were undertaken during the subsequent 41 years (Galle 1894), though until now there appears to have been only one such investigation using the 1846 data in the last 100 years, and even that work (Buckley 1979) relied heavily on von Hepperger's work a century earlier. It quickly became apparent after the comet's discovery that parabolic elements would not adequately represent the comet's positions, but initial orbital computations in the months following discovery of 122P/de Vico yielded orbital periods (P) from 55.4 years (Hind 1846) to 95 years (Peirce 1846). Most such calculations seemed to settle down around $P \simeq 76$ years (*e.g.*, Breen 1846), and a similar result was obtained by von Hepperger (1887), who used four normal places for the comet and estimated an uncertainty in the period of ±3 years.

Brian G. Marsden (Harvard-Smithsonian Center for Astrophysics) recently collected and re-reduced the 1846 visual astrometric observations of 122P/de Vico from the astronomical literature, using the new *PPM Star Catalogue* (Röser and Bastian 1991) and a computer program written by Gareth Williams. In 1994, we took these new reductions of the comet's positions to assess the uncertainty of the orbital period of 122P/de Vico. It is clearly obvious that the 1846 observations are generally quite poor in quality. There is great difficulty in representing the May observations, which have much higher residuals (> 10″), and this was also noted by the earlier computers, particularly Buckley (1979). In fact, the May observations — which were made at three observatories (at Cambridge and at the U.S. Naval Observatory, Washington, in the U.S.A.; and at Bonn) — are so discordant that it seems virtually impossible to select even two (out of the total of eleven) that can be trusted for the solution!

Prior to the recent re-discovery of 122P/de Vico, by concentrating therefore on a two-month arc from late February through late April, I was able to get good agreement for a couple of dozen observations yielding a mean residual of ~ 1″.9 and orbital elements with $P \approx 80$ years. This solution indicated the next perihelion passage as being in 2008, with closest approaches of no less than 0.8 AU to Venus, Earth, and Mars during the period 1846-2008, and no less than 4.4 AU to Jupiter and 2.4 AU to Saturn (the latter occurring in 1929 February); the ascending node of the comet's orbit is 0.33 AU from the earth's orbit. Though Nakano (*e.g.*, 1994) had provided ephemerides based on Buckley's 1996 perihelion date, he and I. Hasegawa had looked at ancient comets and performed calculations that suggested $T \sim$ 2004 June 29 (Nakano 1995a). Meanwhile, Marsden was able to force periods such that perihelion could occur at any time during 1991-2008.

As a demonstration of the general quality of astrometric observations prior to 1850, Williams represented the observations of 1P/Halley in 1835, using an orbit by Yeomans (1986). These observations were recently taken from the *International Halley Watch Comet Halley Archive* (Niedner *et al.* 1992) and are now included in the astrometry files of the Minor Planet Center. The 155 observations are satisfied with an r.m.s. residual of 4″.52, but with a strong negative trend in the residuals. By rejecting observations with residuals > 8″, Williams represented 130 observations with an r.m.s. residual of 2″.99 — and the negative trend almost completely disappears. Adopting 8″ as one possible cutoff for accepting observations of 122P/de Vico in 1846, Williams obtained $P = 78.26$ for epoch 1846 Mar. 5.0 from 67 observations (1846 Feb. 27-May 3; mean residual 3″.91), in turn yielding $T =$ 2002 June 20. Williams also attempted solutions using cutoffs of 9″, 7″, 6″ and 5″. As the rejection limit was lowered, the orbital period increased and the arc that could be represented shortened. The results of our work in 1994 led us to believe that perihelion passage would probably occur around 2002, with an uncertainty of 6-7 years in either direction. The important point here is that the estimated uncertainties of ±3 and ±1 years in P by von Hepperger (1887) and Buckley (1979) were both much too low, considering the quality of the 1846 data; that they both found periods within a year of the truth seems basically due to luck. And as-yet-undetermined nongravitational forces likely play a role in the motion of this comet, as well.

Buckley (1979) included perturbations by seven major planets (Venus-Neptune) in his calculations, which involved 98 observations spanning 1846 Feb. 27-May 20; he obtained a mean residual of 5″.15, which is quite large for having much confidence in such an orbital result. As noted, this was the first real attempt at re-computing the orbital elements of 122P/de Vico in nearly a century, a result no doubt due to the difficulties in dealing with observations from an era when the times of observation must also be held as necessarily uncertain. Buckley's predictions yielded $T =$ 1922 July 14.15 and 1996 July 3.22. *(text continued on next page)*

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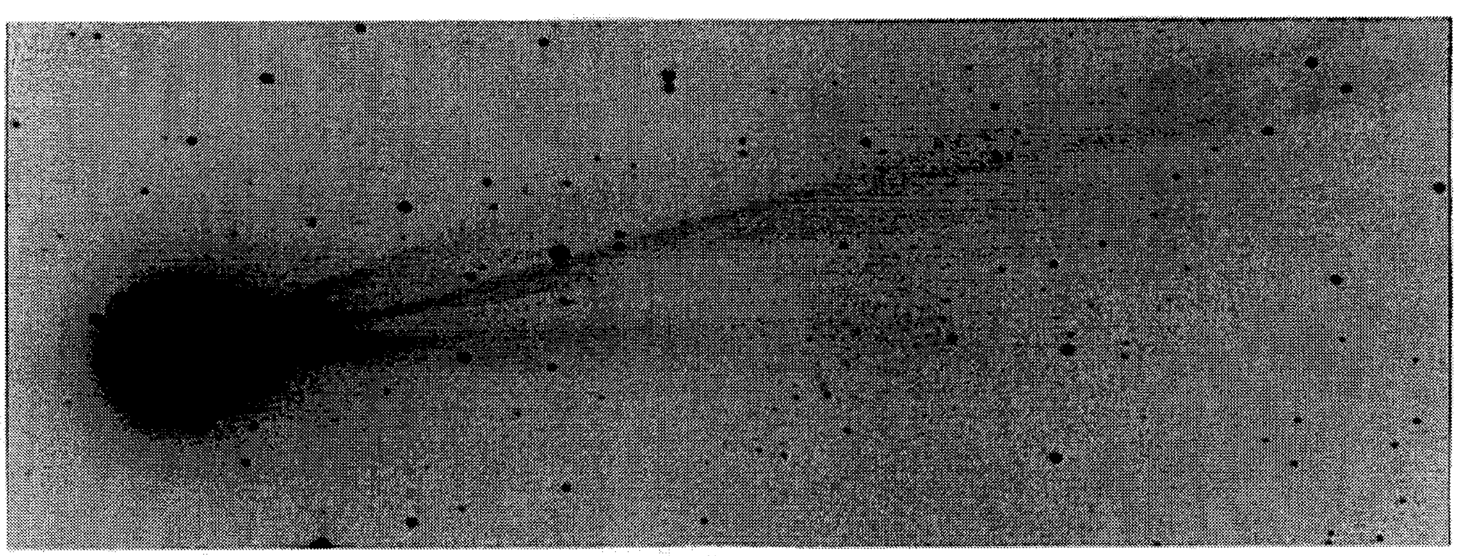
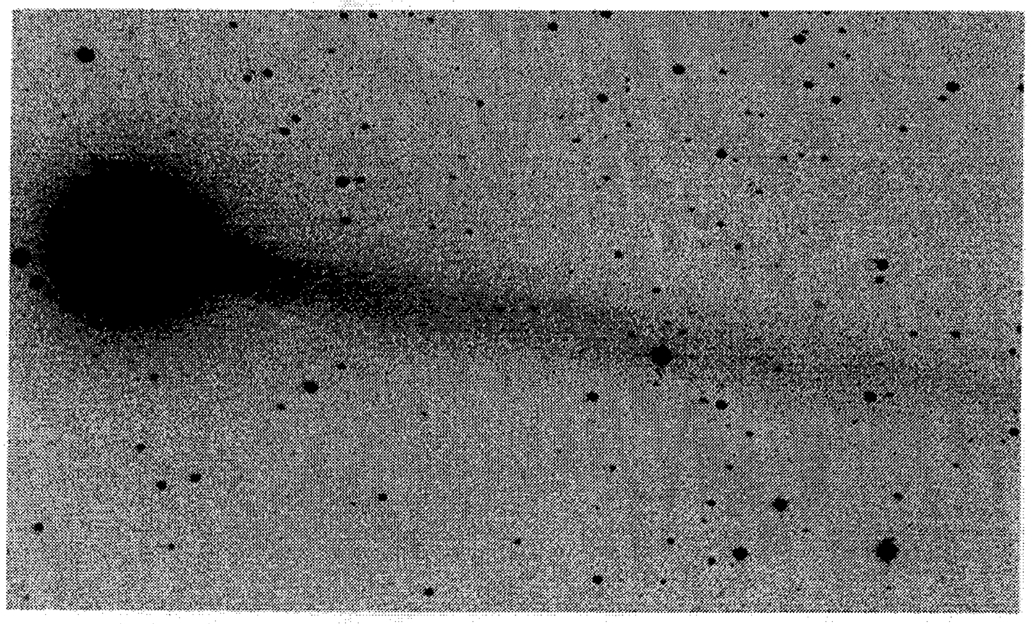
Below: ***Mosaic image of 122P/de Vico taken by Gordon Garradd at Loomberah, New South Wales, Australia, with a 25-cm f/4.1 Newtonian reflector (+ HI-SIS 22 CCD). Two 180-sec images were attached, the left (coma) portion taken on Sept. 27.769 and the right portion taken on Sept. 27.774 UT (horizonal length of field is 39′, with north up). Taken during rapidly-brightening twlight with comet low in the sky.***





Above: *Gordon J. Garradd obtained this 180-sec exposure of 122P/de Vico on Sept. 18.781 (instrumentation as noted at bottom of p. 63).*

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Knowing now that the period is shorter than we suspected leads to the enigmatic conclusion that large residuals from old, micrometric positions are not a sufficient requirement for omission from an orbital solution. Table 1 lists residuals for all of the re-reduced 1846 observations, from a recent orbital calculation by Nakano (1995b) that links observations in 1846 and 1995 (note that Y = semi-accurate measurements given to 1″ instead of the standard 0″.1). A similar case occurred recently with 109P/Swift-Tuttle, in which the poor quality of the 1862 astrometry was such that realistic assessments of the comet's true orbital period were highly difficult prior to its recovery in 1992 (see Marsden *et al.* 1993).

III. The Missed 1922 Return

Indeed, the work by von Hepperger (1887) seems to have been the most widely-accepted calculation by astronomers of the 1910s and 1920s. M. Viljev (1917) had search ephemerides published in the *A.N.* without mention of the corresponding orbital elements, though the period was suggested as being near 76 years; a search ephemeris by Viljev was also published by Andrew C. D. Crommelin (1917b), the Director of the Comet Section of the British Astronomical Association (BAA). P. Hügeler (1917) published five search ephemerides for 1917-1918, inexplicably assuming T = Nov. 20 in each year from 1917 to 1921; Hügeler's ephemerides were widely circulated — for example, printed also in *The Observatory* (in 1917), the *Journal of the British Astronomical Association* (Crommelin 1917a), and *Popular Astronomy* (in 1919). Crommelin stated on several occasions that "1921 Nov. 20 is considered the most probable time of perihelion passage, but the uncertainty is estimated as three years", but there is no indication that either he or Hügeler performed any calculations using original 1846 data; indeed, immediately below this remark about uncertainty, Crommelin (1920) lists the orbital elements by von Hepperger, whose period of 75.7 yr leads directly to T = 1921 Nov. 20 when added (without perturbations) to T = 1846 Mar. 6.

Crommelin's own feeling of the uncertainty in the comet's orbital period was highlighted by a development several years later: In December 1927, J. F. Skjellerup in Australia reported a new third-magnitude comet (C/1927 X1; O.S. 1927 IX = 1927k), which sported a 3° tail. This new comet, also found by Maristany, revealed an orbital inclination of 85°, leading Crommelin to state that "it appears very probable that this is De Vico's long-period comet 1846 IV, which has been searched for by Southern observers since 1920. If so, its period is 81.75 years . . . No one has computed the perturbations of this comet since 1846, and it is possible to represent the position within a few degrees by the unperturbed elements . . . The period is several years longer than the predicted one, but that causes no surprise. The comet Brorsen-Metcalf, 1847 V, returned in 1919, nine years before it was expected" (Crommelin 1927). Crommelin soon realized that the two comets could not be identical, but this reveals the feeling of great uncertainty surrounding 122P/de Vico's orbital period. Recall that our work during the past year (noted above) showed that the 1846 micrometric positions naturally tend more toward solutions of $P \sim 80$ years than 75 years.

At any rate, Crommelin does appear to have tried hard to get observers to search for 122P/de Vico — writing for example in 1919 that "a persistent search should be maintained" — though the excess emphasis by both Crommelin and Hügeler on southern-hemisphere observers' being much better placed than their northern counterparts may have prevented much effort from northern latitudes. He later remarked: "Search for De Vico's comet of 1846 has been made by our Southern [BAA] Members [led by Skjellerup and W. Reid]; it is hoped that this will be steadily maintained, as the date of return is uncertain by several years" (Crommelin 1921).

(text continued on page 66)

Table 1. Orbital elements and residuals for 122P/de Vico.

122P/de Vico
Epoch 1995 Oct. 10.0 TT = JDT 2450000.5

T	1995 Oct. 6.02280 TT				Nakano
q	0.6589113		(2000.0)	P	Q
n	0.01325503	Peri.	12.97317	+0.15784939	-0.11746782
a	17.6827171	Node	79.61910	+0.79340113	-0.57602492
e	0.9627370	Incl.	85.39141	+0.58787603	+0.80894784
P	74.36				

From 146 observations 1846-1995, mean residual 2".39.

Residuals in seconds of arc

460227 802(14.4+ 1.4+)Y	460323 787 (8.8+ 3.3-)	460520 802 (8.3- 70.3-)Y
460301 533(44.4+ 18.4+)	460323 539 (2.7+ 10.0+)Y	950917 412 (0.3- 4.9+)
460302 802 3.9- 5.8- Y	460323 516 3.6- 2.9+	950918 422 0.6- 1.0-
460302 007 1.5+ 3.1-	460323 512 2.3- 0.7+	950918 422 1.7- 1.6-
460303 802 (7.6- 7.8+)Y	460324 539 3.9- 4.0+ Y	950918 422 1.0- 1.2-
460303 533(11.4+ 9.1+)	460324 527 1.9- 4.4+	950918 422 0.4- 1.4-
460303 027 (9.0+ 13.7+)Y	460327 516 (8.0+ 2.1+)	950918 422 0.7- 0.9-
460304 802 (3.6- 22.7-)Y	460330 516 2.0- 6.0+	950918 422 1.0- 0.8-
460304 787(13.1+ 2.3+)	460331 787 (7.6- 3.0-)	950918 356 (0.1- 2.3-)
460304 787 6.5+ 2.5+	460331 787 5.2- 4.0-	950918 356 (2.2- 3.0-)
460305 802 5.9- 2.5- Y	460331 545 5.7+ 4.9+	950918 356 1.4- 1.2-
460305 787 (8.1+ 0.5-)	460331 516(16.8+ 6.7+)	950918 356 2.2- 2.2+
460305 007 (9.1+ 1.6-)	460331 512 5.2- 6.3-	950918 356 1.8- 0.5-
460306 787 5.2+ 3.7+	460401 802(10.8+ 10.0+)Y	950918 893 1.7- 0.3-
460306 007 2.8- 1.7+	460401 787(10.5- 6.4+)	950918 893 1.6- 0.2-
460307 802 (6.8- 9.9+)Y	460401 548 1.6- 2.3-	950918 356 (2.8- 0.2+)
460307 533(81.5+ 1.6+)	460401 520 6.4+ 5.7-	950918 893 1.7- 0.2-
460308 007 3.1- 2.1+	460401 520 (8.0- 0.5+)	950918 372 2.5- 1.4+
460308 007 0.6- 0.7-	460402 802 4.9+ 5.4+ Y	950918 359 (2.7- 0.0)
460309 787 (4.3+ 19.4+)	460402 520 4.2+ 3.2-	950918 359 1.7- 1.6+
460309 007 (9.3+ 2.3-)	460402 520 5.4- 4.2-	950918 372 1.6- 1.0+
460309 802 (0.1+ 11.9+)Y	460402 520 0.6- 2.5-	950918 360 1.1- 0.2-
460310 007 (8.4- 8.8-)	460403 802(17.0- 2.7+)Y	950918 360 0.9- 0.1-
460311 802 4.5+ 2.1+ Y	460403 539 (9.6- 4.4+)Y	950918 360 1.0- 0.4-
460311 787 (9.4+ 0.9+)	460403 007 3.9- 2.6-	950919 965 0.6- 1.3- Y
460311 533 (1.1- 30.7+)	460404 802 (4.7- 41.5-)Y	950919 965 1.1- 0.3- Y
460312 802 (1.4+ 13.3-)Y	460405 520(13.0+ 5.2-)	950919 402 0.8- 0.2-
460312 787 2.0+ 6.4-	460405 520 1.9+ 2.5-	950919 402 1.4- 0.1+
460312 533(17.5+ 11.9+)	460413 520(16.2- 64.1-)	950919 402 0.5- 0.2-
460312 516 3.9+ 5.8+	460414 548(26.4+ 11.8-)	950920 422 0.2- 1.3-
460312 527 0.5+ 4.0+	460415 802 2.9+ 4.1- Y	950920 422 0.4- 1.3-
460312 007(28.1+ 3.3+)	460416 802 0.6- 4.4- Y	950920 422 0.0 1.1-
460313 802 0.9+ 2.4- Y	460416 539(35.1- 31.8+)Y	950920 422 0.3- 0.9-
460313 533 (6.6+ 9.2+)	460416 516 (3.9+ 9.7-)	950920 422 0.3+ 0.5-
460315 787 4.6+ 5.3-	460417 802(20.3+ 8.4+)Y	950920 422 0.6+ 1.0-
460315 548 0.8- 3.1+	460417 548(15.0+ 11.6+)	950920 422 0.2+ 0.0
460315 516 2.0- 0.6-	460418 516(11.8- 10.1+)	950920 422 0.9- 1.2-
460315 527 2.6+ 1.1-	460421 787 (5.4+ 11.1-)	950920 388 0.2- 0.1-
460316 533(46.2+ 0.2+)	460421 787 (8.6- 10.4-)	950920 388 0.1+ 0.5+
460317 516 2.3+ 3.7-	460421 787(22.3- 9.6-)	950920 388 0.8- 0.0
460317 527 1.6+ 2.0+	460421 520(10.8+ 0.8-)	950920 411 0.0 0.1+
460317 503 1.9+ 6.8+	460422 520 6.3+ 0.2-	950920 897 1.0- 1.0-
460318 802 4.6- 4.2+ Y	460423 520(13.5+ 6.3-)	950920 388 0.3- 0.0
460318 787 1.6- 2.8+	460423 520 1.8- 2.9-	950920 356 1.0- 1.5+
460319 802 (7.7+ 5.9+)Y	460425 520 (1.4- 69.3-)	950920 894 0.4- 0.0
460320 516 (1.7+ 16.6+)	460427 520 (6.6+ 8.9-)	950920 411 0.6- 0.2+
460320 548 2.5- 3.0+	460428 787(18.3- 5.0-)	950920 356 0.9- 0.9-
460320 503 (1.3- 15.2+)	460428 787 5.4+ 3.9+	950920 897 1.4- 0.0
460321 520 0.9+ 5.3-	460428 802 5.7- 2.3+ Y	950920 894 0.8+ 0.6-
460321 520 4.8+ 4.5+	460428 520(13.5+ 13.4-)	950920 388 0.1+ 0.3+
460322 802 (2.3- 13.6-)Y	460429 520 2.6+ 3.0-	950920 388 0.2- 0.7+
460322 787 2.2+ 3.0+	460502 520 (7.6- 13.4+)	950920 411 0.5- 0.1+
460322 545 (0.4+ 17.8+)	460503 787 (3.6- 12.5-)	950920 897 1.4- 0.2-
460322 539 (9.9- 13.1+)Y	460505 802 (1.0+ 40.4-)Y	950920 388 0.7- 0.7+
460322 548 4.2- 0.3-	460519 802(22.3- 27.3-)Y	950920 360 0.1- 0.0

Table 1. *(cont. from previous page)*

950920	356	1.2-	2.6-	950923	476	2.0-	2.4-	950924	875	1.3+	0.7-
950920	360	0.0	0.1+	950923	046	1.1+	0.3+	950924	893	0.5+	0.2-
950920	360	0.1+	0.2-	950923	046	1.3+	0.1+	950924	875	0.5-	0.1-
950921	422	1.2+	1.7-	950923	046	1.0+	0.2+	950924	875	0.8+	0.6+
950921	422	0.2+	1.9-	950923	589	0.1-	1.3+	950924	875	0.7+	0.4-
950921	422	0.7+	1.8-	950923	589	0.6+	1.3-	950924	897	0.5-	1.1-
950921	893	0.6-	0.2+	950924	540	0.9+	0.0	950926	046	2.3+	1.0+
950921	422	1.1-	1.4-	950924	540	0.0	0.4+	950926	046	2.6+	1.1+
950921	422	0.9-	0.4-	950924	540	0.6+	1.7+	950926	046	2.1+	0.5+
950921	893	0.6-	0.5+	950924	540	0.0	0.9+	950927	367	2.2+	0.9+
950921	893	0.5-	0.3+	950924	893	0.1+	0.1-	950927	367	1.8+	1.0+
950922	046	1.8+	0.2+	950924	897	1.6+	0.4+	950927	367	2.3+	0.8+
950922	046	0.6+	0.2-	950924	893	0.2+	0.0	950930	046	3.8+	1.0+
950922	046	1.8+	0.1-	950924	875	0.8-	0.0	950930	046	3.8+	0.9+
950923	589	1.4-	1.5+	950924	897	0.2+	1.2+	950930	046	4.1+	0.9+
950923	589	(2.6+	1.4-)	950924	875	0.4-	0.0	950930	568	3.1+	2.3+

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(text cont. from page 64)

We now know that perihelion occurred on or very close to 1922 Apr. 8 (Green 1995b). This meant, assuming an inverse-sixth-power absolute magnitude $H_{15} = 8.0$, that the comet was south of declination $\delta = -45°$ from 1921 into mid-February of 1922, and probably fainter than mag 10 or 11 until this time (when the solar elongation, ϵ, was $\sim 51°$). The comet should have reached total visual mag $\sim$ 6-7 during March and April 1922, moving rapidly northward as it crossed the celestial equator in the third week of March ($\epsilon \sim 35°$). The comet was at $24° < \epsilon < 30°$ during Mar. 25-Apr. 28, but was near $\delta \sim +45°$ in late April and so well-placed for northern-hemisphere observers (if they were looking). In May, the comet likely would have faded rapidly from mag 7.5 or so to 10 or fainter by month's end. The comet would have already become a difficult object for southern-hemisphere observers by February, and — because of the remarks by Crommelin and Hügeler about northern-hemisphere observers' not being favored for searches — comet hunters at northern latitudes may not have expended much effort. Indeed, at one point, Crommelin (1924) remarks that "so few observers are devoting themselves [to] comet sweeping".

IV. The 1995 Return

Prior to its re-discovery, ome observers may have been looking in recent months along the predicted line of variation for P/de Vico, given that predictions were published with perihelion in 1996 (Buckley 1979; Nakano 1994), but we have no concrete information to this effect. Some mention was made by observers (and at least one re-discoverer of this comet) in September of searching along the track of the Kreutz sungrazers (though 122P was moving in the opposite direction).

Though the preliminary orbital elements from the 1995 astrometry alone showed that clearly this must be the 1846 comet, it took considerable effort to link the two apparitions (Green 1995a). It was necessary to perform many hours of computer calculations to find convergence, and the first linked orbit (Green 1995b) required that the eccentricity (e) be held fixed while solving for the other five orbital elements. Images of the comet suggest that this comet has much gas and little dust; combining this with the fact that its apparent absolute magnitude is rather fainter than comets such as 1P/Halley and 109P/Swift-Tuttle (exhibiting less activity and inferring a smaller nucleus), one would suspect that there must be measurable (if not appreciable) nongravitational forces acting on the orbital motion of 122P/de Vico. Such forces will likely help explain the systematic trends in the 1846 observations in fitting orbital periods longer than 76 years; note that there are also systematic trends visible in the residuals of the 1995 observations (see Table 1).

The comet has displayed a nice gas tail (see the accompanying images by Gordon Garradd, Kazuyuki Ito, and Martin Mobberley) and has been a barely-naked-eye object in the morning sky since re-discovery, passing near Regulus in Leo. Given here is an ephemeris for the comet, based on orbital elements by Nakano (1995b), to supplement the ***1996 Comet Handbook***, issued several months ago.

No obvious candidates have yet appeared in from the literature that might represent pre-1846 apparitions of 122P/de Vico. It is possible that there is none to be found, as this comet is not intrinsically as bright as 109P/Swift-Tuttle or 1P/Halley. Nonetheless, it is a good feeling to have solved another case of lost short-period comets found in the 19th century; numerous other similar cases have been "solved" in the last 30 years — a success rate that is partly due to admirable efforts by orbit computers such as Marsden who have improved the predictions to allow more promising searches and partly due to luck. There are still eight single-apparition short-period comets with $P < 100$ years that were discovered in the 1800s that are yet to be re-found, although some of them may no longer exist.

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Perturbed ephemeris for 122P/de Vico (see text, above)

1995/96	α_{2000}	δ_{2000}	Δ	r	ϵ	β	m_1
Oct. 10	11h09m.69	+22°26'.9	0.964	0.664	39°.5	73°.1	5.3
20	12 43.24	+30 09.7	0.997	0.719	42.3	68.8	5.8
30	14 12.97	+31 28.7	1.124	0.820	45.1	59.0	7.0
Nov. 9	15 20.21	+29 08.3	1.305	0.947	46.2	49.1	8.2
19	16 07.32	+25 58.2	1.509	1.086	45.9	40.8	9.4
29	16 41.44	+23 06.9	1.714	1.230	44.9	34.4	10.5
Dec. 9	17 07.51	+20 50.9	1.909	1.376	43.6	29.6	11.5
19	17 28.39	+19 10.1	2.088	1.520	42.8	26.1	12.3
29	17 45.66	+18 00.6	2.247	1.663	42.7	23.6	13.1
Jan. 8	18 00.18	+17 18.0	2.384	1.804	43.6	22.1	13.7
18	18 12.46	+16 58.4	2.498	1.942	45.6	21.2	14.3
28	18 22.72	+16 58.7	2.589	2.077	48.8	20.9	14.8
Feb. 7	18 31.08	+17 16.0	2.657	2.209	53.0	20.9	15.3
17	18 37.53	+17 48.0	2.705	2.340	58.2	21.0	15.7
27	18 41.98	+18 32.5	2.733	2.467	64.2	21.2	16.1
Mar. 8	18 44.29	+19 26.7	2.744	2.593	70.8	21.2	16.4
18	18 44.31	+20 28.0	2.742	2.716	78.0	21.0	16.7
28	18 41.83	+21 32.9	2.732	2.837	85.7	20.5	17.0
Apr. 7	18 36.72	+22 37.0	2.717	2.956	93.7	19.7	17.2
17	18 28.90	+23 35.2	2.704	3.074	102.0	18.6	17.5
27	18 18.44	+24 21.3	2.699	3.189	110.2	17.2	17.7
May 7	18 05.69	+24 48.9	2.707	3.303	118.0	15.7	17.9
17	17 51.22	+24 52.6	2.733	3.415	124.9	14.1	18.2
27	17 35.85	+24 28.8	2.784	3.525	130.3	12.7	18.4
June 6	17 20.55	+23 36.9	2.862	3.634	133.4	11.7	18.7
16	17 06.20	+22 19.8	2.968	3.742	133.6	11.3	19.0
26	16 53.53	+20 42.5	3.103	3.848	131.1	11.5	19.2

Brightness-Variation Patterns of Recent Long-Period Comets vs. C/1995 O1

Daniel W. E. Green

Abstract. *Forty-one long-period comets that became binocular objects in the past 40 years (and one telescopic comet) were analyzed in terms of their observed brightness, using the archives of the International Comet Quarterly and the Minor Planet Center. Some apparent groupings and correlations are discussed, and cautious comparison is made with the newly-discovered comet C/1995 O1 (Hale-Bopp) in light of its anticipated brightness during the next two years.*

Long-time comet observer and *ICQ* contributor Alan Hale of Cloudcroft, New Mexico, and amateur astronomer Thomas Bopp of Glendale, Arizona, both independently discovered a comet (designated C/1995 O1) on the night of July 22-23 while looking at the nearby globular cluster M70 in Sagittarius, the comet then being around total visual magnitude 10.5 (cf. *IAUC* 6187). It immediately became obvious from astrometric observations that this comet was still far from the sun at discovery — in fact, near $r = 7$ AU, meaning that the observed coma diameter (2′-4′) was hundreds of thousands of kilometers across (and even larger when imaged via CCD with large telescopes; West 1995) and that the comet's absolute magnitude is at least temporarily very bright.

Many are speculating as to how bright this new comet might become as it nears perihelion on $\simeq$ 1997 April 1.0 TT. There are some questions that will not be answered immediately, and perhaps not for well over a year (if at all): Was the comet undergoing a recent outburst that began in the weeks just prior to discovery? If so, what would the comet's brightness be now and in the future without an outburst, and how much might the comet now fade (intrinsically) and shrink in apparent size? How can a comet be so active at such a large heliocentric distance, inbound — with a noticeable northward tail that was even seen visually in small telescopes? Water ice, thought to be the major volatile ice component of cometary nuclei, supposedly does not sublimate when a comet is further than $\sim$ 3 AU from the sun. Can this be a dust venting, perhaps combined with a venting of CO_2 (or other) ices? What if, for example, a comet such as C/1995 O1 were to have more non-H_2O volatiles than water ice? And how rapidly might we expect the comet to rise in brightness, as it approaches perihelion in the first third of 1997?

Representing the Brightness of Past Comets

We can already begin to answer this last question, however cautiously, based on our experience and knowledge concerning long-period comets observed in the past. The well-known infamous C/1973 E1 (known as comet Kohoutek, old-style designation 1973 XII = 1973f) rings through the minds of many as an example to remember. But many data have been obtained on the brightness of long-period comets that were not available a quarter-century ago. As Roemer (1976) noted regarding C/1973 E1 (Kohoutek), "no comet ever before was followed from discovery at a heliocentric distance of nearly 5 AU through a perihelion passage less than 0.2 AU from the sun. The experience, therefore, was highly instructive."

While attempts have been made to derive a more-physically-meaningful formula to represent the brightness of comets, none has yet been produced, and most people still rely on the so-called power-law formula for this purpose:

$$m_1 = H + 5 \log \Delta + 2.5n \log r,$$

where m_1 is the comet's total integrated magnitude (usually visual), H is the so-called absolute magnitude (if the comet were placed at $\Delta = r = 1$ AU), n is the power-law exponent (or photometric index), and Δ and r are the comet's geocentric and heliocentric distances (in Astronomical Units, AU). Thus, we say that a comet generally varies in brightness according to r^{-n} (or varies to the inverse nth power).

In the case of C/1973 E1, we can see now that its brightness was not so unusual; not only can its lightcurve be rather well represented with a power-law formula, but many other long-period comets follow a similar type of formula, in which the comet varies in brightness as $\sim r^{-3}$. Another recent example that current observers will recall is that of C/1989 X1 (known as comet Austin, O.S. 1989c$_1$), which rose rather steeply ($\sim r^{-5}$) and then leveled off rather abruptly ($\sim r^{-2}$) a couple of months prior to perihelion passage.

Surprisingly, most long-period comets may be much more predictable than was C/1989 X1, in that the photometric index (which signifies the rate of brightness increase with decreasing heliocentric distance) tends to be rather more stable over time; but whether C/1995 O1 will be predictable or not is not predictable! Unfortunately, long-period comets are not usually found until they are at or well inside Jupiter's distance from the sun (*e.g.*, see Figure 5 of Svoreň 1988). Numerous comets have shown significant comae (especially recently, as they are being imaged at larger heliocentric distances post-perihelion; *cf.* Meech 1991), such as C/1927 E1 (Stearns) at $r > 11$ AU, C/1983 O1 (Černis) at $r = 15.3$ AU, C/1984 U1 (Shoemaker) at 10.3 AU, and 1P/Halley at $r > 10$ AU — and 95P/Chiron at $r = 11.8$ AU *pre*-perihelion — suggesting that some mechanism other than H_2O sublimation is fueling this activity (*e.g.*, Sekanina 1991; Meech and Jewitt 1987). C/1980 E1 (Bowell) even exhibited a coma at $r = 7.3$ AU pre-perihelion and at $r = 13.6$ AU post-perihelion (Meech and Jewitt 1987).

Forty-Two Comets

For two decades now, the author has been compiling the *ICQ* archive of photometric data on comets, which concentrates on collecting total visual magnitude (m_1) data rather than so-called "nuclear" (m_2) data — the latter being much more difficult to define and interpret (see historical reviews by Green, Rokoske, and Morris 1986; Morris and Green 1992). A valuable base of data not previously available has been steadily compiled in this manner, largely improved by the introduction of standard observing and collecting procedures.

It is with this rapidly-increasing database that data were analyzed for 42 long-period comets observed in the past 40 years, with the so-called Kreutz sungrazers excluded (due to their unique nature). The chosen comets had perihelion distances in the range 0.14-1.95 AU, with four exceptions: C/1962 C1 (Seki-Lines) had q = 0.03 AU; C/1991 B1 (Shoemaker-Levy) had q = 2.26 AU; C/1983 O1 had q = 3.32 AU; and C/1980 E1 had q = 3.36 AU. In general, the comets that were chosen were visible over several (if not many) months and had a fair amount of reliable magnitude data available. Forty-one of the 42 comets were observed with binoculars (C/1980 E1 was the only comet in the group that was not so observed, reaching $m_1 \sim 11$ at maximum brightness), and 22 were observed with the naked eye. Unfortunately, there is an inevitable overall availability of more post-perihelion than pre-perihelion data for the average long-period comet, due to unpredictable discovery circumstances.

Some comets — such as C/1980 Y2 (Panther), C/1984 V1 (Levy-Rudenko), and C/1994 N1 (Nakamura-Nishimura-Machholz) — were omitted at this time because of a lack of many pre-perihelion observations (although three comets in Table 2 actually have no available pre-perihelion data). It is anticipated that a future paper will deal with other, less-well-observed long-period comets observed in the past 15-30 years that are not included herein. Table 1 lists the number of 1-line, 80-character observations for each of the 66 best-observed long-period comets in the *ICQ* archive, and it can be seen that nearly all of the top 40 comets in Table 1 were included in the present study; this was constructed including observations published in the July 1995 *ICQ*, there being then a total of 41,849 observations of long-period comets in the archive.

The actual magnitude data were selected as follows. The m_1 data of numerous experienced *ICQ* contributors were selected over those portions of each comet's observed arc during which the comet was visible in small instruments. (The following observers were used the most often in establishing a comet's true m_1, listed here by *ICQ* observer code: BEY, BOR, BOU, CLA, HAL, JON, KEI, MIL, MOR, PEA, SEA; some observers are generally some 0.5-1.0 mag on the faint side, notably JON — and sometimes BEY and HAL — requiring slight systematic corrections.) These data were then supplemented by whatever total magnitudes could be gleaned from the astrometric archives of the Minor Planet Center, so as to extend the arc of observation as far as possible in each case; it was generally assumed that the true visual m_1 was 1-3 mag brighter than was given by photographic astrometrists [though note that the discrepancy is often far greater; for example, for C/1984 N1, photographic astrometrists reported m_1 = 16 on 1984 Nov. 21 (*MPC* 9317), while visual observers were following it throughout that same month at m_1 = 10-11!]. Aperture correction was largely ignored, though it was always the policy to choose magnitude estimates made with the smallest possible apertures and magnifications, so as to minimize any aperture effects (see Green 1991 for further discussion of this issue); "astrometric" magnitudes contributed little to the overall picture in most cases. *(text continued on next page)*

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Table 1. The 66 long-period comets with the most observations in the ICQ archive.

1990 K1	4813	1970 N1	511	1990 E1	233
1989 X1	2339	1985 R1	497	1961 R1	230
1987 P1	2216	1969 T1	476	1987 B1	229
1989 Q1	1468	1984 N1	453	1985 T1	227
1988 A1	1421	1989 W1	444	1966 P1	227
1977 R1	1132	1990 N1	428	1994 T1	225
1975 N1	1081	1983 H1	398	1963 F1	210
1982 M1	991	1984 V1	368	1994 J2	198
1993 Y1	972	1968 N1	330	1989 T1	195
1973 E1	945	1991 Y1	325	1987 Q1	172
1986 P1	861	1991 B1	323	1987 W2	169
1991 T2	857	1967 Y1	314	1988 P1	168
1993 A1	821	1993 Q1	305	1959 Y1	162
1974 C1	683	1980 Y1	305	1991 X2	161
1980 Y2	674	1962 C1	305	1964 P1	159
1979 Y1	656	1987 U3	294	1983 J1	152
1969 Y1	630	1980 V1	286	1953 T1	146
1992 F1	596	1963 A1	277	1980 E1	144
1994 N1	591	1989 Y1	268	1984 K1	133
1986 V1	576	1983 O1	265	1964 N1	133
1975 V1	533	1956 R1	260	1975 T2	124
1994 G1	529	1965 S1	245	1948 E1	123

The *ICQ* archival data become progressively better in both quality and length of orbital arc as one nears the present date. The advent of inexpensive, good-quality CCD cameras and software for amateur astronomers has meant that magnitudes of comets in the magnitude range 13-20 are now being collected on a wide basis, so that much more will be learned about photometry of comets when they are faint and further from the sun; in the past, the photographic procedures utilized by astrometrists (short exposures; emulsions with blue sensitivity; etc.) have prevented the routine acquisition of reliable m_1 data of comets — the result being that understanding the brightness of comets has necessarily lagged for many years. Comets observed over many years, such as C/1983 O1 (Černis), have reliable magnitudes for only weeks or months when amateurs were observing them visually; in the case of C/1983 O1, this means that good m_1 data are available for only ~ 6 months after perihelion passage — though if this comet were observed today, amateur CCD observers would assure that reliable photometry would extend over several years. This points to the problems of Table 2, in which the data do not cover respectable arcs of most of the comets' orbits, so one must be cautious in using the data at face value. *(text continued on page 172)*

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Table 2. Photometric Parameters of Long-Period Comets, 1956-1995

Comet	q	a	H	2.5n	Range in r*	Notes
C/1956 R1	0.32	-10000	5.0	8.0	2.7-0.3-3.0 pre,post	
C/1989 Q1	0.64	-4590	7.7	7.0	1.61-0.64-0.94 pre,post	
			8.0	15.0	0.94-1.25 post	
C/1993 Q1	0.97	300000	7.5	8.0	3.3-1.3 pre, 0.97-1.1 post	
			7.5	15.0	1.1-1.9 post	
C/1973 E1	0.14	50000	5.5	7.5	2.1-0.65 pre	
			6.3	7.0	0.65-0.3-2.0 pre,post	
C/1978 H1	1.14	42000	4.0	7.5	2.99-1.13-4.83 pre,post	
C/1962 C1	0.03	40000	6.0	10.0	1.5-0.03 pre	
			5.0	7.5	0.03-1.2 post	
C/1980 E1	3.36	37000	4.2	7.5	7.4-3.36 pre	
			4.0	9.0	3.36-13.6 post	
C/1989 X1	0.35	31000	4.0	12.5	2.4-1.5 pre	
			6.0	5.5	1.5-0.35 pre	
			8.5	8.0	0.35-2.1 post	
C/1983 O1	3.32	22000	3.5	8.0	3.32-3.75 and 13.3 post	
C/1993 A1	1.94	17000	4.5	10.0	4.5-1.94-1.95, 2.4-3.0 pre,post	
C/1986 P1	1.20	15000	5.3	7.5	3.6-1.2-4.3 pre,post	(1)
C/1990 K1	0.94	5130	4.2	10.0	2.5-0.94-3.1 pre,post	
C/1977 R1	0.99	4330	6.7	10.0	1.44-0.99-1.44(-3.0?) pre,post	(2)
			6.5	15.0	1.0-1.8(-3.0?) post	(2)
C/1970 N1	1.11	3530	5.0	8.5	1.9-1.1 pre, 1.6-3.2 post	
C/1986 V1	1.7	2680	1.0	25.0	2.35-q pre	
			4.0	15.0	q-2.95 post	
C/1969 T1	0.47	1970	6.5	7.0	1.5-0.47-2.5 pre,post	
C/1984 N1	0.29	1960	7.5	6.0	0.93-0.3 pre; 0.5-2.2 post	
C/1985 R1	0.69	1910	8.5	10.0	1.7-0.69-1.4 pre,post	
C/1989 W1	0.30	1830	7.5	9.0	1.06-0.30-0.95 pre,post	
C/1974 C1	0.50	1450	7.3	8.5	0.9-0.50-3.1 pre,post	
C/1994 T1	1.84	1450	5.5	15.0	1.85-2.6 post	

Table 2 (continued)

Comet	q	a	H	2.5n	Range in r*	Notes°
C/1975 N1	0.43	1220	7.0	7.5	1.4-0.43-1.2 pre,post	
			7.3	10.0	0.5-2.4 post	
C/1967 Y1	1.7	1190	4.0	11.0	1.86-1.70-3.4 pre,post	
C/1991 T2	0.84	1070	8.2	9.3	4.2-0.8-1.0 pre,post	
C/1980 Y1	0.26	1040	7.0	5.0	0.43-0.26-1.1 pre,post	
C/1994 G1	1.36	1020	6.5	13.0	1.46-1.36-1.7, 2.7-4.4 pre,post	
C/1987 U3	0.84	671	6.0	8.0	1.2-1.0 pre; 0.9-2.5 post	(3)
C/1975 V1	0.20	637	4.5	15.0	3.57-1.4 pre	
			5.0	13.0	3.57-0.2 pre	
			4.0	9.0	0.2-3.34 post	
C/1982 M1	0.65	600	7.5	7.5	1.4-0.65-2.2 pre,post	
			(4.5	20.0)	2.2-3.5 post	(4)
C/1991 B1	2.26	331	5.0	10.0	4.1-2.26-6.1 pre,post	
C/1992 F1	1.26	292	6.0	10.0	1.31-1.26 pre	(5)
			4.0	20.0	1.3-3.8 post	(5)
C/1995 O1	0.91	(276)	-2.5?	10.0?	7.1- pre	(9)
C/1980 V1	1.52	252	6.5	8.0	1.58-1.52-2.52 pre,post	
C/1990 N1	1.09	213	5.7	10.0	1.60-1.1-2.28 pre,post	
C/1988 A1	0.84	205	6.5	10.0	1.6-0.84 pre	
			5.0	10.0	0.84-2.4 post	
C/1987 P1	0.87	157	6.0	8.0	1.7-1.4 pre	(1)
			5.7	6.2	1.4-0.87-2.5 pre,post	(1)
C/1993 Y1	0.87	139	8.5	10.0	1.20-0.87-1.9(-3.0) pre,post	
C/1969 Y1	0.54	136	4.0	10.0	1.7-0.54-3.8 pre,post	
C/1989 T1	1.05	105	10.5	15.0	1.6-1.0-1.5 pre,post	
C/1983 H1	0.99	96	9.2	8.0	1.04-0.99-1.22 pre,post	(6)
C/1963 A1	0.63	88	6.0	8.5	1.42-0.63 pre	
			5.5	8.5	1.8-3.2 post	
C/1994 J2	1.95	47	7.5	6.0	2.05-1.95-3.9 pre,post	
C/1979 Y1	0.55	43	7.8	7.5	0.6-1.7 post	
P/1992 S2	0.96	(26)	4.5	15.0	4.5-0.96 pre	(7)
P/1982 U1	0.59	(18)	1.8	21.0	5.2-1.5 pre	(8)
			4.3	8.0	1.5-0.6 pre	(8)
			3.4	7.5	0.6-2.9 post	(8)

Notes:

(1) Green (1989)

(2) beyond $r = 1.8$ AU post-T, only four photographic m2 points available; data from 1.44-1.8 are all by Albert Jones, who is systematically 0.5-1.5 mag fainter than other experienced observers; first parameters seem more logical to match the later nuclear magnitudes

(3) 1-mag outburst at 1.1 AU post-T

Table 2 (continued)

(4) unreliable; scanty data
(5) a 1.5-mag outburst occurred at $r = 1.28$ AU post-T
(6) Green (1991)
(7) Green (1993)
(8) Green and Morris (1987)
(9) original $1/a$ from Marsden (1995b); assumed H and n from m_1 data obtained during July and August 1995 only

Name/designation correspondences in Table 2 (listed chronologically):
C/1956 R1 (Arend-Roland) = 1957 III
C/1962 C1 (Seki-Lines) = 1962 III
C/1963 A1 (Ikeya) = 1963 I
C/1967 Y1 (Ikeya-Seki) = 1968 I
C/1969 T1 (Tago-Sato-Kosaka) = 1969 IX
C/1969 Y1 (Bennett) = 1970 II = 1969i
C/1970 N1 (Abe) = 1970 XV
C/1973 E1 (Kohoutek) = 1973 XII = 1973f
C/1974 C1 (Bradfield) = 1974 III
C/1975 N1 (Kobayashi-Berger-Milon) = 1975 IX
C/1975 V1 (West) = 1976 VI = 1975n
C/1977 R1 (Kohler) = 1977 XIV
C/1978 H1 (Meier) = 1978 XXI
C/1979 Y1 (Bradfield) = 1979 X
C/1980 E1 (Bowell) = 1982 I
C/1980 V1 (Meier) = 1980 XII
C/1980 Y1 (Bradfield) = 1980 XV
C/1982 M1 (Austin) = 1982 VI
1P/1982 U1 (Halley) = 1986 III
C/1983 H1 (IRAS-Araki-Alcock) = 1983 VII
C/1983 O1 (Cernis) = 1983 XII
C/1984 N1 (Austin) = 1984 XIII
C/1985 R1 (Hartley-Good) = 1985 XVII
C/1986 P1 (Wilson) = 1987 VII
C/1986 V1 (Sorrells) = 1987 II
C/1987 P1 (Bradfield) = 1987 XXIX
C/1987 U3 (McNaught) = 1987 XXXII
C/1988 A1 (Liller) = 1988 V
C/1989 Q1 (Okazaki-Levy-Rudenko) = 1989 XIX
C/1989 T1 (Helin-Roman-Alu) = 1989 XXI = 1989v
C/1989 W1 (Aarseth-Brewington) = 1989 XXII
C/1989 X1 (Austin) = 1990 V
C/1990 K1 (Levy) = 1990 XX = 1990c
C/1990 N1 (Tsuchiya-Kiuchi) = 1990 XVII
C/1991 B1 (Shoemaker-Levy) = 1991 XXIV = 1991d
C/1991 T2 (Shoemaker-Levy) = 1992 XIX = 1991a1
C/1992 F1 (Tanaka-Machholz) = 1992 X = 1992d
109P/1992 S2 (Swift-Tuttle) = 1992t
C/1993 A1 (Mueller) = 1993a
C/1993 Q1 (Mueller) = 1993p
C/1993 Y1 (McNaught-Russell) = 1993v
C/1994 G1 (Takamizawa-Levy) = 1994f
C/1994 J2 (Takamizawa) = 1994i
C/1994 T1 (Machholz) = 1994r
C/1995 O1 (Hale-Bopp)

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Power-law parameters were then derived to approximate best each comet's light curve, such that the magnitudes were almost always within 0.5-1.0 mag of the parameters specified in Table 2, with the applicable range in heliocentric distance (r) also given therein. These parameters were done individually by computer-running an ephemeris program with various values of H and $2.5n$ and comparing these carefully with the observed magnitudes, adjusting the power-law parameters until the best single set of H and $2.5n$ were found to match closely the data over as long a range in r as possible. In most cases, this meant deriving H and $2.5n$ to the nearest 0.5 unit; in a few cases a determination was made to better than 0.5 unit, where magnitude data were more plentiful and/or of lower scatter to perceive finer variations.

This procedure was chosen over the standard least-squares solution in order to look for smaller details in the brightness data, for better representation of the light curves over larger ranges in r; the "astrometric" magnitude data were used more as guides to see that derived parameters were reasonable out to larger observed heliocentric distances than would be possible by ignoring such (usually photographic) data. Table 2 lists the new-style comet designation; the perihelion distance (q, in AU); the 'original' semi-major axis (a, in AU) — where a negative value indicates a hyperbolic solution — computed from 'original' $1/a$ barycentric values compiled by Marsden (1994); H and $2.5n$; the range in r (in AU); and specific Notes regarding parameters for certain comets (including mention of previous publication in a few cases).

Old vs. New

One can immediately see that solutions are generally such that $2.5n$ falls in the range 7-15 (meaning n in the range 2.8-6.0). This is not a new result, as numerous efforts have been made in the past to catalogue power-law parameters of comets (see p. 415 of the review by Meisel and Morris 1982). Oort and Schmidt (1951) proposed a correlation between a comet's brightness behavior and its orbital "age", in which a "new" comet (possibly on its first visit to the inner solar system from the so-called Oort cloud of comets) varies differently in brightness than does an "old" comet that has a smaller orbit (and thus has made many more trips around the sun). A comet is generally considered to be dynamically "new" when the "original" value of its orbital semi-major axis, a_{orig}, is > 10,000 AU (Oort and Schmidt 1951; Marsden and Roemer 1982; "original" means running the comet's orbit back with the inclusion of planetary perturbations to outside 30 AU — the heliocentric distance of Neptune — and referring it to the center of mass of the solar system); thus, it is considered probable that comets with $a_{orig} > 10{,}000$ AU are passing through the inner solar system for the first time (see also Fernández 1980). However, it is more certain that a comet with $a_{orig} < 10{,}000$ AU is "old" than it is that a comet with $a_{orig} > 10{,}000$ AU is "new", in that some "old" comets are perturbed by the planets back into larger orbits. Eleven of the comets selected for this study would thus be tentatively classified as "new" — the remaining 31 comets have likely passed through the inner solar system at some time in the past (some having done so many times). Whipple (1978) noted earlier remarks by Marsden and Sekanina that nongravitational forces could further cause some comets with apparent $a_{orig} < 10{,}000$ AU actually to be entering the inner solar system for the first time.

Oort and Schmidt (1951) found that "new" comets rose less steeply in brightness with decreasing heliocentric distance than do "old" comets. Meisel and Morris (1976) noted that Oort and Schmidt were using the old magnitude formula derived by B. Levin (cf. Schmidt 1951); they therefore provided a more extensive look at correlations of magnitude (using the standard power-law formula) *vs.* orbital characteristics, finding that a correlation with perihelion distance (q) was more notable than was any correlation with the "age" of the comet. Meisel and Morris reported an average value of $2.5n = 8.0$ for "new" comets and 10.5 for "old" comets (from solutions representing 141 cometary apparitions), though some assignments of "old" and "new" to comets were found by the present author to be different (by comparison with the extensive set of original $1/a$ values compiled by Marsden 1994). Whipple (1978) also tried to build on this earlier work, looking only at older magnitude compilations by N. Bobrovnikoff and M. Beyer.

The New Results: Pre-perihelion

The comets in Table 2 are arranged in order of decreasing original semi-major axis (a_{orig}). The comments that follow deal chiefly with the pre-perihelion magnitude behavior of each comet, as this is the phenomenon that interests most people. Two periodic comets (1P/Halley and 109P/Swift-Tuttle) having good observational arcs are listed in Table 2 along with C/1995 O1 (Hale-Bopp) and the 42 other long-period comets observed in past 40 years and analyzed for this paper. Three of these 42 long-period comets in Table 2 have post-perihelion photometric data only, leaving 39 long-period comets (not counting C/1995 O1) that have pre-perihelion data of varying quantity and quality. Table 3 shows the distribution of the range in r for each comet's set of pre-perihelion photometry. Despite attempts to select the best comets for this study, fully 25 of the 39 comets have pre-perihelion arcs that constitute ≤ 1.0 AU in the range of heliocentric distance; six comets have a range of 1.0-2.0 AU, and eight comets have a range of > 2.0 AU. [For comparison, Whipple (1978) looked at > 100 comets, only 15 of which had pre-perihelion r ranges > 1.0 AU.]

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Table 3. Distribution of Pre-perihelion Ranges in Heliocentric Distance for Photometric Data on 39 Long-Period Comets

No. Comets	Range in r (AU)
5	0.1 or less
13	0.5 or less
25	1.0 or less
28	1.5 or less
31	2.0 or less
8	more than 2.0

Because of this difference in the range of heliocentric distance, the weighted arithmetic means of the photometric index, $\langle 2.5n \rangle_w$, were obtained by weighting the derived parameters according to three different schemes intended to give emphasis to the range in r or $\log r$ for which each set of (H, n) parameters were found to be valid. The small pre-perihelion range of r for numerous comets in Table 2 suggests that power-law parameters derived over such short periods are not likely to be as reliable. The weighting was done to compensate for this, in three different ways: (1) by figuring the absolute value of the pre-perihelion range in observed $\log r$ — denoted $R(\log r) \equiv (\log r_1) - (\log r_2)$, where $r_1 > r_2$ — and using that value as a weight; (2) by figuring the pre-perihelion range in r (to 0.01 AU) — denoted $R(r)$ — and multiplying this figure by $r_{min}^{-1/2}$ [where r_{min} is the smallest comet-sun distance for which magnitude data were used to derive a given set of (H, n) parameters], and using this product as a weight; and (3) weighting as in procedure (2), except using $R(r) \cdot r_{min}^{-1/3}$ as the weighting value. [Weighting based on range in r alone suffers from a failure to compensate for a larger gradient in cometary brightness variation over unit heliocentric ranges at different mean r — *e.g.*, a heliocentric range of 1 AU, centered on $r = 1.0$ AU (or 0.5-1.5 AU) *vs.* $r = 5.0$ AU (or 4.5-5.5 AU).] The results of determining these weighted mean values (and the unweighted means with standard deviations) are given in Table 4.

A glance at the ten "new" comets in Table 2 that have pre-perihelion data might suggest a clumping around $2.5n$ (unweighted) ≈ 7.5, though from Table 4, one sees that $\langle 2.5n \rangle_w \approx 8.3$ for this sample. The 14 comets with $1000 < a_{orig} < 10000$ show a less-prominent peak around $2.5n$ (unweighted) ≈ 9.5, with $\langle 2.5n \rangle_w \approx 9.0$ for this sample. In the case of long-period comets with $a_{orig} < 1000$ AU, one might detect in Table 2 an apparent double peak around $2.5n$ (unweighted) ≈ 7.5 and 9.5, but the mean weighted value of this sample of 15 comets is $\langle 2.5n \rangle_w \approx 10.8$. The mean for all 29 "old" comets considered here is $\langle 2.5n \rangle_w \approx 9.9$. The differences in $\langle 2.5n \rangle_w$ for the three different weighting schemes are rather small, though one will also observe that there are rather larger differences between the weighted and the unweighted means (not unexpected, considering that in the unweighted case, a comet with an observed range of 0.05 AU in r is treated the same as one with a range of 4 AU). There does seem to be a trend toward increasing n as a_{orig} decreases, though it should be noted that the standard deviations are not as small as one would like; ultimately, there is a need to extend this sample to many more comets — preferably with better magnitudes and better ranges in r obtained from future cometary apparitions. (Again, the unweighted values place too much emphasis on individual comets with short observational arcs, so histograms are not provided to illustrate the ranges or categories because they would be potentially misleading.) These results generally support conclusions drawn by the previous researchers (noted above), although there is no definite correlation between n and q in the data of Table 2.

As noted earlier, two "short-period" comets are included at the end of Table 2, 1P/1982 U1 (Halley) and 109P/1992 S2 (Swift-Tuttle), as representative examples of such "Halley-type" comets — both having observations over a wide range in r. Note that $2.5n$ for both comets is rather high for pre-perihelion behavior, compared to most long-period comets in this study. Indeed, the (unweighted) mean pre-perihelion value for 129 short-period comets — from parameters derived by this author during a decade of preparing the annual *ICQ Comet Handbook* (*e.g.*, Nakano and Green 1995) — is $\langle 2.5n \rangle \sim 17.0$. There very clearly is an increase in the average value of n as a comet progresses from a "new" comet to one that has experienced many passes through the inner solar system. [However, neither of these two short-period comets was included in the statistical analyses of long-period comets in Tables 3-6.]

The New Results: Past Perihelion

There are 39 solutions in Table 2 that contain parameters representing both pre- and post-perihelion brightness data. Of these 39 solutions, 24 sets of parameters represent the entire range of observed m_1 values for those 24 comets. It may surprise some readers that nearly two-thirds of the comets can be represented by a single set of power-law parameters, but it should be noted that in only four cases out of 39 comets are there reliable m_1 data spanning more than 2.0 AU in r for *both* pre- and post-perihelion portions of the comets' orbits; in these four cases, two comets have a single set of power-law parameters, and the other two comets each have one set of pre-perihelion parameters and one set of post-perihelion parameters. Fully two-thirds of the comets (26) have observed ranges in $r \leq 1.0$ AU. Still, only seven or eight comets out of the 39 showed a definite change in the power-law exponent, n, during either the pre-perihelion portion or the post-perihelion portion of observability (as opposed to, say, a change at the time of perihelion). Eight comets can be represented by two sets of separate pre- and post-perihelion parameters, suggesting a change in the brightness behavior around the time of perihelion.

Of the eight comets showing an apparent brightness change around the time of perihelion, three comets showed a decrease in n from pre- to post-perihelion and three comets showed an increase in n — the other two comets showing a slight increase in H only. No correlations can be seen between such brightness changes and dynamical ages. Of the remaining six comets with multiple sets of (H, n), two show decreases in n and four show increases in n (again, no obvious correlation with dynamical age). Thus, post-perihelion brightness behavior in long-period comets generally parallels the pre-perihelion behavior, but there are frequent exceptions in both directions (more- and less-rapid post-perihelion fading).

Table 5 contains the unweighted and weighted means for $2.5n$ from the post-perihelion data of 42 comets. It can be seen that $\langle 2.5n \rangle_w \sim 8.2$ for comets with $a_{orig} > 10^4$ AU, ~ 9.2 for comets with $10^3 < a_{orig} < 10^4$, and ~ 9.7 for comets with $a_{orig} < 10^3$ AU. While $\langle 2.5n \rangle_w$ is similar for both pre- and post-perihelion parameters of comets with $a_{orig} > 1000$ AU, there is a noticeably-higher pre-perihelion $\langle 2.5n \rangle_w$ for comets with $a_{orig} < 1000$ AU than post-perihelion $\langle 2.5n \rangle_w$; whether this is significant or not is uncertain from the data.

Because there is so much overall similarity in $\langle 2.5n \rangle_w$ for pre- and post-perihelion activity, and because so many solutions continue across perihelion, it seemed logical to look at the combined data, presented here in Table 6. The trend of increasing n for decreasing dynamical age is still visible. But unlike the marked conclusions of Whipple (1978), who found that $\langle 2.5n \rangle$ increased from pre- to post-perihelion for "newer" comets and that $\langle 2.5n \rangle$ decreased from pre- to post-perihelion for "older" comets, this study yields no clear difference in the average values of n before *vs.* after

Table 4. Pre-perihelion mean values of 2.5n

Range in a_{orig} (AU)	> 10000	1000-10000	<1000	<10000	all comets
Unweighted mean	8.17	9.99	9.26	9.60	9.19
Standard deviation	1.84	4.78	2.31	3.63	3.26
Weighted* means:					
R(log r)	8.27	8.85	10.54	9.62	9.03
$R(r)/r_{min}^{1/2}$	8.47	9.15	11.16	10.18	9.35
$R(r)/r_{min}^{1/3}$	8.30	9.33	10.95	10.14	9.27

* R = range; thus R(log r) means "range in (log r)"; r_{min} = the closest observed sun-comet distance. See text.

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Table 5. Post-perihelion mean values of 2.5n

Range in a_{orig} (AU)	> 10000	1000-10000	<1000	<10000	all comets
Unweighted mean	9.04	9.68	9.61	9.64	9.47
Standard deviation	2.76	2.83	3.47	3.12	3.00
Weighted* means:					
R(log r)	8.15	8.98	9.59	9.28	8.90
$R(r)/r_{min}^{1/2}$	8.12	9.22	9.68	9.47	8.95
$R(r)/r_{min}^{1/3}$	8.23	9.40	9.75	9.59	9.07

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Table 6. Combined (pre- and post-perihelion) mean values of 2.5n

Range in a_{orig} (AU)	> 10000	1000-10000	<1000	<10000	all comets
Unweighted mean	8.62	9.82	9.43	9.62	9.33
Standard deviation	2.36	3.80	2.91	3.35	3.11
Weighted* means:					
R(log r)	8.21	8.93	9.93	9.41	8.95
$R(r)/r_{min}^{1/2}$	8.28	9.19	10.17	9.71	9.10
$R(r)/r_{min}^{1/3}$	8.26	9.38	10.12	9.77	9.14

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perihelion other than a possible slight decrease for all categories of dynamical ages.

C/1980 E1 (Bowell) vs. C/1995 O1 (Hale-Bopp)

A perusal of Table 2 will show that the largest orbital arc, in terms of range in heliocentric distance, that can be fairly well represented by a *single set* of power-law parameters (in the entire group of 42 long-period comets) is 4.0 AU pre-perihelion and 10.2 AU post-perihelion — both cases belonging to C/1980 E1 (Bowell). Except for this one comet (which had q = 3.4 AU), the next such largest ranges in r are 5.1-5.7 AU (comets C/1956 R1, C/1978 H1, C/1986 P1, and C/1991 B1) — all these ranges including combined pre- and post-perihelion data. In contrast, comet C/1995 O1 was at r = 13.1 AU in April 1993 (and at r = 16.8 AU in early Sept. 1991), meaning that the arc of available (positive) observations — assuming that the April 1993 observation is correct — already extends more than 6 AU in heliocentric distance, which is more pre-perihelion range than for any other comet in our historical sample. So we really are entering uncharted territory with C/1995 O1 (Hale-Bopp). It is encouraging (for those with hopes on C/1995 O1) that one comet with a large range in r that can be represented by a single set of power-law parameters, C/1991 B1, varied as an inverse-fourth power.

C/1980 E1 (Bowell) varied with fairly constant values of n over several years of observation, with an apparent discontinuity (and change from 2.5n = 7.5 to 9.0) only at about the time of perihelion in 1982. This comet never got closer than 3.36 AU from the sun, and this can be seen as both favorable when compared with C/1995 O1 (because of the unusually large heliocentric distances for which photometry of the coma is available and for which the light curve was rather 'dependable') and unhelpful (in that C/1995 O1 will come much closer to the sun than did C/1980 E1, with the inherent complication of much greater overall activity, and in that C/1980 E1 appears to have been dynamically "new"). But one should also note that none of these long-period comets brightened more steeply than 10 log r prior to perihelion over continuous ranges in r of more than ~ 3.5 AU.

Further Cautions Regarding C/1995 O1 (Hale-Bopp)

One must be very careful in making extrapolations of comet brightness over too much of a comet's orbit (or over too much time). For example, one could look at Rob McNaught's pre-discovery magnitude estimate (18) from the U.K. Schmidt *R* survey plate taken on 1993 April 27 (*IAUC* 6198), and the fact that he could not find an image of C/1995 O1 on a plate taken on 1991 September 1, combined with the m_1 estimates in 1995 July and August, and derive a power-law formula with $H = -10.5$ and $2.5n = 20$; this would in turn yield a maximum projected brightness of -10 to -11 in early 1997, which is fun to consider and would be wonderful if it turned out that way, but which is not good science.

Indeed, some comets such as C/1989 X1 (Austin) have very disjointed and discontinuous light curves over a range of only a few AU. It would be foolish to assume that C/1995 O1 (Hale-Bopp) will vary according to any single set of (H, n) parameters throughout its entire apparition, or even from now until perihelion passage. But that will not stop people from speculating on the future, especially when we have not had a really bright comet in many years and when C/1995 O1 is giving many indications of being a large, promising comet — already incredibly luminous at $r = 7$ AU.

So what is a good, educated guess, having looked at the data collected on long-period comets over time to determine patterns in brightness behavior? One issue regarding that single image found by McNaught is that early predictions by Marsden (1995a) assumed that the April 1993 image is a real image of C/1995 O1. But *if* the 1993 image should be wrong, it could not be known whether the comet was dynamically "new" or not based only on the 1995 observations through early September. If this had been a "new" comet, one would be well advised to assume an r^{-3} law — which, assuming that the comet is at "normal" brightness in August 1995, would project the comet reaching seventh magnitude in May 1996, fifth magnitude in October, third magnitude in January 1997, and mag ~ 0 at peak in March.

However, a more recent orbital analysis (Marsden 1995d), "confirms" that the comet cannot be "new" — based now on only the 1995 astrometric observations through early September. Even excluding McNaught's single 1993 observation, a six-week arc in 1995 gives orbital solutions with $P = 8000$ ($\pm$ several thousand) yr and $a \sim 400$ AU (Marsden 1995b). It is therefore not unreasonable to project that C/1995 O1 will vary *on average* as r^{-4} between now and perihelion passage, given that it appears to be a comet that has made previous passages to the inner solar system and that there does seem to be a clear trend towards an average value of $2.5n \sim 10$ (as noted above) for comets with orbital periods similar to that of C/1995 O1. If one looks at the ten "old" comets (in the present study) that have perihelion distances within 0.2 AU of that of C/1995 O1, one finds a pre-perihelion mean $\langle 2.5n \rangle_w \simeq 9.60$; applying that to the present comet, using its brightness in 1995 August to obtain H, one could speculate that C/1995 O1 might be expected to reach $m_1 \sim -2.0$ in March/April 1997. On a pessimistic note, looking at C/1989 X1 (Austin) and assuming $2.5n = 6.0$ from here on in to perihelion, one gets $m_1 \sim +1.5$ in March 1997. Though it may be coincidence that C/1989 X1, C/1987 P1, and 1P/1982 U1 all had significant pre-perihelion decreases in n around $r = 1.4$-1.5 AU, if we would extrapolate the light curve of C/1995 O1 from now until $r = 1.5$ AU as $2.5n = 10$, and from there in to perihelion as $2.5n = 6.0$, one gets $m_1 \sim 0$ in March 1997. *(text continued on next page)*

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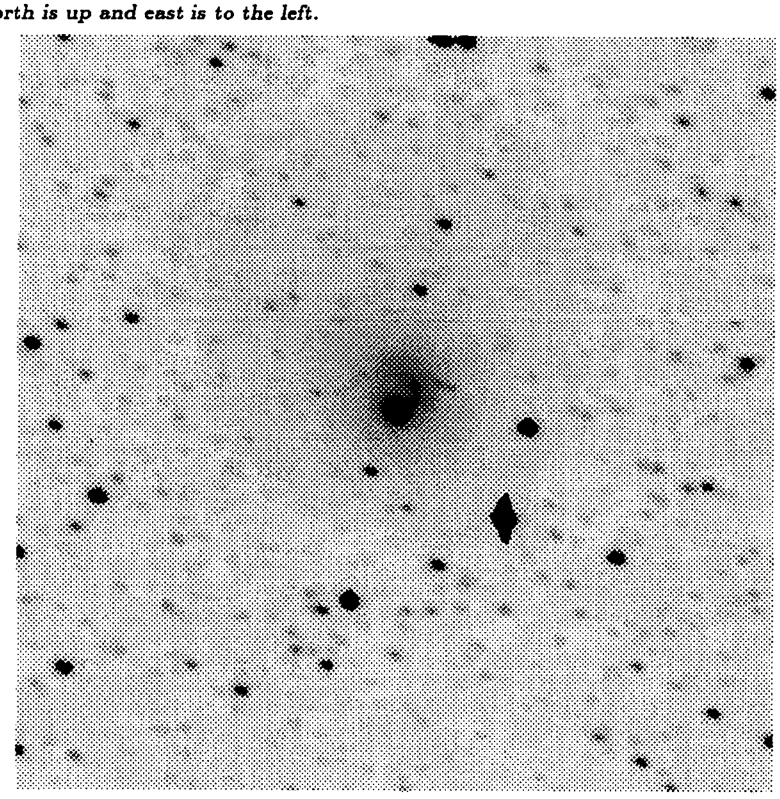
Below: ***CCD image of C/1995 O1 (Hale-Bopp) obtained by Jun Chen on 1995 Aug. 28 with the University of Hawaii's 2.2-m reflector at Mauna Kea. The field size is 1'.9 × 1'.9; 300-sec exposure. A distinct jet, shaped like a spiral arm, is seen emerging to the upper right of the strongly-condensed nucleus. North is up and east is to the left.***



Even though the comet may appear to be rising as r^{-8} when considering McNaught's April 1993 observation (and negative 1991 observation), one should assume that such a rapid rise in brightness will not continue to perihelion; note that not one object in our sample of 39 long-period comets definitely went from a smaller to a greater value of n while approaching perihelion (though some experienced steeper post-perihelion values). Furthermore, of the 39 comets studied for this paper that were observed pre-perihelion, only five showed pre-perihelion brightness behavior such that $2.5n > 10$, and then for relatively small ranges in r (only the split comet C/1975 V1 having such a steep pre-perihelion increase in brightness over a range of more than 0.9 AU in r); it would thus not be prudent to suggest that this will be the case for C/1995 O1. Charles Morris cautions: "Statistics are wonderful for evaluating the general characteristics of a population of objects, but are potentially meaningless when attempting to predict what a single member of that population will do in the future. The performance of [any particular] comet will be determined by the size and distribution of the active regions on the surface of the nucleus, the rotation rate and orientation of the nucleus, and the available volatiles."

The strong early activity in the new comet was accented by recent images of C/1995 O1 showing a temporary but recurring, prominent jet-like feature within its comet's coma in August, September, and October (see August 28 image by Jun Chen on page 176 and the September 26 image below). Sekanina (1995a, 1995b) states, with regard to the recurrent emission episodes: "One inference [that] one can make out of all this is that [C/1995 O1] might be (relatively) CO-rich and, at the same time, dust-rich. This would be a rather unusual combination. We know that comets such as C/1908 R1 (Morehouse) or C/1961 R1 (Humason) were CO-rich, but they both had hardly any dust. If CO supplies in [C/1995 O1] last until perihelion, then the comet could indeed be very bright. Yet, it does not have to have an excessively large nucleus. . . . The three spiral jets in late August, late September, and mid-October were almost certainly made up of dust ejecta from the same source, located in the comet's equatorial plane." Indeed, CO has been detected in the radio at 230 GHz (Matthews *et al.* 1995; Rauer *et al.* 1995), and Fitzsimmons (1995) reported CN at optical wavelengths on Aug. 30. A tentative infrared detection of water ice was also reported recently (Davies *et al.* 1995).

Whether the brightness of C/1995 O1 slows to $n \sim$ 3-4, or teases us with $n \geq 5$, remains to be seen. Huge outbursts sometimes occur, up to 9 mag in the case of 41P/Tuttle-Giacobini-Kresák (*e.g.*, Misconi and Whitlock 1983). [Coincidentally, 41P experienced another large outburst to $m_1 \simeq 9$ recently, in August 1995; the last time this occurred was in July 1973 as preparations were being made in anticipation of a grand performance by comet Kohoutek later that year!] Once more to the conservative side, one should remember that some comets that were expected to put on a fairly good show have actually fizzled out completely, apparently falling apart (see Sekanina 1984, Kresák 1984, and Kresák 1987 for good reviews of numerous such cases) — so almost anything can happen with comets! C/1995 O1 is exhibiting impressive activity at large heliocentric distance since discovery, and Marsden (1995c) has noted some similarities to the Great Comet C/1811 F1. Supposing that C/1995 O1 may be one of the larger comets that we see, we have little previous experience with which to make accurate extrapolations on possible future activity. What surprises does it hold for us? Regardless, it seems that we have a really good object for cometary science that will keep us busy for quite awhile.

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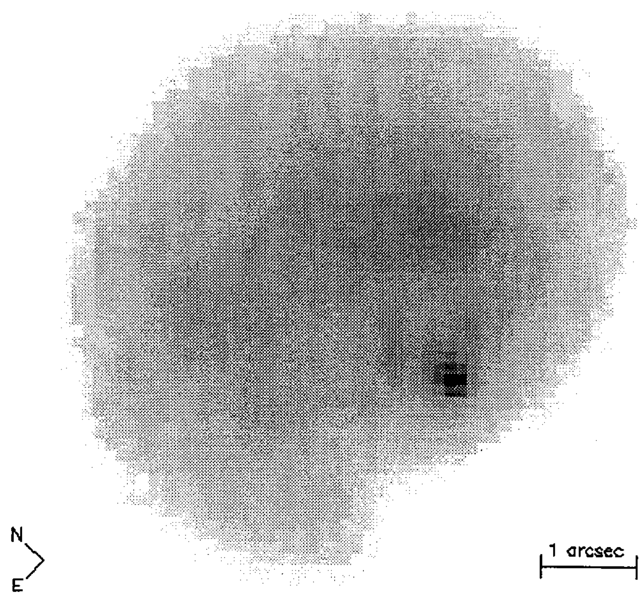
Below: ***Hubble Space Telescope image of C/1995 O1 (Hale-Bopp), taken with the Wide Field Planetary Camera 2. Notice the strongly condensed nuclear region and the northward "spiral" jet that is not unlike that seen in 29P/Schwassmann-Wachmann 1 when that comet undergoes its typical outbursts. Image reproduced here courtesy of H. A. Weaver, P. D. Feldman, and NASA.***



Comet Hale–Bopp : HST WFPC2 Wide Field
26 September 1995

Acknowledgements

I thank Brian G. Marsden and Charles S. Morris for their very helpful discussions and critical readings of the manuscript prior to publication.

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Comet C/1995 O1 (Hale-Bopp) and the Public

Daniel W. E. Green and Charles S. Morris

Those of us who have been involved in conveying the latest information regarding comet C/1995 O1 (Hale-Bopp) to the news media and the public have been amazed at the attention given to this object at such an early stage, with a year and a half until perihelion passage. This comet is likely to get more press, by both the electronic and print media, than any bright comet in the past. This may be both fortunate (in that astronomy gains through increased visibility) and unfortunate (in that the public may again be led to expect too much). It is the downside of this coverage that concerns us.

Fireworks and Comet C/1995 O1 (Hale-Bopp)

The first question is whether the public would be impressed with a comet that reaches total visual (integrated) magnitude 0 to −2, in light of the possibility that C/1995 O1 gets that bright. The average city person is accustomed to (and accepts) constant excesses in bright outdoor night lighting; most urban dwellers are also accustomed to lots of bright eye-catching video in today's indoor and outdoor advertising, in movies, in television, and in computers, and many are familiar with artificial outdoor holiday ('Fourth of July') fireworks. Such fireworks are typically as bright or much brighter than the full moon in brightness. So would a comet that reaches only the brightness of the brightest stars (or planets) cause much awe in the average city person of today? Perhaps not. Those who spend more time away from the city, particularly those who really enjoy nature itself, are much more likely to appreciate such a comet. So there are probably two types of people who will hear the news about a "bright" comet, with two different types of expectations.

Our knowledge of cometary brightness (see the previous article on the brightness of long-period comets) suggests that we can only conjecture that C/1995 O1 (Hale-Bopp) will be somewhere between magnitude +4 and −4 at its brightest in March and April 1997, assuming that it does not fizzle out altogether (and disappear!) as some previous comets have been known to do.

Is a comet without a tail "A Comet"?

A second question, for most in the general public, is whether or not the comet "looks like a comet" — which is another way of saying, "Does it have an impressive tail?" As most avid comet observers know, very few comets display bright, impressive tails.

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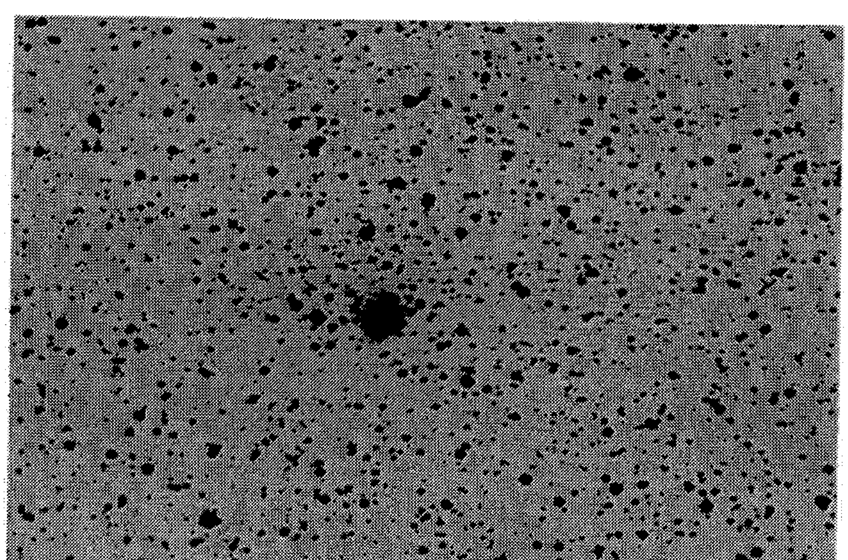
Below: *In the months immediately following discovery in July, comet C/1995 O1 (Hale-Bopp) moved through the crowded Milky-Way starfields of Sagittarius, so readily seen in this 300-sec CCD exposure of the comet by Gordon J. Garradd (Loomberah, New South Wales, 25-cm f/4.1 reflector) on July 26.40 UT.*



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When one looks at recent comets that have shown impressive dust tails — such as C/1975 V1 (West), C/1969 Y1 (Bennett), C/1965 S1 (Ikeya-Seki), C/1962 C1 (Seki-Lines), and C/1956 R1 (Arend-Roland) — one sees that they all had perihelion distances around $q = 0.5$ AU or less. Few comets with perihelion distances around 1 AU (C/1995 O1 has $q = 0.91$) ever show impressive tails. The Great Comet of 1811 was such an exception, and people are talking about that as a positive sign; with a perihelion distance just outside the earth's orbit (and closest approach to the earth being similar to that of C/1995 O1 — over 1 AU distant), the 1811 comet displayed a tail at least 25° long in October of that year, according to Kronk (1995), the comet reaching perhaps a peak apparent magnitude of +1 during that month according to Holetschek (see Vsekhsvyatskii 1964).

It should also be noted that tails typically reach their maximum length one to three months after perihelion, this was certainly true of the Great Comet of 1811. Thus, the tail produced by C/1995 O1, even if bright, is likely to be relatively short when the comet is at perihelion.

An important factor in this discussion is that of dust production: How dusty is a given comet? Observers of 122P/de Vico know (and a glance at the images of 122P in this issue show) that this comet is very dust-poor, showing a long, narrow, and fairly-low-surface-brightness gas tail at visual wavelengths, with no real dust tail. Gas tails are inherently blue, making them much more difficult to detect than the yellowish dust tails (which are seen due to reflected sunlight). If C/1995 O1 (Hale-Bopp) does not produce an extensive amount of dust, it may appear more similar to comet C/1983 H1 (IRAS-Araki-Alcock) — a bright, round ball with little or no tail — than to, say, comet C/1975 V1 (West).

What to Tell the Press

So the best advice to tell the public and the media at this stage is that astronomers are eagerly awaiting what may well be the brightest comet visible from the ground in 20 years, and that a lot of good science should be learned from this comet. Current optimistic projects suggest that C/1995 O1 (Hale-Bopp) may rival the brightest stars in March and April 1997, when the comet is near its perihelion passage (closest approach to the sun occurs on 1997 April 1). While such a sight would doubtless excite astronomers and many in the general public, some non-astronomers will find such a sight uninspiring. The development of an impressive, bright dust tail will be a key factor in addition to the brightness of the comet's coma or atmosphere.

While numerous comets have been known to fall apart completely on approach to perihelion, for unknown reasons, it would be more likely that C/1995 O1 — which is showing sustained and unusually large jet, tail, and coma activity at a large distance from the sun in the three months since its July 1995 discovery — would merely reach faint naked-eye visibility (similar to 1P/Halley in 1986) in the most pessimistic projection. Should the comet exceed all expectations, becoming as bright or brighter than the brightest planets (Venus and Jupiter), the public can be informed of such details in real time as such events unfold. In the meantime, it might be advised that the general news media sources (newspapers and news magazines, radio, television) refrain from getting the public too excited many months in advance of what is truly an unknown performance.

Good explanations of what is expected of C/1995 O1 (Hale-Bopp), and of comets in general, may be found on the World Wide Web at `http://cfa-www.harvard.edu/cfa/ps/HaleBopp.html` ("Press Information Sheet") and at `http://encke.jpl.nasa.gov/hale_bopp_info.html` ("Information on Comet Hale-Bopp for the Non-Astronomer"). For those who lack access to the Web, the former write-up ("Press Information Sheet") can be e-mailed (send your request to `green@cfa.harvard.edu`) or sent via postal mail (send your request to the Editor on page 160 of this issue); likewise, contact `csm@encke.jpl.nasa.gov` for an electronic version of the latter write-up.

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SOME RECENT OBSERVING EXPERIENCES

From Richard Keen, Mt. Thorodin, Colorado, while observing 73P/Schwassmann-Wachmann 3 on Oct. 7: "I might add that a bear sauntered by, less than a hundred yards away, as I sat out in the meadow with the portable 6-inch *f*/3 [telescope] making the observation. He didn't acknowledge my presence, and a few minutes later got into an argument with some coyotes as he entered the forest. And who said observing comets doesn't have its exciting moments?"

From Gary Kronk, Troy, Illinois, while observing 122P/de Vico and C/1995 Q1 (Bradfield) on Sept. 26: "So here I am looking at these comets this morning and all of a sudden I hear little footsteps running towards me in my yard. Then, 'daddy?' It is my youngest son, Michael, who is 5 years old. I respond, 'Yes, Michael?' He says, 'Are you looking at a comet?' 'Yes.' 'Can I see it?' 'Sure.' Up to this point I was looking at P/de Vico, and when I looked at Michael, I realized he was in his underwear. He did at least have shoes and socks on, but it is 45° [F] out and he is in his underwear! So I pick him up and his response was almost typical of most comet observers, 'Oh, that's really neat. It [the comet] has stuff sticking out all over it!' Curious, I asked, 'What kind of stuff?' And he said, waving his hands over his head and then to his side, 'Fuzzy stuff all around it!' It was great."

Visual Observations of C/1995 O1 (Hale-Bopp)

Stephen J. O'Meara

I give here some notes about comet C/1995 O1 (Hale-Bopp) based on four consecutive nights of observations with the Lick 36-inch (91.4-cm) Clark refractor. To locate the comet each night, I used a special eyepiece, which provided a "wide field" (0°.5?) and 115×. Once the comet was centered, I switched to a normal eyepiece setup, which provided a "low" magnification of 588× and a medium magnification of 1176×. For the comet observations, we experienced sub-arcsec seeing on all but the last night, which had variable seeing.

Aug. 11 UT: After an intriguing and encouraging phone conversation with Daniel Green, I turned the 36-inch refractor to C/1995 O1 (Hale-Bopp) at Aug. 11.260. Despite full moonlight nearby, the comet appeared as a tiny haze in the wide-field eyepiece. At 588× and 1176×, the comet displayed a very sharp inner nucleus (mag ≈ 15), which was surrounded by a tight inner coma that gradually diminished in brightness away from the nucleus. Using drift method, the diameter of the *inner* coma diameter was estimated to be 40″. This night I spent considerable time trying to discern any fine details in the inner coma that might indicate a flaring or unusual activity, but the coma was most uniform. Most striking was the bright, crisp pseudo-nucleus embedded in a tightly packed inner coma. I did notice a suspicious-looking star, ~ 20″ to the east-northeast of the nucleus. But the comet got too low for the 36-inch, and observations had to cease. Since the comet is traveling through the star-rich Sagittarius region, I would guess this was a faint field star.

Aug. 12: Comet C/1995 O1 (Hale-Bopp) was a most bewitching sight this night, because its appearance had changed dramatically. Although the Moon had begun to wane and move away from the comet, the pseudo-nucleus was barely visible at mag ≃ 16.5. (The three observers with me did not see the nucleus at all!) The inner coma was much more diffuse, with little condensation. (The other three observers did not see any condensation, just a uniform diffuse glow!) Despite this dramatic change, the coma displayed no details indicative of violent nuclear activity. The inner coma remained uniform, though it was less intense. The suspicious star observed the previous day to the east-northeast of the nucleus was not visible at that position, though there was a similarly bright star within the coma, but ≈ 10″ to the northwest of the nucleus. There was also a fuzzy star ≈ 2′ to the southeast of the nucleus outside the inner coma, but it did not seem to move with the comet. [Because of its low southerly declination, our window of opportunity for observing Comet C/1995 O1 (Hale-Bopp) with the 36-inch refractor was limited.] My *impression* is that these secondary-nucleus features are field stars unrelated to the comet. (I had no time to determine a coma diameter, but would estimate that its size was comparable to 40″).

Aug. 13: Once again dramatic changes. The very stellar nucleus of comet C/1995 O1 (Hale-Bopp) was estimated to be mag 14, the coma diameter swelled to 60″, and it once again had a tight inner-coma (an aspect confirmed by the one other observer with me that night). The inner coma had hints of counterclockwise spiral structure within 10″ of nucleus. Equally surprising was a 30″-long jet, a spike of material flowing due north of the nucleus. This sharp feature was first noticed in the wide-field eyepiece at 115×. Higher powers revealed it to be contained in a fan of material of the same length, which was brightest on the eastern and western edges and essentially invisible next to the jet. There were no signs of any secondary nuclei.

Aug. 14: The nucleus had faded to mag 15.5. The inner coma was less intense, though it clearly had a bright innermost region with a more diffuse outer halo that extended to only 45″. The area 10″ from the nucleus was very mottled — either with faint starlight or nuclear activity; several faint stars could be seen in the adjacent outer envelope (note that there was no or little interference from Moon). The northward fan was still obvious, though less distinct. In place of the sharp jet was a more diffuse, spread of light.

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RECENT NEWS AND RESEARCH CONCERNING COMETS

Having not written this column since the July 1994 issue, I realize that much has happened since then. Don Machholz of Colfax, California, discovered two additional comets in the second half of 1994 [1994o = P/1994 P1 (Machholz 2) and 1994r = C/1994 T1 (Machholz)], making him the world's second-most-successful active visual comet discoverer — with nine comets named for him. The leader continues to be Bill Bradfield of Dernancourt, Australia, who found his seventeenth comet in July 1995 (C/1995 Q1), 23 years after finding his first comet. Additional visual discoveries in the past year include those of C/1995 O1 (Hale-Bopp) and 122P/1995 S1 (de Vico), which are both discussed in articles elsewhere in this issue (and in the descriptive and tabulated listings that follow).

New photographic discoveries in the past year include P/1994 X1 (McNaught-Russell; O.S. 1994u) and C/1995 Q2 (Hartley-Drinkwater), both found with the U.K. Schmidt Telescope at Siding Spring (Australia). Another comet was discovered with the CCD-aided Spacewatch telescope at Kitt Peak — P/1995 A1 (Jedicke) — last January.

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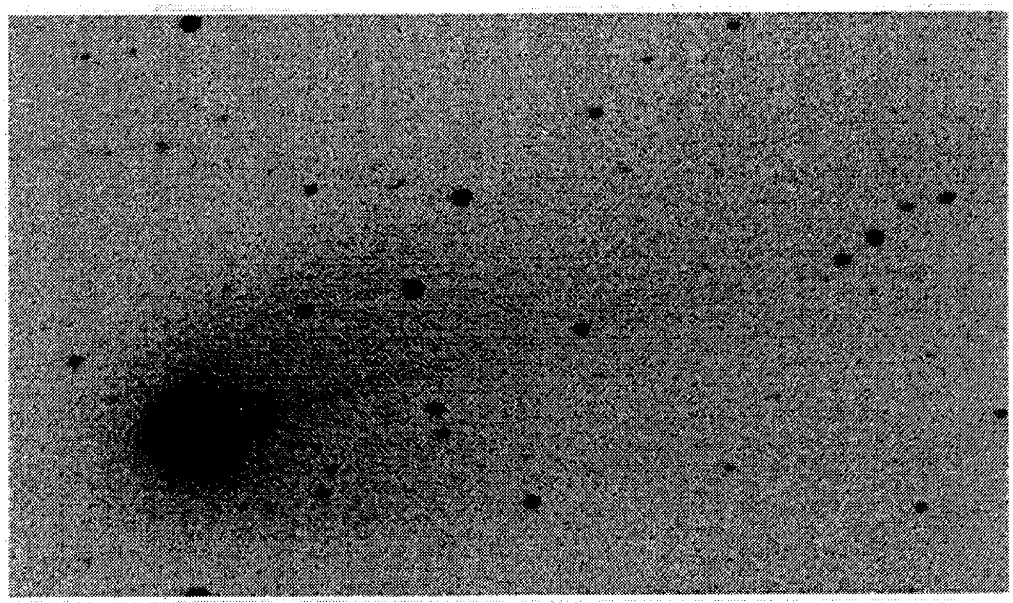
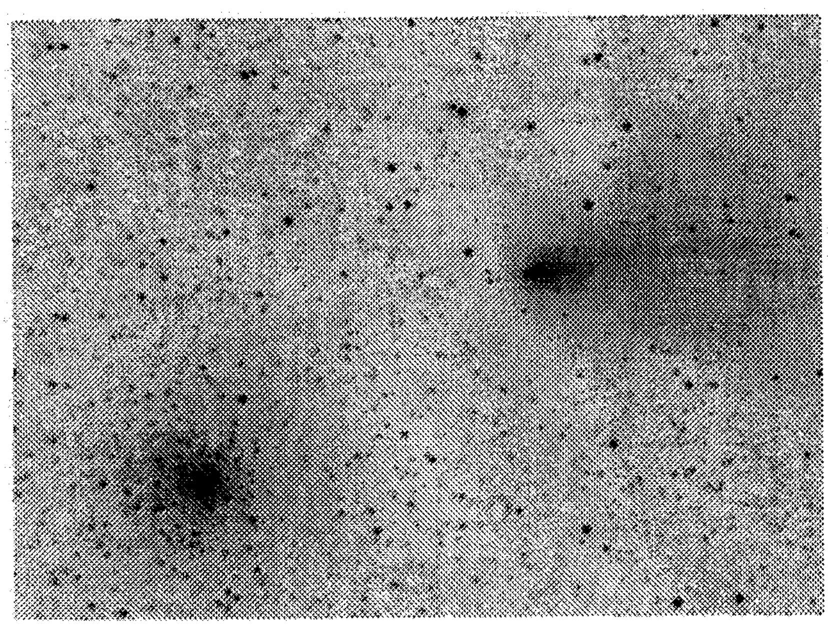
A noticeable lack of new discoveries occurred from January until July, when C/1995 O1 (Hale-Bopp) was found — undoubtedly due to the termination of regular, monthly photographic hunting with the 18-inch Schmidt telescope at Palomar by Gene Shoemaker *et al.* and Eleanor Helin *et al.* at the end of last year. Comets are surely being missed, and it is unfortunate that the Palomar program terminated before other search programs could be in place for continuation of coverage. Meanwhile, the amateur hunter will surely have a good opportunity during the next few years to find comets, until all-sky CCD-scanning programs can be put into place.

With the new designation system for comets in place since last January, the term "recovery" has been re-defined such that provisional designations are given generally to comets that are making their first predicted return to perihelion (or, as in the case of 122P/de Vico, upon re-discovery). Since January 1, we have added "newly-numbered" comets 117P/Helin-Roman-Alu 1, 118P/Shoemaker-Levy 4, 119P/Parker-Hartley, 120P/Mueller 1, 121P/Shoemaker-Holt 2, and 122P/de Vico.

Big comet news during the past few months has included the spectacular outbursts in brightness seen in both 41P/Tuttle-Giacobini-Kresák and 73P/Schwassmann-Wachmann 3. In mid-August, 41P was found to be near visual mag 8 — some 4-5 mag brighter than expected, though not quite as impressive as its 1973 outburst. The outburst of 73P, which in mid-September was found to be again ~ 4 mag brighter than expected, was much longer lived — the comet peaking near mag 5.5-6.0 in mid-October and still being near mag 7 at month's end as this is being written. Both comets were near perihelion during their unexpectedly-high activity. — *D. W. E. Green*



41P/Tuttle-Giacobini-Kresák as imaged by Gordon J. Garradd at Loomberah, N.S.W., for 180 sec beginning 1995 Aug. 23.395 UT; 25-cm f/4.1 reflector + CCD (no filter).



73P/Schwassmann-Wachmann 3 near the globular cluster M62, as imaged by Steven Lee (Anglo-Australian Observatory). Two co-added, 30-sec exposures taken with a 20-cm f/4.5 Newtonian reflector (+ CB245 CCD) centered on 1995 Oct. 21.416 UT. Scale 3″.87/pixel. North is down, east to the right (uncertainty ~ 2°).

DESIGNATIONS OF RECENT COMETS

Listed below, for handy reference, are the last 20 comets to have been given provisional letter designations in the old system (pre-1995) or designations in the new system (as of 1995 Oct. 31). The name, preceded by a star (⋆) if the comet was a new discovery (compared to a recovery from predictions of a previously-known short-period comet) or a # if a re-discovery of a lost comet. Also given are such values as the orbital period (in years) for periodic comets, date of perihelion, T (month/date/year), and the perihelion distance (q, in AU). Four-digit numbers in the last column indicate the *IAU Circular* (4-digit number) or *Minor Planet Circular* (5-digit number) containing the discovery/recovery or permanent-number announcement. [This list updates that in the April issue, p. 81.]

Old			*New-Style Designation*	*P*	*T*	*q*	*IAUC*
1994p	=		30P (Reinmuth 1)	7.3	9/3/95	1.9	6072
1994q	=		77P (Longmore)	7.0	10/9/95	2.4	6084
1994r	=	⋆	C/1994 T1 (Machholz)		10/2/94	1.8	6091
1994s	=		22P (Kopff)	6.4	7/2/96	1.6	6111
1994t	=		71P (Clark)	5.5	5/31/95	1.6	6112
1994u	=	⋆	P/1994 X1 (McNaught-Russell)	18.2	9/7/94	1.3	6115
1994v	=		116P/1994 V1 (Wild 4)	6.2	8/31/96	2.0	6121
1994w	=		73P (Schwassmann-Wachmann 3)	5.3	9/22/95	0.93	6122
		⋆	P/1995 A1 (Jedicke)	14.3	8/15/93	4.1	6124
			117P (Helin-Roman-Alu 1)	9.6	3/27/97	3.7	24597
			118P/1995 M1 (Shoemaker-Levy 4)	6.5	1/11/97	2.0	6180
			119P/1995 M2 (Parker-Hartley)	8.9	6/25/96	3.0	6180
		⋆	C/1995 O1 (Hale-Bopp)		4/1/97	0.91	6187
			120P/1995 O2 (Mueller 1)	8.4	4/24/96	2.7	6199
		⋆	C/1995 Q1 (Bradfield)		8/31/95	0.44	6206
		⋆	C/1995 Q2 (Hartley-Drinkwater)		8/3/95	1.9	6217
			121P/1995 Q3 (Shoemaker-Holt 2)	8.1	8/19/96	2.7	6219
		#	122P/1995 S1 (de Vico)	74.4	10/6/95	0.66	6228
			P/1995 S2 (West-Hartley)	7.6	5/12/96	2.1	6249
			P/1995 S3 (Mrkos)	5.6	11/9/96	1.4	6250

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Tabulation of Comet Observations

Contributors frequently place erroneous codes on the tabulated data records for comparison-star references. It is advised that, if the 2-letter code is uncertain for a specific reference, the contributor should instead specify the reference in full (title, author, year of publication, and journal or book of publication). Frequently observers find appropriate new sources, and we must assign new codes (as below). The entire updated list of references is available by e-mail or postal mail upon request. – Ed.

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New code to the magnitude-methods key:
k = CCD magnitude with Cousins R filter.

New references:
HI = ***Hipparcos Input Catalogue*** (C. Turon ***et al.*** 1992, European Space Agency Special Publication SP-1136); derived V magnitudes for 118,000 stars brighter than mag 13, with the distribution peak around $V = 9$; see also HJ
HJ = magnitudes in the Hipparcos photometric system, H_p (see code HI, above); peak of H_p is closer to true visual than to Johnson V, though it has a long red wing

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Descriptive Information (to complement the Tabulated Data):

◇ *Comet C/1990 K1 (Levy; O.S. 1990c = 1990 XX)* ⟹ 1990 Feb. 27.92: asymmetric, parabolic, 6′ × 8′ coma [VAN06].

◇ *Comet C/1994 G1 (Takamizawa-Levy; O.S. 1994f)* ⟹ 1994 May 15: "bright nuclear region" [BIV]. July 6: start of a 2.′5 tail at p.a. 70° [BIV]. 1995 Jan. 31.98: w/ 20-cm *f*/2 Baker-Schmidt camera + V filter + ST-6 CCD, coma appears stellar; fan-like tail ~ 5′ in p.a. ~ 80° [MIK].

◇ *Comet C/1995 O1 (Hale-Bopp)* ⟹ 1995 July 23.27: discovery [HAL]. July 23.58: "pre-announcement-of-discovery" [TAK05]. July 24.18: rich star field; obs. somewhat hampered by nearby stars [HAL]. July 24.28: coma extended toward the N, as it is during most of this obs. period [MOR]. July 24.59: "significantly fainter using Swan Band filter" [SEA]. July 26.22: obs. hampered by 10th-mag star close to comet [HAL]. July 28.23: w/ 60-cm *f*/7 Y (+ CCD), comet is fainter than on July 24 and 25 (when the coma dia. was ≃ 4'.39 (N-S) by 4'.26 (E-W); tonight the coma is about half that size; m_1 = 14.0 (ref: HS) [Warren Offutt, Cloudcroft, NM]. July 29.24: obs. hampered by two faint stars within coma [HAL]. July 29.50: stellar nucleus suspected at 71× and 114× [SEA]. July 30.29: overall coma more diffuse than before, but a previously-unseen stellar cond. was visible [HAL].

Aug. 1.11: w/ 41-cm L (90×), Lumicon Swan-band filter suppresses comet's image; area of greatest cond. offset to S [BOR]. Aug. 1.8 and 3.8: w/ 40-cm *f*/5.5 L (+ CCD camera), ten 4-min exposures were taken on each night, showing an inner coma of dia. ~ 1' w/ an extension of length ~ 1' toward the N and a fainter, circular outer coma of dia. ~ 3'; integrated "visual magnitude" of the inner coma (and limiting mag) of the images are 11.3 (17.4) and 11.5 (16.3), respectively (ref: HS) [M. Nicolini, M. Facchini, and R. Calanca, Osservatorio Astronomico "G. Montanari", Cavezzo, Italy]. Aug. 2.18: the cond. seen on July 30 has started to diffuse out somewhat [HAL]. Aug. 4.29: another cond., reminiscent of that seen on July 30, is visible; the obs. was somewhat hampered by three faint stars within the coma [HAL]. Aug. 5.35: m_2 ~ 13.5 [MOR]. Aug. 13.2: w/ 0.9-m reflector (+ CCD; scale 0''.68/pixel; 2'' seeing) at Kitt Peak, mag V = 12.4 in a 10'' aperture around the comet's "optocenter" (which was offset from the center of the coma, which was asymmetric toward the NE), V = 12.8 in a 7'' aperture, and V = 13.2 in a 5'' aperture (ref: HS) [B. E. A. Mueller]. Aug. 14.06: w/ 41-cm L (90×), significantly more bright material lies to the N of the area of greatest cond. than elsewhere; at 70×, "there is a very small, dense, condensed region of dia. ~ 0'.75 that is offset well to the S of the coma's center; at 90× and 114×, the condensed region becomes even more prominent, and bright material seems to extend from it toward the N"; a Lumicon Swan-band comet filter strongly suppresses the comet" [BOR]. Aug. 14.42: w/ 25.4-cm *f*/4 L (71×), m_1 = 10.4 (MM: M), DC = 6; stellar false nucleus [SEA].

Aug. 15.15: very brief obs. obtained between storms [HAL]. Aug. 17.51: almost-stellar cond.; m_2 ≈ 13 [SEA]. Aug. 18.18: central cond. of dia. 3'' and mag 12.2; coma quite symmetrical w/ no hint of any associated tail structure [ROQ]. Aug. 19.18: "dia. of central cond. was slightly over 1'', mag 13.0; both central cond. and coma appear to have diminished somewhat in apparent size and intensity during the preceding 24-hr interval" [ROQ]. Aug. 19.23: in 51-cm L (275×), the stellar cond. resolves into a small knot of material [MOR].

Aug. 20.07: w/ 41-cm L (114×), perfectly hard, sharp "star" occupies heart of condensed region, mag 12.2 (GSC stars); small but fairly strong cond. of dia. 0'.5 surrounds nucleus (remainder of 2'.5 coma rather faint and uncondensed); also suggestions of a short, broad tail to the N [BOR]. Aug. 20.19: bright stellar cond. in 51-cm L (275×); most of light of coma w/in 0'.6 [MOR]. Aug. 21: comet observed at very low alt. (8°); other observations made at more southerly latitudes (close to Pic-du-Midi, France; and Pico-Veleta, Spain) [BIV]. Aug. 21.08: w/ 41-cm L (90×), fairly sharp nucleus of mag 11.6-11.7 (ref: AC, HS), surrounded by 0'.3 bright knot (outburst in progress!); cond. offset to S; remaining coma has faded and is very weak [BOR]. Aug. 21.23: bright, starlike stellar cond. in the center of the coma; m_2 ≃ 11.0 [HAL]. Aug. 22.06: w/ 41-cm L (90×), sky hazy and too poor for regular observations but comet's central region is obvious; nucleus is stellar and mag 11.5 (ref: HS) — very obvious, and surrounded by tiny bright knot [BOR]. Aug. 22.12: comet alt. ~ 13°; m_2 = 11.3 [MOD]. Aug. 22.85: coma somewhat larger and less condensed than on Aug. 21.84; starlike nucleus of mag 11.8 clearly present [MIK]. Aug. 23.08: w/ 41-cm L (90×), sky again too poor for normal observations, nucleus probably not quite stellar, much less sharp than previously, mag 11.8 (ref: HS); surrounding cond. stronger, now 0'.5 [BOR]. Aug. 23.13: m_2 = 11.4; in 45.7-cm *f*/4 L (75×), suspected fan coma elongated to N [MOD]. Aug. 23.20: the cond. seen on Aug. 21 is still noticeable, but not quite as bright or prominent; m_2 = 11.7 [HAL]. Aug. 23.52: "profound change in comet's appearance since the 17th; bright stellar 'nucleus' contributed most of the comet's light and overpowered coma; 'nucleus' had increased in brightness by ~ 3 mag, but there was little increase in total brightness of coma; the bright 'nucleus' was also observed on evening of Aug. 22, but no estimate was made then due to the comet's proximity to a bright star; 'nucleus' itself was mistaken for another bright star!" [SEA]. Aug. 24.06: w/ 41-cm L (90×), sky too poor for normal observations, nucleus now clearly non-stellar but very small, perhaps 0'.1 in size; the surrounding cond. is ~ 0'.5; nucleus has mag 11.6 (ref: HS) [BOR].

Aug. 25.09: w/ 41-cm L (70×), coma very suddenly sharply condensed, center appears like a slightly soft star of mag 11.5 (ref: HS); "nuclear" region occupies only 3%-5% of total coma; at 114×, comet looks very much like 29P when in double outburst state [BOR]. Aug. 25.20: m_2 = 11.5 [MOR]. Aug. 25.92: fan tail spans p.a. 295°-310° [DES01 and LOU]. Aug. 26.05: w/ 41-cm L (70×), nucleus clearly non-stellar, mag 11.5 (ref: HS), surrounding cond. now more blended with remaing coma [BOR]. Aug. 26.23: the cond. that was so prominent during the preceding observations has started to diffuse out somewhat [HAL]. Aug. 26.51: "comet near star; central cond. of false nucleus seemed a little 'softer' than on previous nights; m_2 = 10.5 (ref: AC); 'nucleus' a little less bright than previous evenings" [SEA]. Aug. 26.78: at 170×, asymmetric coma [BAR06]. Aug. 27.79: very strong, starlike central cond.; at 195×, m_2 [12 (ref: HS) [BAR06]. Aug. 28.55: "stellar or near-stellar 'nucleus' of mag ~ 13; comet similar in appearance to before outburst" [SEA]. Aug. 29.05: w/ 41-cm L (90×), coma has grown obviously smaller in the past two weeks, bright mass of former outburst now occupies fully 50% of coma (0'.7-0'.8), coma condenses pretty steadily from edges to center; Lumicon Swan-band filter suppresses comet's image but not as strongly as previously [BOR]. Aug. 29.77: at 195×, fan-like coma open toward p.a. 300°-360°, brighter in p.a. 350°; possible narrow, straight jet [BAR06]. Aug. 30.75: fan-like coma open toward p.a. 300°-360° [BAR06]. Aug. 31.19: in 26-cm L (156×), a broad plateau of brightness in the coma [MOR].

Sept. 3.16: difficult object, low and in strong moonlight [SPR]. Sept. 12.12: the comet has entered a very rich star field; the stellar background is almost a solid "carpet" of extremely faint stars; as a result, there is little contrast between the outer coma of the comet and this stellar background; all observations (beginning with this one) through the end of Sept. were affected by this [HAL].

Sept. 15.73: fan-like coma open to p.a. 260°-310° [BAR06]. Sept. 17.16: in 26-cm L (156×), m_2 = 13.0 [MOR]. Sept. 17.20: obs. hampered by 11th-mag star near center of coma [HAL]. Sept. 17.74: fan-like coma open to p.a. 300°-10° [BAR06]. Sept. 18.08: comet was close to a 12th-mag star [KRO02]. Sept. 19.02: w/ 41-cm L (90×), suggestions of a very faint outer halo; Swan-band filter only slightly suppresses comet's image [BOR]. Sept. 19.09: star of mag ~ 12 involved w/ coma [MOD]. Sept. 21.14: obs. hampered by 9th-mag star next to the comet [HAL]. Sept. 21.15: in 26-cm L (156×), a diffuse knot of material (0'.5) is present [MOR]. Sept. 21.74: coma elongated toward p.a. 65° [BAR06]. Sept. 26.16: small, dense, inner coma, reminiscent of another fairly bright cond. [HAL]. Sept. 28.01: w/ 41-cm L (90×), comet seems decidedly fainter and quite small compared to recent observations [BOR]. Sept. 29.01: w/ 41-cm L (90×), Swan-band filter no longer has any affect on visibility, being essentially neutral [BOR]. Sept. 29.17: obs. hampered by 11th-mag star next to the comet; the appearance of the inner coma is similar to that on Sept. 26 [HAL]. Sept. 30.01: w/ 41-cm L (90×), 4- to 5-day-old moon in SW sky; coma consists of a tiny (0'.3-0'.4) but bright and strong cond. surrounded by an extremely faint, tenuous halo — very difficult to integrate these two features for a meaningful mag determination [BOR]. Sept. 30.17: in 26-cm L (156×), stellar cond. becomes a small knot of material [MOR]. Oct. 13.00: bright starlike cond. confirmed by comparison with Digital Sky Survey [GRE].

◇ *Comet C/1995 Q1 (Bradfield)* ⟹ 1995 Aug. 18.36: "considerably enhanced using Swan Band Filter" [SEA]. Sept. 26.16: twilight; observing site Mt. Grappa (1600 m) [MIL02]. Sept. 26.50: low alt., moderately strong twilight; very brief obs. before the comet was covered up by clouds [HAL]. Sept. 27.22 and 29.21: "reported tail may be a narrow but obvious sunward anti-tail, at least 10' long on Sept. 29.21"; observed at dawn from Pico Veleta [BIV]. Sept. 28.49: low alt., twilight [HAL]. Oct. 1.50: twilight [HAL]. Oct. 3.16: 3-min exposure w/ 14.0-cm *f*/2 A on hypered TP2415 film shows 1'.5 coma, DC = 4, 0°.18 tail in p.a. 140° [HAS02]. Oct. 6.16: m_1 = 8.6, 8.7, and 8.7, using refs HI, S, and HD, respectively; twilight [GRA04]. Oct. 11.16: found inconsistent m_1 with different sources (m_1 = 9.0 from MC, using 2 stars; 8.7 from AG, 3 stars; 8.6 from BD, 4 stars; and 9.4 from HI, 2 stars) [GRA04]. Oct. 12.82: anti-tail > 0°.13 in p.a. 142° [KIN]. Oct. 14.16: sunward tail ~ 11' long in p.a. 150°; no trace of tail in antisolar direction [MIK]. Oct. 18.18: size and brightness comparable to M1; coma was considerably larger than previously, probably due to a darker sky; ref AC for R LMi [GRA04]. Oct. 19.10: used AAVSO R LMi chart [GRA04]. Oct. 20.05: m_1 = 8.4 via ref S, and 8.6 via ref AC (T UMa) [GRA04]. Oct. 21.09: surface brightness of coma was comparable to the central part of M33 [GRA04]. Oct. 23.09: 10' tail spans p.a. 50°-70° [SAR02]. Oct. 24.10: faint, fan-shaped anti-tail spans p.a. 60°-150°, within which are two brighter regions and one filament — one region spans p.a. 60°-80° (tail length 25'), second region spans p.a. 140°-150° (40'), 8' filament in p.a. 170°; also a faint 30' tail in p.a. 330° and a very faint 20' tail in p.a. 25° [SAR02]. Oct. 24.15: photometry obtained w/ 19-cm *f*/4 flat-field T (+ *V* filter + CCD) shows sunward conic tail ~ 12' long in p.a. ~ 155°, and no trace of tail in anti-solar direction [MIK]. Oct. 27.15: photometry obtained w/ 20-cm *f*/2 Baker-Schmidt camera (+ *V* filter + ST-6 CCD) shows faint, broad sunward tail ~ 15' long in p.a. ~ 160° [MIK]. Oct. 28.16:. clearly fainter than M97 [GRA04].

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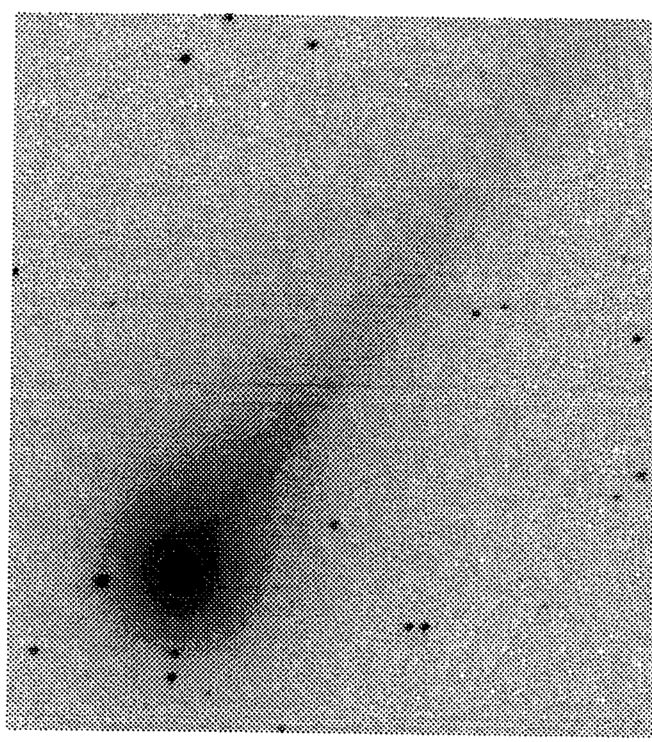
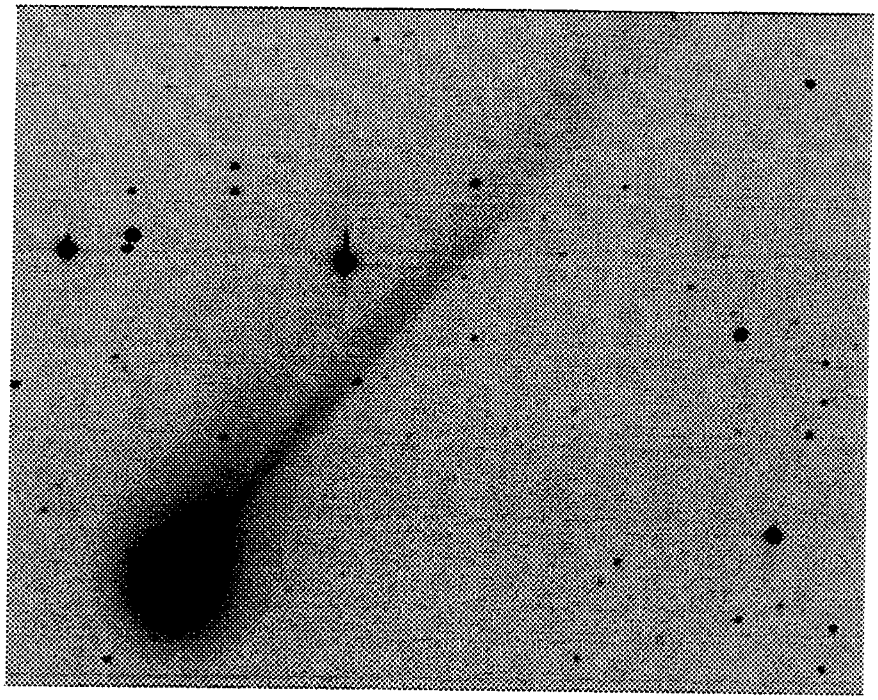
Below: ***CCD image of C/1995 Q1 (Bradfield) taken by Gordon J. Garradd (Loomberah, N.S.W., Australia; 25-cm f/4.1 reflector + HI SIS22 CCD), at 1995 Aug. 18.367 UT.***





Above: *Image of C/1995 Q1 (Bradfield) by Garradd (see image at bottom of previous page); 120-sec exposure beginning Aug. 19.3710.*

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◇ *Comet 6P/d'Arrest* ⟹ 1995 May 10.46: moderately-rich star field, which tended to affect most of the subsequent obs. attempts [HAL]. June 21.38: search attempt affected by moonrise [HAL]. July 8.02: fan-like tail spans p.a. 230°-335°; tail length ≃ 2'.3 at all p.a.; coma and tail sizes measured on a 6-min co-added image taken by L. Šarounová [PRA01]. July 8.04: comet was also detected at limit (averted vision) around mag 13.0 with a 20-cm *f*/10 T (91×); near Pic-du-Midi in the French Pyrennees [BIV]. July 9.04: fan-like tail spans p.a. 235°-325°; tail length ≃ 2'.5 at all p.a.; coma and tail sizes measured on a 4-min co-added image taken by L. Šarounová [PRA01]. July 9.36: in 1.5-m C, m_2 ~ 18, w/ the coma extended in p.a. 250° [MOR]. July 19.92: comet diffuse and rather difficult; observed from the island of Cres, Croatia [MIK]. July 19.98, 20.99, 22.00, 24.02: "fan-shaped tail spans p.a. 240°-340°; all magnitudes in *V* calibrated using the Landolt standards (for comparison, mean HS magnitudes of stars in these fields were all within 0.4 mag of the *V* magnitudes obtained using the Landolt standards)" [PRA01]. July 20.94: obs. made under very good conditions and with comet higher on the sky than on July 19.92, apparently yielding a much larger, delicate coma and brighter m_1 [MIK]. July 22.95 and 24.96: V Peg chart used [LOO01]. July 24.95: photometry obtained with 20-cm *f*/2 Baker-Schmidt camera + *V* filter + ST-6 CCD; reduced with Daophot II for PCs [MIK]. July 24.99: comet very diffuse; only slight enhancement w/ Lumicon Swan Band Filter [MEY]. July 26.90, 30.91, 31.93, Aug. 5.97, and 6.96: weak central cond. [LEH]. July 27.04: w/ 44.5-cm L *f*/5 (220×), 4' coma, 0°.06 tail in p.a. 290° [SAR02]. July 28.56: noticeably enhanced using Swan Band Filter [SEA]. July 29.18: small disk of light with dia. 1' in coma's center, more easily visible in blue filter [DES01]. July 29.35: coma elongated toward p.a. 330° [MOR]. July 29.38: a tiny starlike cond. was suspected in 41-cm L [HAL]. July 30.01: at 117×, fan-shaped tail spans p.a. 310°-350° [VIC]. July 30.19: w/ 25×100 B, 14' coma, DC = 1-2 [BOR]. July 31.30: in 20×80 B, 14' coma, DC = 1 [BOR].

Aug. 1.22: fan tail spans p.a. 240°-325° [DID]. Aug. 2.01: at 214×, 3' coma, fan-shaped tail spans p.a. 260°-350° [SZE02]. Aug. 3.38: obs. affected by clouds and nearby bright stars [HAL]. Aug. 4.98: fan-shaped coma open towards p.a. 260°-310° [BAR06]. Aug. 5.41: in 20×80 B, complex tail structure — broad fan, 1° in length, spanning p.a. 260°-35°, w/ plumes of brighter material at p.a. 260° and 355° [MOR]. Aug. 5.98: fan-shaped coma open towards p.a. 270°-320° [BAR06]. Aug. 6.03: bright central region (dia. 3'-4') surrounded by wide, faint outer halo [MEY]. Aug. 8.32: in 20×80 B, 10' coma, DC = 2 [BOR]. Aug. 8.33: fan coma spans p.a. 200°-315° [DID]. Aug. 19.30: obs. hampered by bright star in outer coma [HAL]. Aug. 20.26: coma spans p.a. 185°-243° [DID]. Aug. 20.30: moon 5 days from new in E [BOR]. Aug. 21.31: in 20×80 B, 8'.5 coma, DC = 2 [BOR]. Aug. 21.95: coma elongated in p.a. 310° [BAR06]. Aug. 22.12–Sept. 1.14 (each night observed), and Sept. 25.13: comet brighter w/ Swan-band filter [DEA]. Aug. 25.01: w/ 35-cm *f*/5 L (70×), m_2 = 12.0 (ref: GA) [BAR06]. Aug. 25.92: coma is very strongly condensed; w/ 25-cm *f*/4 L (33×), star-like central cond. of mag 9.7 (ref: S); w/ 35-cm *f*/5 L (70×), bright central disk of dia. 2' and faint outer coma [BAR06]. Aug. 26.27: comet almost perfect twin to NGC 7293 in size and brightness [BOR]. Aug. 26.29: large, faint outer coma w/ bright, 3' central cond. of mag 10.5 [DID]. Aug. 26.86: star-like central cond. of mag 11.5; 4' disk-like inner coma; faint, large outer coma [BAR06]. Aug. 27.12: fan-like coma visible toward E [DEA]. Aug. 27.22: 40.6-cm *f*/5 L (114×) shows a tiny knot/non-stellar nucleus of mag 12-13 at coma's center; at 70×, coma dia. 4'.5, DC = 4 [BOR]. Aug. 27.38: slight brightening evident w/ Swan-band filter [SHA04]. Aug. 27.95: w/ 35-cm *f*/5 L (70×), m_2 = 12.2 (ref: GA) [BAR06].

Aug. 28.12: star of $m_v = 5.2$ near the comet was troublesome [DEA]. Aug. 28.30: jets at p.a. 200° and 285°; stellar nucleus [DID]. Aug. 28.92: fan-like coma open toward p.a. 260°-330°; $m_2 \sim 13$ [BAR06]. Aug. 30: w/ 10×50 B, circular coma of dia. ~ 25′; DC = 1-2 [HAV]. Sept. 22.44: very diffuse and quite large; enhanced with Swan Band Filter [SEA].

◇ *Comet 9P/Tempel 1* ⟹ 1995 Aug. 30.48: also 1′.3 and 0′.4 tails in p.a. 267° and 320°; m_1 estimates are from 300-s exposures; the coma and tail measures here are from co-added exposures totally 900 sec [HER02].

◇ *Comet 18P/Perrine-Mrkos* ⟹ 1995 Aug. 26.95 and Sept. 1.98: w/ "Celestron 8" (+ Alpha 500 CCD camera at the *f*/10 focus; scale 1″.96/pixel), this comet was not detected w/in an 8′ radius of the expected position (elements from *MPC* 20123); observed from Orcieres-Merlette (Hautes Alpes, France, elevation 1830 m) [GAR02].

◇ *Comet 19P/Borrelly (O.S. 1994l)* ⟹ 1994 Dec. 30.81: ill-defined coma [MEY]. 1995 Jan. 29.035: an unfiltered 25-min exp. on hypered 4415 film w/ 67-cm D (Asiago Astrophysical Obs.) shows a 0′.8 circular coma and a fan-shaped tail toward p.a. 180°; the edges of the fan are the 1′.5 anti-tail (p.a. 112°) and the 2′ main tail (p.a. 243°) [MIL02 and M. Tombelli].

◇ *Comet 29P/Schwassmann-Wachmann 1* ⟹ 1995 Apr. 1.20 (and following evening): obs. hampered by nearby star of mag ~ 9 [HAL]. Oct. 5.49: low alt., zodiacal light [HAL]. Oct. 27.16: photometry obtained w/ 20-cm *f*/2 Baker-Schmidt camera (+ *V* filter + ST-6 CCD) shows star-like central cond. surrounded by delicate coma [MIK].

◇ *Comet 32P/Comas Solá* ⟹ 1995 Aug. 30.46: m_1 estimates are from 300-s exposures; the coma and tail measures here are from co-added exposures totally 900 sec [HER02].

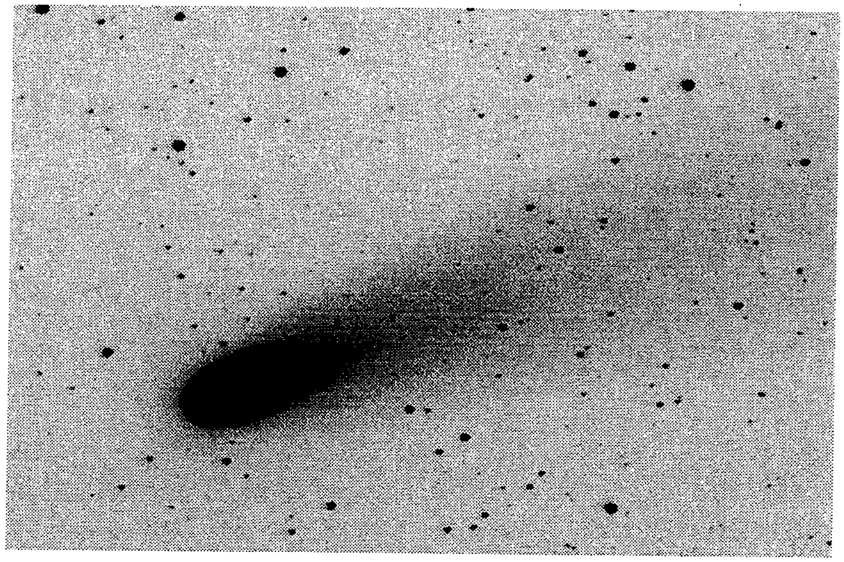
◇ *Comet 41P/Tuttle-Giacobini-Kresák* ⟹ 1995 Aug. 19.17 and 20.17: faint fan of material connects the tails going through N; tail 0°.07 long in p.a. 335° [MOR]. Aug. 19.36: "considerably enhanced using Swan Band Filter" [SEA]. Aug. 19.45: w/ 28-cm T (+ ST-6 CCD), there was a long (> 15′), straight tail toward the E [KIN]. Aug. 21.14: low alt.; high moisture content in air [HAL]. Aug. 25.83: comet alt. ~ 6°; large, diffuse object [BOU]. Aug. 29.13: brief obs. made just before comet set; the coma is larger and more diffuse than it was on Aug. 21 [HAL]. Sept. 19.05: comet alt. ~ 7° [MOD]. Sept. 24.05: comet alt. ~ 5° [MOD].

◇ *Comet 58P/Jackson-Neujmin* ⟹ 1995 July 8.96 and 09.98: nearly stellar appearance [PRA01]. July 19.92, 21.97, 23.95: brightness integrated on clear filter images; comparison star *V* magnitudes calibrated using the Landolt standards; faint circular coma w/ prominent central cond. [PRA01]. July 25.96, 30.96, and 31.93: all magnitudes are calibrated using the same Landolt standards, as for earlier July estimates — consistency of all magnitudes is ≃ 0.1 mag; circular coma with bright central cond.; faint 30″ tail to SW on July 30.96 images [PRA01]. Aug. 23.28: $m_2 = 15.3 \pm 0.3$ [MOD]. Aug. 23.99: nuclear and total magnitudes measured from unfiltered, *V* and *R* (Cousins system; cf. Landolt 1983) CCD images taken in quick succession, each w/ 180-sec integration time; $V - R = u - r = +0.5$, *i.e.*, both nuclear cond. and whole coma is slightly redder than the sun (which has $V - R = +0.36$); the unfiltered CCD magnitudes from Aug. 16.98, 20.04, and 23.99 were calibrated using *V* standards to the same system as that of nearly all July "c" and "C" magnitudes for this comet (consistency 0.1 mag); circular coma with moderate central cond. on all nights [PRA01 and L. Šarounová]. Sept. 2.04: tail toward p.a. 67°, curved to p.a. 96° [GAR02]. Sept. 17.84: photometry obtained with 36-cm *f*/6.8 T (+ *V* filter + CCD), reduced with Daophot II for PCs; starlike central cond. of dia. ~13″; delicate asymmetric coma extending in p.a. ~ 15° [MIK]. Sept. 24.23: $m_2 = 15.2 \pm 0.1$ [MOD]. Sept. 26.92: "no perceived variation in m_2 between 22^h00^m and 23^h13^m UT [any variation would have been < 0.2 mag]" [GAR02].

◇ *Comet 67P/Churyumov-Gerasimenko* ⟹ 1995 Sept. 26.94: second tail 1′.9 long in p.a. 77° [GAR02]. Oct. 13.80: fan-like tail ~ 5′ long spanning p.a. 40°-65°; photometry obtained with 19-cm *f*/4 flat-field T + *V* filter + CCD [MIK]. Oct. 18.83: fan-like tail ~ 4′ long in p.a. ~ 30°-60° [MIK].

◇ *Comet 71P/Clark* ⟹ 1995 Apr. 8.48: rich star field [HAL]. May 6.46: comet located w/in small, tight group of faint stars [HAL]. May 27.57: "far less visible using Swan Band filter" [SEA]. June 20.56: "possible tail at p.a. 290° seen in 25.4-cm L at 114×" [SEA]. June 21.36: obs. affected by low alt. and, to some extent, moonlight [HAL]. July 1.53 and 18.48: "some interference from nearby star" [SEA]. July 29.27: the comet's appearance is noticeably more diffuse than during previous observations [HAL]. July 31.54: "some interference from nearby 12th-mag star; possible broad tail extending W from the coma" [CAM03]. Sept. 26.90: "quite diffuse"; second tail (more pronounced but shorter) 0′.7 long in p.a. 47° [GAR02].

◇ *Comet 73P/Schwassmann-Wachmann 3* ⟹ 1995 Sept. 17.09: very brief obs. made just before comet set; the coma is very distinctly fan-shaped; the comet retained this appearance throughout all the observations [HAL]. Sept. 20.09: low alt., twilight, difficult observing conditions; the given brightness is probably an underestimate [HAL]. Sept. 21.13: in 26-cm L (156×), a very faint stellar cond. is surrounded by a (relatively large, ~ 1′) bright disk of material that is elongated in the direction of the tail; this is surrounded by a much fainter parabolic outer coma; comet is very low (< 10° alt.) for all observations [MOR]. Sept. 22.90: tail appears to be a narrow fan; coma brighter w/ Swan-band filter [SEA]. Sept. 24-Oct. 2: all obs. were made in twilight [KRO02]. Sept. 26.09: low alt. [HAL]. Sept. 26.8, 27.8, and 28.8: observations from IRAM, Pico Veleta, Spain (elevation 2850 m); comet very low (alt. 2°-6°), but well seen (good sky transparency); secondary narrow, 4′ tail in p.a. 85° [BIV]. Sept. 27.38: bright fan tail spans p.a. 90°-105° [SEA]. Sept. 29.38: very condensed in 25.4-cm L at 71×, 114×, and 190× [SEA].



Above: *Image of 73P/Schwassmann-Wachmann 3 by Gordon Garradd (25-cm f/4.1 Newtonian reflector; 180-sec CCD exposure taken on Sept. 22.417 UT. North is down; field is 23′ × 13′.*

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Oct. 2.04: "comet seemed to be undergoing a major outburst, appearing as a star w/ the slightest hint of fuzziness; no tail seen" [ROB03]. Oct. 3.08: low alt., relatively bright moonlight; w/ 20-cm $f/6$ L (49×), 0°.33 tail in p.a. 112° [HAL]. Oct. 7.38: "very bright false nucleus; comet yellow in color and is greatly reduced [in brightness] w/ Swan-band filter; broad tail" [SEA]. Oct. 9.38: false nucleus a little "softer" than on Oct. 7 [SEA]. Oct. 10.38: tail very intense near head; false nucleus fainter [SEA]. Oct. 10.92, 11.90, 12.91: comet faintly visible the naked eye; blue color suspected in coma; dust tail's brightness fades after first 1° of length, but may be longer than 2°, and is similar in appearance to the tail of 1P/Halley in 1986 March [DES01]. Oct. 11.38: comet very bright and spectacular in 25.4-cm L; false nucleus less bright than on Oct. 7 [SEA]. Oct. 11.93: fainter w/ Swan-band filter; the coma is stellar in appearance also w/ 96-cm $f/9$ L (60×) [DEA]. Oct. 12.01: "fan-shaped tail was still barely visible and I estimated it as perhaps 4′ long in p.a. 92°; there was a diffuse patch just E of the cond. that seemed elongated, but was irregularly shaped (almost rectangular) — the intense cond. was [evidently] at the very tip of the coma" [KRO02]. Oct. 12.4: false nucleus sharp and bright again [SEA]. Oct. 12.93: fainter w/ Swan-band filter; comet visible to naked eye [DEA]. Oct. 12.97: same m_1 value using references HJ, NO, MC; bright diffuse central cond. is neither starlike nor disklike but dominates brightness [GRE].

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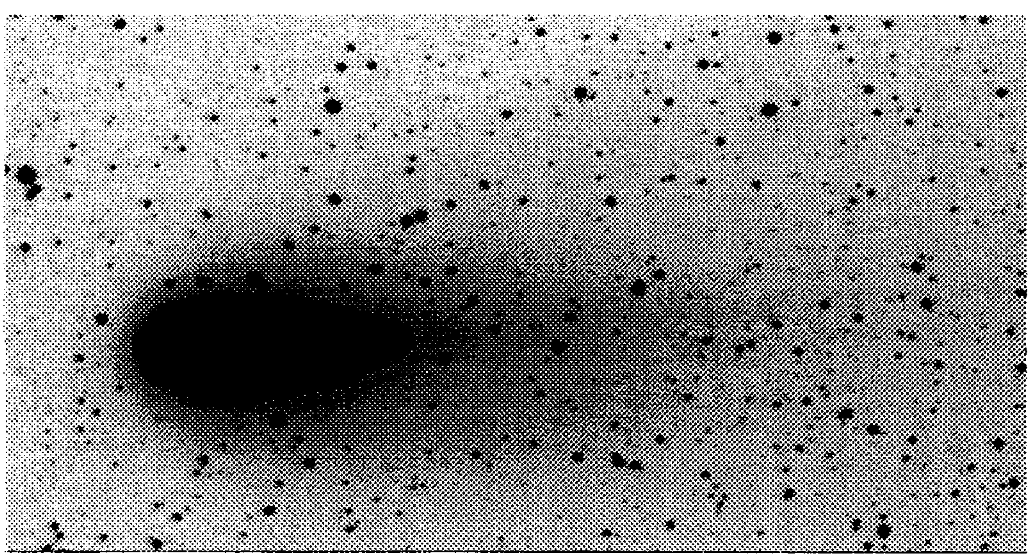
Below: *CCD image of comet 73P taken by Garradd (same scale and orientation as above; 120-sec exposure) on Oct. 27.423.*



◇ *Comet 73P/Schwassmann-Wachmann 3* ⟹ *(cont. from previous page)* Oct. 13.01: w/ 33.3-cm L, central cond. was noticeably fainter than on Oct. 12; cond.'s mag was somewhat brighter than an 8.2-mag star (hence, $m_2 \sim 7.6$); despite the fainter cond., the comet seemed slightly brighter than on the previous night, with the coma again visible; w/ the cond. toned down in brightness, I could see that the structure, or detached coma, of the previous night was actually part of an elongated coma, 1'.1 wide at the cond. and ~ 4' long, extending toward p.a. 89° [KRO02]. Oct. 13.39: w/ 25×100 B, 3' coma, DC = 8; w/ 25.4-cm L, comet appeared as 1P/Halley did in 1986 Mar. in 15-cm L; yellow color; small spectroscope showed strong continuum; brightness of both coma and false nucleus were reduced somewhat w/ Swan Band Filter; parabolic hood to coma (and probable larger halo surrounding head); stellar false nucleus; comet and some tail clearly visible in 2×2.5 opera glass, and faintly seen via naked eye as an "elongated star" [SEA]. Oct. 13.39 and 15.39: w/ 15×80 B, $m_1 = 5.7$, 1°.5 tail (comet visible to naked eye on Oct. 13.39) [LOV]. Oct. 14.39: false nucleus a little "softer" than on previous night; comet visible to naked eye; probable short spine in tail visible in 25×100 B [SEA]. Oct. 15.40: comet still faintly visible w/ naked eye; in 25×100 B, tail less broad since Oct. 8 — resuming its longer and more narrow form of late Sept. (though brighter now and even longer) [SEA]. Oct. 22.92: the tail beyond 1°.0 is less evident [DES01]. Oct. 23.95: the comet (both coma and tail) faded abruptly from previous night, and the DC was noticeably lower; the bright central cond. that was visible in the previous week is now gone [DES01]. Oct. 24.93: the comet's DC continues to fluctuate noticeably [DES01].

◇ *Comet 74P/Smirnova-Chernykh* ⟹ 1995 Aug. 30.26: m_1 estimates are from 300-s exposures; the coma measure here is from co-added exposures totalling 840 sec [HER02].

◇ *Comet 95P/Chiron [(2060) Chiron]* ⟹ 1995 Apr. 1.37 and 24.24: appearance completely stellar [HAL]. Apr. 25.21: there is a vague hint that the comet may be slightly less stellar than nearby stars of similar brightness [HAL].

◇ *Comet 109P/Swift-Tuttle* ⟹ 1992 Nov. 18.75: 8' dust tail in p.a. 90° [VAN06]. Nov. 21.73: 8' dust tail in p.a. 22° [VAN06].

◇ *Comet 119P/Parker-Hartley* ⟹ 1995 Aug. 27.06: "a well-pronounced fan-tail is visible from p.a. 234° to 246° [GAR02]. Sept. 2.12: "strong" tail spans p.a. 226°-249° [GAR02]. Sept. 27.05: fan-shaped tail spans p.a. 230°-250° [GAR02].

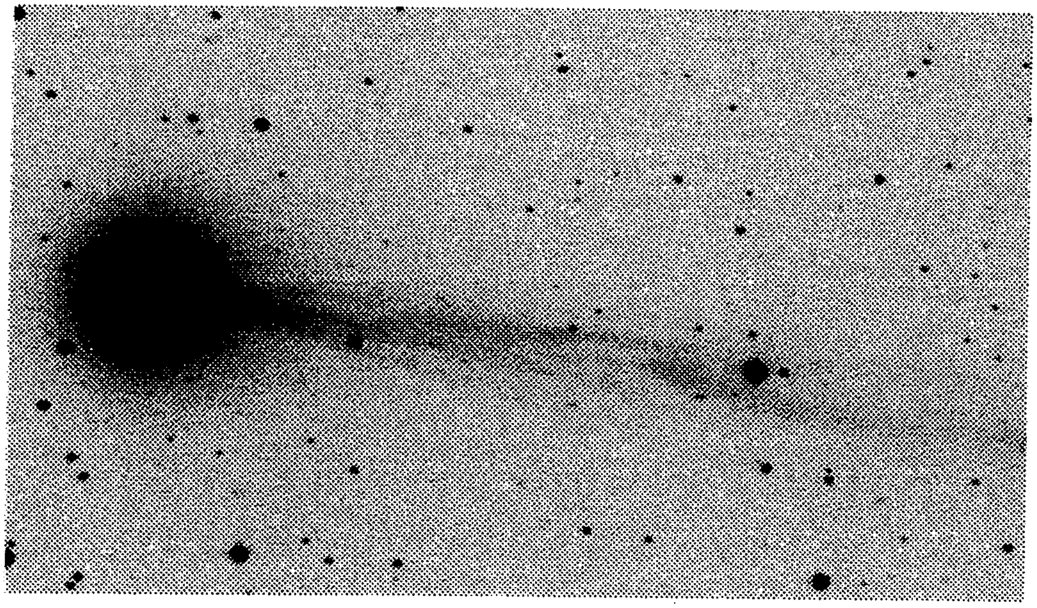
◇ *Comet 120P/Mueller 1* ⟹ 1995 Aug. 30.37: m_1 estimates are from 300-s exposures; the coma measure here is from co-added exposures totalling 600 sec [HER02].

◇ *Comet 122P/1995 S1 (de Vico)* ⟹ 1995 Sept. 18.50: 0°.75 tail in p.a. 0° [MOR]. Sept. 18.80: w/ 20-cm *f*/6.3 T (+ CCD), coma dia. 4'.0 × 3'.7, 20' tail in p.a. 260° [YUS]. Sept. 19.38: w/ 20×120 B, 3'.6 coma, DC = 7 [BOR]. Sept. 19.42: starlike nucleus at 75× [DAH]. Sept. 19.49: w/ 20-cm L (85×), coma dia. 4'; 20' tail in p.a. 255°; comet strongly enhanced with a Lumicon Swan Band filter [Tom Polakis, near Phoenix, AZ]. Sept. 20.38: in 20×80 B, 4'.3 coma, DC = 7 [BOR]. Sept. 20.51: 0°.5 tails in p.a. 0° and 5° [MOR]. Sept. 21.76: brightness enhanced w/ Swan Band Filter; straight, narrow tail [SEA]. Sept. 23.11: 15' dust tail spans p.a. 340°-360° [SAR02]. Sept. 23.135: CCD image obtained w/ 50-cm reflector at the Col Druscié Obs. (Cortina, Italy) shows a disconnection event in the tail [DIM]. Sept. 23.16: starlike central cond. [ZAN]. Sept. 23.46: w/ 28-cm *f*/10 T (310×), coma dia. 2'.2 [DIL]. Sept. 23.50: in 20×80 B, 0°.5 tail in p.a. 340°; in 25.6-cm *f*/4 L (45×), 4'.0 coma [MOR]. Sept. 24.39: w/ 20×120 B, straight, narrow tail perhaps half as wide as coma's dia. [BOR]. Sept. 24.41: w/ 10×70 B, 0°.8 tail (as wide as coma — 4'.5) in p.a. 272° [MOD]. Sept. 24.50: in 20×80 B, DC = 8, tails 0°.5 and 1°.33 long in p.a. 340° and 270° [MOR]. Sept. 24.52: comet much brighter in Lumicon Premium Swan-Band filter [SPR]. Sept. 25.14: short, faint tail [BOU]. Sept. 25.48: w/ 41-cm *f*/4 L (72×), 1°.15 tail in p.a. 275° [HAL]. Sept. 27, 28, 29, Oct. 6, 7, 8, 9, 10: second tail (> 0°.1 long) toward p.a. 275°, 270°, 270°, 290°, 295°, 303°, 295°, and 306° (respectively); a short (≃ 1'.5) tail was seen in p.a. 235° and 203° on Oct. 9 and 10 with the 1-m telescope (735×) of Meudon Observatory [BIV]. Sept. 27.140: photo (9-min exp., Scotch 800/3200 film) w/ 300-mm f.l. *f*/4.5 lens shows 2°.3 tail in p.a. 277° (measured at the end of the tail) [HAV].

Sept. 27.14: 2-min wide-field CCD images show an ion tail that may be traced up to 6°.3 from the comet nucleus; "clouds" and knots of material are present along the tail stream; the disconnected cloud of material (visible on Sept. 26) is still clearly present (since its front edge is well-defined, it may be followed on both dates); under the assumption that the "cloud" moves along the sun-comet line (anti-solar direction), the average velocity of its front edge during the 0.995-day interval was 12.8 ± 1 km/s; while the initial ~ 1°.7 of the tail stream on Sept. 26.14 was straight in p.a. ~ 275°, the corresponding Sept. 27.14 images show it slightly curved and turned toward p.a. ~ 282° [MIK]. Sept. 27.17: "nearly-stellar with the 8×50 finderscope; coma dia. ~ 10' (w/ a 12.7-cm L), w/ a strong tail toward W" [GAR02]. Sept. 28.41: in 20-cm *f*/5 L (169×), $m_2 = 10.5 \pm 0.2$ [MOD]. Sept. 29.38 and 30.38: central cond. appeared as a very bright disk [DID]. Sept. 29.39: w/ 10×50 B, tail seems as wide as coma's dia., edges more-or-less parallel; in 20×80 B, 1°.1 tail in p.a. 283° [BOR].

Sept. 30.13: 2-min CCD images (taken as on Sept. 27.14) show that the ion tail may be traced up to ~ 6° in p.a. ~ 276°; a distinct "cloud" of material is present 1°.8 from the nucleus; furthermore, two very conspicious rays extend from the main ion tail stream — the first starting at 20' from the nucleus and continuing for ~ 2°.6 in p.a. ~ 279°, while the second one extends ~ 0°.6 from the coma region in p.a. ~ 283° [MIK]. Sept. 30.39: w/ 10×50 B, tail growing brighter, fairly narrow and straight, edges slightly divergent after leaving coma [BOR]. Sept. 30.42: tail as wide as coma; in 20-cm *f*/5 L (169×), $m_2 = 10.4 \pm 0.2$ [MOD].

Oct. 1.13: 2-min wide-field CCD images (taken as on Sept. 30.13) shows that the ion tail may be traced up to ~ 6°.6; there is a narrow stream of fresh plasma extending for ~ 2°.1 from the nucleus in p.a. ~ 275°; at the nucleus distance of 67', the stream curves to the S in p.a. ~ 263°; at the same point (67'), the old tail is connected to the new one; after ~ 16', it splits into two separate tails, w/ the main one continuing for ~ 5°.3 in p.a. ~ 279° and the less-conspicious one for



Above: *Image of 122P/de Vico by Gordon Garradd (25-cm f/4.1 Newtonian reflector); 180-sec unfiltered CCD exposure taken on Sept. 20.783 UT. Field size is 23′ × 13′; scale 1″.8/pixel. North is up. Note disconnection event in tail just left of the brightest star (right of center).*

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(text continued from previous page) ~ 3°.3 in p.a. ~ 282°; a distinct "cloud" of material is present on the main stream at 4°.3 from the nucleus; prominent spike (probably dust) extends from the coma region ~ 0°.5 in p.a. ~ 290°; as a distinct cloud of material may be followed on both dates (Sept. 30.13, Oct. 1.13), its velocity can therefore be calculated; under the assumption that it moves along the sun-comet line (anti-solar direction), the average velocity of its central region during the 1.01-day interval (range of nucleus distance 5.1-12.7 × 10^6 km) was 87 ± 5 km/s [MIK]. Oct. 1.15: strongly condensed coma with a greenish tint near center; starlike false nucleus of mag 9.0 (ref: AC) [GRA04]. Oct. 1.32: brighter w/ Swan-band filter [DEA]. Oct. 1.52: in 10-cm R, tail "shows an uneven, dual, split-fork structure at the head; elongated coma, with a very bright asymmetric centre; comet also visible with naked-eye as a stuctureless glow of mag 5.3 above α Leo" [SPR]. Oct. 2.15: tail very obvious; comet faintly visible to naked eye [BOU]. Oct. 2.31: slightly fainter w/ Swan-band filter [DEA]. Oct. 2.83: another tail in p.a. 270° [KOB01]. Oct. 3.15: 5-min exposure w/ 14.0-cm f/2 A on hypered TP2415 film shows 6′.0 coma, 4°.0 tail in p.a. 285° [HAS02]. Oct. 3.49: w/ 10×50 B, 2°.5 tail in p.a. 284° [HAL]. Oct. 5.46: w/ 28-cm f/10 T (310×), coma dia. 1′.5; at 50×, faint, narrow tail ~ 15′ long in p.a. ~ 300° [DIL]. Oct. 5.48: w/ 10×50 B, 2°.5 tail in p.a. 281° [HAL]. Oct. 5.95-5.99: w/ 29-cm f/2 'HELIOS' (+ ST-6V CCD camera), guided w/ a 60-cm telescope, 19 15- and 30-sec exposures show a bulb-shaped head and a tail at least 5°.5 long in p.a. 290°; also a weaker tail in p.a. ~ 300° w/ length about one-third that of the main tail [V. Tejfel, Fessenkov Astrophysical Institute Observatory, Alma-Ata, Kazakhstan]. Oct. 6.16: coma was blue-green and appeared much bluer than comparison star 51 Leo; twilight [GRA04]. Oct. 8.17: bluish coma (the color was more distinct at 50×); the m_2 estimate refers to an apparently stellar cond. at the center of coma [GRA04]. Oct. 9.18: blue-green coma, much bluer than 72 Leo; interference from twilight and the Moon [GRA04]. Oct. 11.12-11.16: same m_1 using method B; coma bluish-green [GRA04]. Oct. 12.38 and 13.35: bright, diffuse central cond. [DID]. Oct. 13.09: observing was interrupted by clouds [GRA04]. Oct. 14: moon interference and fog [BIV]. Oct. 15.11: w/ 6.3-cm R (52×), 20′ tail in p.a. 270° [KIS02]. Oct. 18.12: the comet was located near the Coma cluster (Melotte 111) [GRA04]. Oct. 18.18: an apparently stellar "nucleus" was observed at m_2 = 9.5: (ref: AC, R LMi); coma was bluish (and bluer than γ Com) [GRA04]. Oct. 18.76: first observation in evening sky [GRA04]. Oct. 19.07: interference from auroral light [GRA04]. Oct. 21.12: w/ 17-cm L (78×), 35′ tail in p.a. 335° [SZA03]. Oct. 21.18: coma appeared somewhat brighter and more condensed than M3; faint tail [GRA04]. Oct. 22.09: 20′ dust tail spans p.a. 20°-30° [SAR02]. Oct. 23.12: 50′ dust tail spans p.a. 340°-360°; 30′ bright filament in p.a. 345° [SAR02]. Oct. 24.12: 1° dust tail spans p.a. 10°-30° [SAR02]. Oct. 24.14: 30′ dust tail spans p.a. 30°-65° [SAR02]. Oct. 28.13: visibility comparable to that of M3 [GRA04]. Oct. 31.10: despite First Quarter moon, much brighter in Lumicon Swan-Band Premium filter; very bright central, circular, cond. of coma [SPR].

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Key to observers with observations published in this issue, *with 2-digit numbers between Observer Code and Observer's Name indicating source [07 = Comet Section, British Astronomical Assn.; 11 = Dutch Comet Section; 16 = Japanese observers (c/o Akimasa Nakamura, Kuma, Japan); 23 = Czech group (c/o P. Pravec); 32 = Hungarian group (c/o K. Sarneczky); etc.]. Those with asterisks (*) preceding the 5-character code are new additions to the Observer Key:*

*AIZ	16	Kazuhiro Aizawa, Miyagi, Japan
*ALD01	07	John Aldridge, England
BAK01	32	Gaspar Bakos, Budapest, Hungary
BAR		Sandro Baroni, Italy
BAR06	26	Alexandr R. Baransky, Ukraine
*BEC01		Stefan Beck, Stuttgart, Germany
BIV		Nicolas Biver, France
BOR		John E. Bortle, NY, U.S.A.
BOU		Reinder J. Bouma, The Netherlands
BRO04	27	Eric Broens, Belgium
CHE03		Kazimieras T. Cernis, Lithuania
CHO01	18	Franciszek Chodorowski, Poland
DAH	24	Haakon Dahle, Norway
DEA		Vicente F. de Assis Neto, Brazil
*DEM01	18	Andrej Dementjev, Lithuania
DES01		Jose G. de Souza Aguiar, Brazil
DID		Richard Robert Didick, MA, U.S.A
DIE02		Alfons Diepvens, Belgium
DIL		William G. Dillon, U.S.A.
DIM	36	Alessandro Dimai, Italy
GAR02		Stephane Garro, France
GON03		Victor Gonzalez, Canary Is.
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
HAV		Roberto Haver, Italy
HER02		Carl Hergenrother, AZ, U.S.A.
HOR02	23	Kamil Hornoch, Czechoslovakia
HUR	07	Guy M. Hurst, England
KAT01	16	Taichi Kato, Japan
KEI	07	Graham Keitch, England
KER	32	Akos Kereszturi, Hungary
*KIN	16	Kazuo Kinoshita, Japan
KIS02	32	Laszlo Kiss, Szeged, Hungary
KOB01	16	Juro Kobayashi, Japan
KRO02		Gary W. Kronk, IL, U.S.A.
KRY01	17	Timur Valer'evich Kryachko, Russia
KYS	23	J. Kysely, Czech Republic
LAN02	32	Zsolt Lantos, Budapest, Hungary
LEH		Martin Lehky, Czechoslovakia
LOO01		Frans R. van Loo, Belgium
LOU	35	Romualdo Lourencon, Brazil
MAI	37	Alexander S. Maidic, Ukraine
MAR02		Jose Carvajal Martinez, Spain
MEY	28	Maik Meyer, Germany
MIK		Herman Mikuz, Slovenia
MIL02		Giannantonio Milani, Italy
MOD		Robert J. Modic, OH, U.S.A.
MOE		Michael Moeller, West Germany
MOR		Charles S. Morris, U.S.A.
NAG02	16	Takashi Nagata, Hyogo, Japan
NAK01	16	Akimasa Nakamura, Japan
NEV		V. S. Nevski, Belarus
NOW		Gary T. Nowak, VT, U.S.A.
OFE		Eran Ofek, Israel
OLE	18	Arkadiusz Olech, Poland
OOY	16	Yoshinori Ooyanagi, Japan
PAN	07	Roy W. Panther, England
PAR03	18	Mieczyslaw L. Paradowski, Poland
PER01		Alfredo J. S. Pereira, Portugal
PLE01	18	Janusz Pleszka, Poland
PLS	23	Martin Plsek, Czech Republic
POD	23	M. Podzorny, Czech Republic
POP	23	Martin Popek, Czech Republic
PRA01	23	Petr Pravec, Czech Republic
PRY		Jim Pryal, WA, U.S.A.
*RES	18	Maciej Reszelski, Poland
ROB03		Paul C. Robinson, WV, U.S.A.
ROD01		Diego Rodriguez, Spain
ROQ		Paul Roques, AZ, U.S.A.
*SAI	38	J. Sainz, Madrid, Spain
*SAN04	38	J. M. San Juan, Madrid, Spain
SAR02	32	Krisztian Sarneczky, Hungary
SCI	18	Tomasz Sciezor, Poland
SCO01		James V. Scotti, AZ, U.S.A.
SEA	14	David A. J. Seargent, Australia
SHA02	07	Jonathan D. Shanklin, England
SHA04		Gregory T. Shanos, U.S.A.
SHI	16	Hiroyuki Shioi, Japan
SHU	26	Sergey Shurpakov, U.S.S.R.
*SKO02	32	Judit Skobrak, Budapest, Hungary
SPR		Christopher E. Spratt, BC, Canada
SZA02	32	Levente Szarka, Hungary
*SZA03	32	Gyula Szabo, Szeged, Hungary
SZE02	32	Laszlo Szentasko, Hungary
TAK05	16	Kesao Takamizawa, Japan
TAN02	07	Tony Tanti, Malta
*TAR	16	Hideki Tari, Japan
TAY	07	Melvyn D. Taylor, England
THO03	24	Steinar Thorvaldsen, Norway
TSU02	16	Mitsunori Tsumura, Japan
*UTO	16	Fumiaki Uto, Nara, Japan
VAN04		Tony VanMunster, Belgium
VAN06		Gabriele Vanin, Italy
VEL03		Peter Velestschuk, Ukraine
VIC	32	Zoltan Vician, Hehalom, Hungary
WAT01	16	Nobuo Watanabe, Japan
WIL02		Peter F. Williams, Australia
YOS	16	Shigeru Yoshida, Japan
YUS	16	Toru Yusa, Kogota, Miyagi, Japan
ZAN		Mauro Vittorio Zanotta, Italy
ZNO	23	Vladimir Znojil, Czech Republic

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TABULATED DATA

The headings for the tabulated data are as follows: "DATE (UT)" = Date and time to hundredths of a day in Universal Time; "N" = notes [* = correction to observation published in earlier issue of the *ICQ*; an exclamation mark (!) in this same location indicates that the observer has corrected his estimate in some manner for atmospheric extinction (prior to September 1992, this was the standard symbol for noting extinction correction, but following publication of the extinction paper — July 1992 *ICQ* — this symbol is only to be used to denote corrections made using procedures different from that outlined by Green 1992, *ICQ* 14, 55-59 — and then only for situations where the observed comet is at altitude > 10°); '&' = comet observed at altitude 20° or less with no atmospheric extinction correction applied; '$' = comet observed at altitude 10° or lower, observations corrected by the observer using procedure of Green (*ibid.*); for a correction applied by the observer using Tables Ia, Ib, or Ic of Green (*ibid.*), the letters 'a', 'w', or 's', respectively, should be used].

"MM" = the method employed for estimating the total visual magnitude [B = Bobrovnikoff, M = Morris, S = Sidgwick, C = unfiltered CCD integration, c = same as 'C', but for nuclear magnitudes, V = electronic observations — usually CCD — with Johnson *V* filter, *etc.* — see October 1980 issue of *ICQ*, pages 69-73]. "MAG." = total visual magnitude estimate; a colon indicates that the observation is only approximate, due to bad weather conditions, *etc.*; a left bracket ([) indicates that the comet was not seen, with an estimated limiting magnitude given (if the comet IS seen, and it is simply estimated to be fainter than a certain magnitude, a "greater-than" sign (>) must be used, not a bracket). "RF" = reference for total magnitude estimates (see pages 98-100 of the October 1992 issue, and page 60 of the April 1993 issue, for all of the 1- and 2-letter codes). "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 — given to nearest whole integer (round even).

"COMA" = estimated coma diameter 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); a plus mark (+) precedes a coma diameter when a diaphragm was used electronically, thereby specifying the diaphragm size (i.e., the coma is almost always larger than such a specified diaphragm size). "DC" = degree of condensation on a scale where 9 = stellar and 0 = diffuse (preceded by lower- and upper-case letters S and D to indicate the presence of stellar and disklike central condensations; cf. July 1995 issue, p. 90); a slash (/) indicates a value midway between the given number and the next-higher integer. "TAIL" = estimated tail length in degrees, to 0.01 degree if appropriate; again, an ampersand indicates a rough estimate. Lower-case letters between the tail length and the p.a. indicate that the tail was measured in arcmin ("m") or arcsec ("s"), in which cases the decimal point is shifted one column to the right. "PA" = estimated measured position angle of the tail to nearest whole integer in degrees (north = 0°, east = 90°). "OBS" = the observer who made the observation (given as a 3-letter, 2-digit code).

A complete list of the Keys to abbrevations used in the *ICQ* is available from the Editor for $4.00 postpaid (available free of charge via e-mail). *Please note that data in archival form, and thus the data to be sent in machine-readable form, use a format that is different from that of the Tabulated data in the printed pages of the ICQ;* see pages 59-61 of the July 1992 issue (and p. 10 of the January 1995 issue) for further information [note correction on page 140 of the October 1993 issue]. Further guidelines concerning reporting of data may be found on pages 59-60 of the April 1993 issue.

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Comet C/1989 Q1 (Okazaki-Levy-Rudenko)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 10 03.79		S	8.1	AA	5.0	B		10	2	3			VAN06
1989 10 05.79		S	8.0	AA	5.0	B		10	2	3			VAN06
1989 10 18.77		S	6.7	AA	5.0	B		10	3	4			VAN06
1989 10 19.76		S	6.4	AA	5.0	B		10	3	5			VAN06
1989 10 23.76		B	6.8	AA	5.0	B		10	3	5			VAN06
1989 10 24.76		B	6.8	AA	5.0	B		10	4	5			VAN06
1989 10 26.76		S	6.7	AA	5.0	B		10	4	5			VAN06
1989 11 08.17		S	6.5	AA	5.0	B		10	4	5	0.7	20	VAN06
1989 11 29.21		B	6.1	AA	5.0	B		10	4	5			VAN06

Comet C/1989 X1 (Austin)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 04 24.09		B	5.8	AA	5.0	B		10	4	8	3	325	VAN06
1990 04 25.10		B	5.6	AA	5.0	B		10	4	8	1.5	328	VAN06
1990 04 27.08		B	5.2	AA	5.0	B		10	5	7	1.5		VAN06
1990 04 28.08		B	4.9	AA	5.0	B		10	6	6	1.2	318	VAN06
1990 05 02.09		B	4.8	AA	5.0	B		10	4	4			VAN06
1990 05 05.10		B	4.8	AA	5.0	B		10	9	2	0.25	10	VAN06
1990 05 07.10		B	4.8	AA	5.0	B		10	5	1			VAN06

Comet C/1990 E1 (Černis-Kiuchi-Nakamura)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 03 22.83		S	8.7	AA	8.0	B		15	4	3			PAN
1990 03 24.86		S	8.6	AA	8.0	B		15	4	3			PAN

Comet C/1990 K1 (Levy)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 07 27.92		S	6.8	AA	8.0	B		20	7	1			VAN06
1990 08 15.94			4.0	AA	0.0	E		1					VAN06

Comet C/1990 K1 (Levy) [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 08 15.94		M	5.0	AA	8.0	B		20	12	4	0.3	200	VAN06
1990 08 18.92			3.8	AA	0.0	E		1					VAN06
1990 08 18.92		M	4.3	AA	8.0	B		20	20	5	0.3		VAN06
1990 08 21.86		M	3.8	AA	8.0	B		20	10	5	0.3	50	VAN06

Comet C/1991 Y1 (Zanotta-Brewington)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1992 01 26.76		S	8.5	AA	20	L	5	31	1	2			VAN06
1992 01 27.76		S	8.5	AA	20	L	5	31	2	2			VAN06
1992 01 28.76		S	8.5	AA	20	L	5	31	2	2			VAN06
1992 02 01.76		S	8.5:	AA	25.4	T	10	45	3	2			VAN06

Comet C/1993 F1 (Mueller)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 07 04.21		k	20.5	EB	154.9	L	3		0.12		36	s 338	HER02

Comet C/1993 Y1 (McNaught-Russell)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1994 03 29.78		S	6.8	AA	8.0	B		15	6	3/			HAV
1994 03 31.78		S	6.6	AA	8.0	B		15	5.5	3/			HAV
1994 04 14.85		S	7.0	AA	8.0	B		15	6.5	4	0.25	45	HAV

Comet C/1994 G1 (Takamizawa-Levy)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1994 06 02.86		S	8.2	AA	8.0	B		15	7	2/			HAV
1994 06 07.92		S	8.8	AA	8.0	B		15	7	3/	0.4	117	HAV

Comet C/1994 J2 (Takamizawa)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1994 06 02.90		S	9.8	AA	8.0	B		15	2.5	3			HAV
1994 06 07.86		S	9.8	AA	8.0	B		15	5	2			HAV
1995 09 18.78		C	15.0	GA	28.0	T	6		0.4				KIN
1995 10 12.77		C	15.2	GA	28.0	T	6		0.7				KIN
1995 10 22.81	a	C	15.1	GA	60.0	Y	6		0.9				NAK01
1995 10 27.79	a	C	14.9	GA	60.0	Y	6		1.0				NAK01

Comet C/1994 N1 (Nakamura-Nishimura-Machholz)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1994 07 11.95		S	9.1	AA	8.0	B		15	6.5	1			HAV
1994 08 05.89		S	8.5	AA	8.0	B		15	6.5	3			HAV
1994 08 11.88		S	8.2	AA	8.0	B		15	6	3			HAV
1994 08 12.88		S	8.2	AA	8.0	B		15	6	3/			HAV

Comet C/1995 O1 (Hale-Bopp)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 07 23.27		M	10.5	AC	41	L	4	72		5			HAL
1995 07 23.58		P	11.8	HS	10.0	R	4		1.6	3/			TAK05
1995 07 24.18		M	11.0	AC	41	L	4	183					HAL
1995 07 24.28		M	10.6	AC	25.6	L	4	67	1.7	3/			MOR
1995 07 24.58		C	12.0	HS	25.4	T	6		+ 0.6				YOS
1995 07 24.59		S	10.6	GA	25.4	L	4	71	3	5			SEA
1995 07 25.23		M	10.8	AC	41	L	4	72	1.5	6			HAL
1995 07 25.53		C	11.6	HS	25.4	T	6		0.8				YOS
1995 07 25.89		S	10.8	HS	15.0	L	5	42	1.0	3			BEC01
1995 07 26.17		S	10.8	HS	33.3	L	4	88	1.3	2			KRO02
1995 07 26.22		M	10.8	AC	41	L	4	183	1				HAL
1995 07 26.56	a	C	10.4	GA	60.0	Y	6		3.3				NAK01
1995 07 27.15		S	10.6	HS	33.3	L	4	58	2.4	2			KRO02

Comet C/1995 O1 (Hale-Bopp) [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 07 27.19		M	10.7	AC	41	L	4	72					HAL
1995 07 27.50		S	10.4	GA	25.4	L	4	71	4	4			SEA
1995 07 27.58	a	C	10.3	GA	60.0	Y	6		3.6				NAK01
1995 07 28.15		M	10.7	AC	41	L	4	72					HAL
1995 07 28.15		S	10.5	HS	33.3	L	4	88	2.3	2			KRO02
1995 07 28.43		S	10.5	AC	10.0	B		25					SEA
1995 07 28.60		C	10.5	HS	28.0	T	6		5.4				KIN
1995 07 29.11		B	10.8	AC	10.0	B	4	20	< 1	0			NOW
1995 07 29.15		S	10.5	HS	33.3	L	4	58	2.3	2			KRO02
1995 07 29.24		M	11.1:	AC	41	L	4	183					HAL
1995 07 29.31		M	10.5	AC	25.6	L	4	45	2.6	3			MOR
1995 07 29.50		M	10.7	HS	16.0	W	4	49	2.0	5			TSU02
1995 07 29.50		S	10.5	GA	25.4	L	4	71		6			SEA
1995 07 29.55		C	12.3:	HS	20.0	L	4		0.7				OOY
1995 07 29.62		C	11.5	HS	25.4	T	6		0.9				YOS
1995 07 29.93		M	10.5	TI	35	L	5	106	1.7	4			PLS
1995 07 29.94		M	10.2:	TI	35	L	5	106	1.5	3/			HOR02
1995 07 29.94		S	10.9	TI	35	L	5	106	1.2	3			KYS
1995 07 30.09	a	S	10.3	AC	38.0	L	5	65	2.1	2			BOR
1995 07 30.13	a	M	11.4	GA	20.0	L	5	68	0.6	3/			MOD
1995 07 30.28		M	10.5	AC	25.6	L	4	45	2.6	3			MOR
1995 07 30.29		M	10.9	AC	41	L	4	72		s3/			HAL
1995 07 30.92		S	10.5	TI	35	L	5	106	1.0	2/			KYS
1995 07 30.93		M	10.3	TI	35	L	5	106	1.5	3			HOR02
1995 07 30.93		S	10.7	HS	20.3	T	10	93	0.9	3			HAS02
1995 07 31.09	a	S	10.4	AC	40.6	L	5	70	1.9	3			BOR
1995 07 31.53	a	C	10.2	GA	60.0	Y	6		3.7				NAK01
1995 08 01.11	a	S	10.3	AC	40.6	L	5	90	1.7	3			BOR
1995 08 01.25		c	16.9	FA	91.4	L	5		1.91		51	s 357	SCO01
1995 08 02.18		M	10.8	AC	41	L	4	72		5			HAL
1995 08 02.92		B	10.5	HS	20.3	T	10	67	2	5			BIV
1995 08 03.59	a	C	10.3	GA	60.0	Y	6		3.4				NAK01
1995 08 03.94		B	11.0	HS	28.0	T	11	93	1.5	6			BIV
1995 08 04.29		M	10.7	AC	41	L	4	72		s5			HAL
1995 08 05.35		M	9.7	AC	25.6	L	4	67	4.6	s2/			MOR
1995 08 13.15		S	11.7	HS	28	T	10	156	0.2				DIL
1995 08 13.90		S	10.4	AA	8.0	B		11	1.5	8			DES01
1995 08 14.06	a	S	10.1	AC	40.6	L	5	70	2.2	3/			BOR
1995 08 14.95		S	10.3	AA	8.0	B		11	2	7/			DES01
1995 08 15.09		S	10.2	AA	8.0	B		20	3	9			LOU
1995 08 15.15			10.5:		41	L	4	72					HAL
1995 08 15.51		M	10.9:	HS	20.3	T	6	71	2	3			YUS
1995 08 15.85		S	10.8	MS	25.4	T	6	128	1.2				TAN02
1995 08 15.94		S	10.3	AA	8.0	B		11	2	7			DES01
1995 08 16.00		S	10.2	AA	8.0	B		20	3	8/			LOU
1995 08 16.50	a	C	10.4	GA	60.0	Y	6		3.0				NAK01
1995 08 16.95		S	10.3	AA	8.0	B		11	2	7/			DES01
1995 08 16.96		S	10.5	AC	31	L	8	120	3.0	1			DEA
1995 08 17.51		M	10.2	AC	25.4	L	4	71		s6			SEA
1995 08 17.99		S	10.3	AA	8.0	B		11	1.7	7			DES01
1995 08 18.18		J	10.4	SC	25.4	T	4		0.36	s3/			ROQ
1995 08 18.24		S	10.1	AC	25.6	L	4	67	2.9	2/			MOR
1995 08 18.51	a	C	10.2	GA	60.0	Y	6		3.0				NAK01
1995 08 18.88		S	11.0:	GA	25.4	J	6	88	2.1	5			BOU
1995 08 18.97		S	10.2	AA	8.0	B		11	2	7			DES01
1995 08 19.02		S	10.3	AA	8.0	B		20	2	9			LOU
1995 08 19.18		J	11.5	SC	25.4	T	4		0.27	s2			ROQ
1995 08 19.23		M	10.5	AC	25.6	L	4	67	2.0	S5			MOR
1995 08 19.24		M	10.8	AC	41	L	4	72					HAL
1995 08 19.53		C	10.7	HS	28.0	T	6		3.4				KIN
1995 08 19.76	&	B	10.4	HS	25	L	4	56	2.5	2			KRY01
1995 08 19.84		S	10.8	GA	25.4	J	6	88	2.3	2			BOU
1995 08 19.98		S	10.3	AA	8.0	B		11	2	7			DES01
1995 08 20.07	a	S	10.1	AC	40.6	L	5	70	2.5	5			BOR
1995 08 20.09	a	S	10.4	L	25.4	L	4	44	& 3.1	5			GRE
1995 08 20.11	a	S	10.4	L	25.4	L	4	64	& 3.1	5			GRE

Comet C/1995 O1 (Hale-Bopp) [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 08 20.15		B	10.0	AC	10.0	B	4	20	0.5	0			NOW
1995 08 20.19		M	10.2	AC	25.6	L	4	67	2.0	S7			MOR
1995 08 20.57		M	10.1	HS	12.5	L	6	60					TSU02
1995 08 20.83		S	10.6	GA	25.4	J	6	72	2.2	3			BOU
1995 08 20.97		S	10.3	AA	8.0	B		11	2	7			DES01
1995 08 21.07	a	S	10.1	L	25.4	L	4	64	& 3.2	5			GRE
1995 08 21.08		S	10.4	AA	8.0	B		20	2	9			LOU
1995 08 21.08	a	S	10.3	AC	40.6	L	5	90	2.0	8			BOR
1995 08 21.09		S	10.3	AA	8.0	B		11	2	7			DES01
1995 08 21.23		M	10.9:	AC	41	L	4	72		S4/			HAL
1995 08 21.84		S	11.0	GA	20.0	L	4	47	& 1	8			MIK
1995 08 21.87		B	10.5	HS	20.3	L	6	79	1.2	7			BIV
1995 08 22.10		S	10.4	AA	8.0	B		20	2	9			LOU
1995 08 22.11		S	10.3	AA	8.0	B		11	2	7/			DES01
1995 08 22.12	a	M	11.1	GA	20.0	L	5	68	0.5	6			MOD
1995 08 22.83		S	10.3	GA	25.4	J	6	58	2.8	3			BOU
1995 08 22.85		S	11.2	GA	20.0	L	4	47	& 1.5	S7			MIK
1995 08 23.10		S	10.3	AA	8.0	B		11	1.5	7			DES01
1995 08 23.10		S	10.3	AA	8.0	B		20	2.5	9			LOU
1995 08 23.13	s	M	10.8	GA	20.0	L	5	68	0.8	6			MOD
1995 08 23.20		M	10.7	AC	41	L	4	72	2	s4			HAL
1995 08 23.52		M	9.9	AC	25.4	L	4	71		S8			SEA
1995 08 23.75	&	B	10.3	HS	35	L	5	50	2.0	s2			KRY01
1995 08 23.85		S	10.4	GA	25.4	J	6	58	2.4	4			BOU
1995 08 24.82	&	S	9.9	GA	35	L	5	50	3.5	s2/			BAR06
1995 08 24.84		M	10.2	GA	25.4	J	6	58	2.8	5			BOU
1995 08 24.91		S	10.3	AA	8.0	B		11	2	7/			DES01
1995 08 25.09	a	S	10.1	AC	40.6	L	5	70	2.0	8			BOR
1995 08 25.20		M	10.1	AC	25.6	L	4	67	1.8	S8			MOR
1995 08 25.44		M	9.9	AC	25.4	L	4	71		S7			SEA
1995 08 25.53		C	10.2	HS	28.0	T	6		4.0				KIN
1995 08 25.75	&	B	10.5	GA	25	L	4	33	3.5	s3			KRY01
1995 08 25.84		M	10.1	GA	25.4	J	6	58	2.8	4			BOU
1995 08 25.92		S	10.2	AA	35.5	T	6	111	3.5	5	0.05	310	DES01
1995 08 25.97		S	10.2	AA	35.5	T	6	111	2.5	6/	0.05	295	LOU
1995 08 26.05	a	S	9.9	AC	40.6	L	5	70	1.6	7/			BOR
1995 08 26.10		S	10.0	GA	25.4	L	4	44	& 2.6	5/			GRE
1995 08 26.11		B	10.7	GA	25.4	L	4	64	& 2.2	6			GRE
1995 08 26.19		M	9.8	AC	25.6	L	4	67	1.8	S7			MOR
1995 08 26.23		M	10.7	AC	41	L	4	72					HAL
1995 08 26.51		M	10 :	AC	25.4	L	4	71		S7			SEA
1995 08 26.77	&	B	9.8	HS	25	L	4	33	2.5	5			KRY01
1995 08 26.78	&	S	10.5	GA	35	L	5	70	3.3	S6/			BAR06
1995 08 26.83		M	10.1	GA	25.4	J	6	58	2.2	6			BOU
1995 08 26.83		S	10.0	MS	25.4	T	6	89	0.8	2			TAN02
1995 08 26.85		S	10.2	GA	12.5	B		25		5			BOU
1995 08 26.90		S	10.5:	VB	20	T	10						TAY
1995 08 26.90	c	C	10.9	LB	20.3	T	10		1.3		3 m	339	GAR02
1995 08 26.95		S	10.2	AA	8.0	B		11	2	7			DES01
1995 08 27.13		S	11.2	HS	46	L	4	130	0.9				DIL
1995 08 27.20		M	10.5	AC	25.6	L	4	67	1.0	S7			MOR
1995 08 27.47		C	10.3	HS	28.0	T	6		3.7				KIN
1995 08 27.79	&	S	10.5	GA	35	L	5	70	2.5	S7			BAR06
1995 08 27.81		S	10.8	MS	25.4	T	6	128	0.7	2			TAN02
1995 08 27.86		M	10.3	GA	25.4	J	6	58	2.0	6			BOU
1995 08 27.93		S	10.2	AA	8.0	B		11	2	7			DES01
1995 08 28.10		B	10.0	AC	15	L	8	30	2	3			NOW
1995 08 28.55		M	10.0	AC	25.4	L	4	71		s5			SEA
1995 08 28.77	&	S	10.3	GA	35	L	5	70	3	5/			BAR06
1995 08 28.84		M	10.2	GA	25.4	J	6	72	2.2	5			BOU
1995 08 28.85		S	10.4	MS	25.4	T	6	89	1.0	2			TAN02
1995 08 28.95		S	10.2	AA	8.0	B		11	2	6/			DES01
1995 08 29.05	a	S	10.0	AC	40.6	L	5	90	1.4	6/			BOR
1995 08 29.22		M	10.7	AC	41	L	4	72					HAL
1995 08 29.77	&	M	10.3	GA	35	L	5	70	3	5			BAR06
1995 08 29.84		M	10.1	GA	25.4	J	6	58	2.2	6			BOU

Comet C/1995 O1 (Hale-Bopp) [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 08 29.98		S	10.2	AA	8.0	B		11	2	6/			DES01
1995 08 30.44		M	10.0	AC	25.4	L	4	71		s6			SEA
1995 08 30.75	&	M	10.5	GA	35	L	5	70	3	4/			BAR06
1995 08 30.84		M	10.2	GA	25.4	J	6	72	2.1	5/			BOU
1995 08 30.97		S	10.2	AA	8.0	B		11	2	7			DES01
1995 08 31.06	a	S	9.9	AC	40.6	L	5	70	1.9	6/			BOR
1995 08 31.08		S	9.7	GA	25.4	L	4	44	& 3	5/			GRE
1995 08 31.19		M	9.8	AC	25.6	L	4	67	2.0	s4			MOR
1995 08 31.44		M	9.9	AC	25.4	L	4	71	& 1	s6			SEA
1995 08 31.85		S	10.1	GA	25.4	J	6	72	2.2	4/			BOU
1995 08 31.98		S	10.2	AA	8.0	B		11	2	7			DES01
1995 09 01.17		S	10.3	AA	20.0	T	10	185	3	3			SPR
1995 09 01.22		M	10.7	AC	41	L	4	72					HAL
1995 09 01.46	a	C	10.1	GA	60.0	Y	6		3.0				NAK01
1995 09 01.54		C	10.4	HS	20.3	T	6		2.1				YUS
1995 09 01.78	&	M	10.2	GA	35	L	5	70	3.7	4			BAR06
1995 09 01.86		S	10.8	MS	25.4	T	6	128	1.4	2			TAN02
1995 09 01.98		S	10.1	AA	8.0	B		11	2	7			DES01
1995 09 02.14		S	10.6	HS	33.3	L	4	58	2	2			KR002
1995 09 02.17		S	10.2	AA	20.0	T	10	185	2.5	2/			SPR
1995 09 02.97		S	10.1	AA	8.0	B		11	2.5	6/			DES01
1995 09 03.16		S	10.4	AA	20.0	T	10	81	3	2			SPR
1995 09 10.78	&	S	10.2:	GA	35	L	5	50	3	3			BAR06
1995 09 11.79	&	S	10.2:	GA	35	L	5	50	3	3			BAR06
1995 09 12.02	a	S	9.8	AC	40.6	L	5	90	1.8	4			BOR
1995 09 12.12		M	10.6	AC	41	L	4	72					HAL
1995 09 12.43		M	10.5	AA	25.4	L	4	71	3	4			SEA
1995 09 13.44		M	10.3	A	25.4	L	4	71	& 3	4			SEA
1995 09 13.48		M	10.4	AA	10.0	B		25	& 4				SEA
1995 09 14.78		S	10.8	MS	25.4	T	6	89	1.7	1			TAN02
1995 09 14.99		S	10.6	AC	31	L	8	120	4.0	1			DEA
1995 09 15.72	&	S	10.3	GA	35	L	5	70	2	4			BAR06
1995 09 16.19		M	10.2	AC	25.6	L	4	67	1.7	3/			MOR
1995 09 16.76	&	B	10.1	GA	35	L	5	70	3	3/			BAR06
1995 09 16.80		S	10.0:	TI	20	L	4	57	1.5	3			KYS
1995 09 17.16		M	10.1	AC	25.6	L	4	67	1.7	S5			MOR
1995 09 17.20		S	10.6:	AC	41	L	4	72					HAL
1995 09 17.74	&	S	10.4	GA	35	L	5	70	2	3/			BAR06
1995 09 18.03	a	S	10.0	AC	40.6	L	5	90	1.7	3			BOR
1995 09 18.08		S	10.8	HS	33.3	L	4	58	1.5	2			KR002
1995 09 18.44		C	10.2	HS	20.3	T	6		2.1				YUS
1995 09 18.44	a	C	10.3	GA	60.0	Y	6		2.3				NAK01
1995 09 19.02	a	S	10.0	AC	40.6	L	5	90	2.0	3			BOR
1995 09 19.09	a	M	11.1	GA	20.0	L	5	68	0.8	2			MOD
1995 09 21.14		M	10.7:	AC	41	L	4	183					HAL
1995 09 21.17		S	11.2	AC	25.6	L	4	111	1.8	2			MOR
1995 09 21.74	&	B	10.2	GA	35	L	5	70	3	2		65	BAR06
1995 09 22.79		B	11.0	S	25.0	T	6	100	1.0	3			ROD01
1995 09 22.79		S	10.0	TI	35	L	5	92	1.0	4			KYS
1995 09 22.80		S	10.3	TI	35	L	5	104	1.0	3/			HOR02
1995 09 23.15		S	11.3	AC	25.6	L	4	67	2.1	2			MOR
1995 09 23.77	!	S	9.8	AA	8.0	B		15	2.5	3			HAV
1995 09 24.06		S	10.1	HS	33.3	L	4	58	1.5	1			KR002
1995 09 24.08	a	M	11.1	GA	20.0	L	5	68	1.0	2			MOD
1995 09 24.08	a	S	11.0	GA	20.0	L	5	68					MOD
1995 09 24.17		M	10.6	AC	41	L	4	72					HAL
1995 09 24.19		M	10.8	AC	25.6	L	4	67	2.1	3/			MOR
1995 09 25.63		B	10.5	GA	48	L	5	65	2.3	4			CHE03
1995 09 25.64		S	10.3:	GA	12	R	5	27	1.7	3			CHE03
1995 09 26.16		M	10.7	AC	41	L	4	72					HAL
1995 09 26.62		B	10.6	GA	48	L	5	65	2.1	4			CHE03
1995 09 27.89		B	10.8	HS	20.3	T	10	133	1	5			BIV
1995 09 28.01		S	10.4	AC	40.6	L	5	90					BOR
1995 09 28.01	a	S	10.3	AC	40.6	L	5	90	1.1	6			BOR
1995 09 28.06		S	10.3	HS	33.3	L	4	58	3.5	5			KR002
1995 09 28.46		C	10.0:	HS	20.3	T	6		2.3				YUS

Comet C/1995 O1 (Hale-Bopp) [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 09 28.63		S	10.3:	GA	12	R	5	27	& 2	3			CHE03
1995 09 28.64		B	10.7	GA	48	L	5	65	2.7	4			CHE03
1995 09 28.86		B	10.6	HS	20.3	T	10	133	1.5	5			BIV
1995 09 29.01		S	10.5	AC	40.6	L	5	90					BOR
1995 09 29.01	a	S	10.4	AC	40.6	L	5	90	1.3	6			BOR
1995 09 29.17		M	10.9	AC	41	L	4	183					HAL
1995 09 30.01		S	10.5	AC	40.6	L	5	90					BOR
1995 09 30.01	a	S	10.3	AC	40.6	L	5	90	1.3	6			BOR
1995 09 30.17		M	10.1	AC	25.6	L	4	45	2.8	s3			MOR
1995 09 30.17		M	10.1	AC	25.6	L	4	67	2.1	S5			MOR
1995 10 06.44		C	10.5:	HS	20.3	T	6		1.2				YUS
1995 10 11.75		M	10.2	TI	30	L	15	40	2.5				POP
1995 10 13.00	&	S	9.8	GA	25.4	L	4	44	& 3	7/			GRE
1995 10 13.42		C	10.4:	GA	60.0	Y	6		2.2				NAK01
1995 10 13.44		C	9.8:	HS	20.3	T	6		1.9				YUS
1995 10 13.71		S	10.6	GA	44.5	L	5	200	4	6			SAN04
1995 10 16.73		S	10.7	GA	44.5	L	5	100	5	5			SAN04
1995 10 17.42		C	10.1	GA	60.0	Y	6		2.3				NAK01

Comet C/1995 Q1 (Bradfield)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 08 18.36		M	5.5	AA	10.0	B		25		7	0.33	125	SEA
1995 08 18.91		S	5.7	AA	8.0	B		11	10	5			DES01
1995 08 19.35		M	5.4	AA	10.0	B		25		8		130	SEA
1995 08 19.91		S	5.2	AA	8.0	B		11	8	4/			DES01
1995 08 20.37		S	5.9	AA	5.0	B		10		7			WIL02
1995 08 20.92		S	5.5	AA	8.0	B		11	8	4/			DES01
1995 08 21.90		B	5.6	AA	7.0	B		10	1.5	8			DEA
1995 08 22.36		M	5.3	AA	10.0	B		25			&0.5	145	SEA
1995 08 24.95		B	6.0	AA	7.0	B		10	1.5	8			DEA
1995 09 23.19		S	6.7	S	10	B		14	3.1	5			SHA02
1995 09 23.52	a	M	7.6	S	8.0	B		20					MOR
1995 09 23.52	a	M	7.6	S	25.6	L	4	45		6			MOR
1995 09 24.15		S	7.4	S	10.0	B		25		6			HAS02
1995 09 24.52	a	M	7.6:	S	8.0	B		20		5			MOR
1995 09 25.15		S	7.5	HI	20.3	T	10	80	2.1	5			GRA04
1995 09 25.18		S	7.2	AA	10	B		14	2.1	7			SHA02
1995 09 25.99		B	8.2	S	12	R	5	27	3.2	4			CHE03
1995 09 26.14		M	7.6	HI	20.3	T	10	80	2.2	5			GRA04
1995 09 26.16		S	7.7:	AA	15.0	B		25	4	3/			ZAN
1995 09 26.45		S	7.7	SC	33.3	L	4	58	2	3			KRO02
1995 09 26.50	!	S	8.1:	NP	20	L	6	49					HAL
1995 09 27.00		B	8.0	S	12	R	5	27	3.5	4			CHE03
1995 09 27.15		M	7.8	HI	20.3	T	10	80	2.0	4/			GRA04
1995 09 27.15	!	S	7.5	AA	8.0	B		15	3.5	5	?0.3	320	HAV
1995 09 27.16		S	7.5	AA	15.0	B		25	4	3/			ZAN
1995 09 27.16	&	S	6.5:	AA	8.0	B		20	6	4			MIL02
1995 09 27.20		B	7.8	S	5.0	B		7					BIV
1995 09 27.22		B	8.4	S	20.3	T	10	67	4	6	&0.10	159	BIV
1995 09 27.44		S	7.8	SC	8.0	B		20	3	2			KRO02
1995 09 27.51		M	7.4	HI	8.0	B		20	4.6	6			MOR
1995 09 28.14		S	7.4	AC	35	L	5	97	5	7			VAN04
1995 09 28.18		S	7.7	AA	10	B		14	2.1	6			SHA02
1995 09 28.20		B	7.6	S	5.0	B		7					BIV
1995 09 28.21		B	8.0	S	20.3	T	10	67	3	7	&0.07	160	BIV
1995 09 28.40	a	S	8.0	HR	8.0	B		20	2.9	6			BOR
1995 09 28.44		S	7.8	SC	8.0	B		20	4	2			KRO02
1995 09 28.49	!	S	8.0:	NP	5.0	B		10					HAL
1995 09 29.01		B	7.8	S	12	R	5	27		4			CHE03
1995 09 29.15		M	7.7	TI	11	L	8	32	2.6	5			KYS
1995 09 29.16		S	7.7	AA	15.0	B		25	5	4			ZAN
1995 09 29.18		S	8.3	AA	10	B		14	2.1	6			SHA02
1995 09 29.20		B	7.8	S	5.0	B		7					BIV
1995 09 29.21		B	8.6	S	20.3	T	10	67	3	6	&0.17	156	BIV
1995 09 29.39		S	7.1	AA	8.0	R	3	20	& 7	5/			GRE

Comet C/1995 Q1 (Bradfield) [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 09 29.40	a	B	8.1	HR	8.0	B		20					BOR
1995 09 29.40	a	S	8.0	HR	8.0	B		20	2.9	5			BOR
1995 09 29.99		B	7.8	S	8	R	4	11		4			CHE03
1995 09 30.13		M	7.7	TI	8.0	B		10	4	5			HOR02
1995 09 30.13		S	7.7	AA	5.0	B		10	3.0	3			MOE
1995 09 30.16		S	7.8	AA	15.0	B		25	5	4			ZAN
1995 09 30.40	a	S	8.0	HR	8.0	B		20	3.6	6			BOR
1995 09 30.52	a	M	7.7	AA	8.0	B		20	5	6			MOR
1995 10 01.14		M	8.1	HI	20.3	T	10	50	2.5	5			GRA04
1995 10 01.50		M	8.2	AC	41	L	4	72					HAL
1995 10 01.52		M	7.9	S	8.0	B		20	5	6	0.75	320	MOR
1995 10 01.99		B	8.1	AA	12	R	5	27		4			CHE03
1995 10 02.16		M	7.7	AA	15.6	L	5	29	3.4	5/			BOU
1995 10 02.16		S	7.8	AA	8.0	B		15		4/			BOU
1995 10 02.43		S	7.8	SC	8.0	B		20	4	2			KRO02
1995 10 02.52		M	8.0	S	8.0	B		20		5			MOR
1995 10 02.83		S	7.9	AA	41.0	L	5	80	4	3	0.1	150	KOB01
1995 10 02.99		B	8.1	AA	12	R	5	27		4			CHE03
1995 10 03.14		S	8.4	AA	10.0	B		25	1.5	4			HAS02
1995 10 03.16		M	7.8	AA	8.0	B		15	3.5	5			BOU
1995 10 03.49	!	S	8.3	NP	5.0	B		10					HAL
1995 10 03.52		M	8.1	S	8.0	B		20		5			MOR
1995 10 03.98		B	8.3	AA	12	R	5	27	4.2	4			CHE03
1995 10 04.13		M	7.4	TI	30	L	15	40	2.5				POP
1995 10 04.52		S	8.1:	S	8.0	B		20					MOR
1995 10 04.99		B	8.4	S	12	R	5	27		4			CHE03
1995 10 05.12		S	8.5:	S	15.0	L	8	32	3	3			THO03
1995 10 05.14		M	8.3	TI	20	L	5	48	3	6			PLS
1995 10 05.18		S	8.1	AA	5.0	B		7	4.7	5			SHA02
1995 10 05.18		S	8.3	AA	10	B		14	2.5	5			SHA02
1995 10 05.52		M	8.0	S	8.0	B		20	7	4			MOR
1995 10 06.01		B	8.1	S	8	R	4	11		4			CHE03
1995 10 06.16		M	8.5	BD	20.3	T	10	50	3.3	4			GRA04
1995 10 06.16		S	8.1	AA	8.0	B		15	4.5	4			BOU
1995 10 06.17		S	7.7	AA	15.0	R	8	75	4	3			DIE02
1995 10 06.79		S	7.3	AA	8.0	B		20	5.0	4			YUS
1995 10 06.80		M	7.4	AA	13.0	L	8	50	4	4			AIZ
1995 10 06.81		S	7.5	S	15.0	R	5	25	4	6			NAG02
1995 10 07.00		B	8.5	S	12	R	5	27		4			CHE03
1995 10 07.99		S	8.6	S	12	R	5	27		4			CHE03
1995 10 08.00		B	8.9	S	48	L	5	65	4.5	5			CHE03
1995 10 09.81		S	8.4	SC	41.0	L	5	80	5	3	0.1	155	KOB01
1995 10 10.02		S	9.0	S	12	R	5	27		3/			CHE03
1995 10 10.15		M	9.9:	TI	20	L	5	125	1.4	4			PLS
1995 10 10.15		S	9.9:	TI	20	L	5	48	4	3			HOR02
1995 10 10.80		C	8.5:	HS	20.3	T	6		4.5				YUS
1995 10 10.81		S	8.4	SC	41.0	L	5	80	5	3	0.1	155	KOB01
1995 10 11.02		S	9.1	S	12	R	5	27		3/			CHE03
1995 10 11.16		M	9.0	MC	20.3	T	10	80	2.8	3/			GRA04
1995 10 12.81		C	10.5	HS	20.0	L	4		4.5				OOY
1995 10 12.82		C	8.8	GA	28.0	T	6		6.2		>0.18	308	KIN
1995 10 12.82		C	9.2	GA	8.0	R	6		8.6		19 m	154	NAK01
1995 10 12.82		S	8.4	S	15.0	R	5	25	5	4/			NAG02
1995 10 13.80		C	9.3:	HS	20.3	T	6		4.5				YUS
1995 10 13.83		S	8.5	SC	41.0	L	5	80	6	3	0.1	155	KOB01
1995 10 14.16	!	V	9.2	YF	19.0	T	4		& 7	7	&11 m	150	MIK
1995 10 17.81		S	9.0	S	15.0	R	5	25	5	5			NAG02
1995 10 18.18		M	8.3	AC	20.3	T	10	50	5.2	3/			GRA04
1995 10 18.82		C	10.5	HS	20.0	L	4		2.7		12 m	180	OOY
1995 10 19.10		S	8.3	AC	20.3	T	10	50	5.5	3/			GRA04
1995 10 19.24		S	9.3:	AA	15.2	L	4	26	& 2.5	1/			PER01
1995 10 19.83		C	9.3	GA	8.0	R	6		10.2		20 m	157	NAK01
1995 10 20.05		S	8.4	HI	20.3	T	10	80	5.1	3			GRA04
1995 10 20.78		S	8.9	S	15.0	R	5	25	5	4			NAG02
1995 10 21.09		S	8.7	MC	20.3	T	10	80	5.2	2			GRA04
1995 10 21.14		S	9.4	AA	10	B		14	3.8	5			SHA02

Comet C/1995 Q1 (Bradfield) [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 21.17		S	8.7	MC	5.0	B		10	5				GRA04
1995 10 21.83		C	11.1	HS	20.0	L	4		2.3		12 m	165	OOY
1995 10 22.06		S	9.8	HS	44.5	L	5	72	4	4			KER
1995 10 22.06		S	9.9	HS	44.5	L	5	72	4	4/			SAR02
1995 10 22.06		S	9.9	HS	44.5	L	5	72	5	6			BAK01
1995 10 22.07		S	9.7	HS	6.0	B		20	7	3/			SAR02
1995 10 22.14		S	7.8	AA	15.0	R	8	75	4	2			DIE02
1995 10 23.08		S	9.8	HS	6.0	B		20	8	2			SAR02
1995 10 23.09		S	10.1	HS	44.5	L	5	72	4	4/	0.3	155	SAR02
1995 10 23.20		S	8.7	AA	10	B		14	6.5	4			SHA02
1995 10 24.10		S	10.0	HS	44.5	L	5	72	4	3/	0.7	145	SAR02
1995 10 24.12		S	9.5	HS	6.0	B		20	9	3			SAR02
1995 10 24.15	!	V	9.5	YF	19.0	T	4		& 9	6	&12 m	155	MIK
1995 10 24.17		S	8.8	AA	10	B		14	7.4	3			SHA02
1995 10 25.09		S	10.0	AA	20	L		75	3	0			KIS02
1995 10 26.07		S	9.2:	AC	20.3	T	10	50	3.5				GRA04
1995 10 27.15	!	V	9.5	YF	20.0	T	2		&10	7	&15 m	160	MIK
1995 10 28.16		S	8.9	AC	20.3	T	10	50	5.1	2			GRA04
1995 10 28.83		C	12.1	HS	20.0	L	4		2.1		12 m	163	OOY
1995 10 29.50		S	9.2	AA	20.0	T	10	64	6.5	2/			SPR

Comet C/1995 Q2 (Hartley-Drinkwater)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 08 31.25		S	12.6	AC	25.6	L	4	111	2.7	1			MOR
1995 09 01.55		C	14.9	HS	20.3	T	6		0.8				YUS
1995 09 01.66		C	16.2	HS	20.0	H	8		0.25				UTO
1995 09 01.67		C	15.8	HS	20.0	H	8		0.25				UTO
1995 09 02.01	c	C	15.0	LB	20.3	T	10		0.6		1.0m	316	GAR02
1995 09 02.01	c	c	16.1	LB	20.3	T	10						GAR02
1995 09 02.37	!	S	13.7	AC	41	L	4	183	0.7	3/			HAL
1995 09 03.37	a	S	12.9	NP	25.6	L	4	111	2.1	0/			MOR
1995 09 03.37	a	S	13.0	NP	25.6	L	4	111	2.1	0/			MOR
1995 09 18.45	a	C	16.9	GA	60.0	Y	6		0.5			70	NAK01
1995 09 18.58		C	16.1	GA	28.0	T	6		0.4				KIN
1995 09 26.84	l	C	[17.0	LB	20.3	T	10						GAR02

Comet 6P/d'Arrest

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1976 08 17.75		B	6.5:	BD	5.0	B		7	&10.5	s3			CHE03
1976 08 18.72		B	5.9	BD	5.0	B		7	12	s4			CHE03
1976 08 19.80		B	6.7:	BD	5.0	B		7	15	s4	0.2	80	CHE03
1976 08 20.83		B	6.1	BD	5.0	B		7	16	s4			CHE03
1976 08 21.79		B	6.6:	BD	5.0	B		7	17	s4	0.3	80	CHE03
1976 08 22.79		B	6.7:	BD	5.0	B		7	16	s4	0.3	80	CHE03
1976 08 23.80		B	6.8:	BD	5.0	B		7	15	s3	0.3	80	CHE03
1982 10 09.55		B	10.5:	NP	11.0	B		20	2.0	3			CHE03
1982 10 18.62		B	10.2:	NP	11.0	B		20	3	3			CHE03
1982 10 21.62		B	10.1	NP	11.0	B		20	3	3			CHE03
1982 11 11.68		B	10.3	NP	11.0	B		20	3	3			CHE03
1982 11 12.65		B	9.8	NP	11.0	B		20	5	4			CHE03
1982 11 16.6		B	10.2	NP	11.0	B		20	5	3			CHE03
1995 05 03.96		O	[13.5	HS	20	R	17	140	! 0.5				LEH
1995 05 10.46		I	[13.0:		41	L	4	183					HAL
1995 05 24.96		O	[14.3	HS	20	R	17	280	! 0.5				LEH
1995 05 25.94		O	[14.0	HS	20	R	17	280	! 0.5				LEH
1995 05 28.39		I	[13.5:		41	L	4	183					HAL
1995 05 28.96		O	[14.1	HS	20	R	17	280	! 0.5				LEH
1995 06 03.42		I	[13.5:		41	L	4	183					HAL
1995 06 21.38		I	[12.5:		41	L	4	183					HAL
1995 06 23.98		S	[14.0	GA	35	L	5	98	! 0.5				BAR06
1995 06 24.42		S	13.1	AC	41	L	4	183	1.5	1/			HAL
1995 06 24.97		S	[14.2	GA	35	L	5	98	! 0.5				BAR06
1995 06 28.29		S	[12.5	AC	40.6	L	5	70					BOR
1995 06 29.00		B	14.2	HS	35	L	5	207	0.9	2			HOR02

Comet 6P/d'Arrest [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 06 29.65	a	C	13.7:	GA	60.0	Y	6		1.7			230	NAK01
1995 06 30.94		S	10.0:	S	10	M	10	20	& 2	3			PAR03
1995 06 30.95		S	13.0	HS	20.3	T	10	156	0.4	3			HAS02
1995 07 01.08		M	13.7	HS	30	L	5	200	1				POP
1995 07 01.99		S	12.2	AC	25.4	J	6	88	1.8	0/			BOU
1995 07 02.02		O	[13.0	HS	20	R	17	87	! 0.5				LEH
1995 07 03.32		S	12.9	GA	35.9	L	7	85	0.9	1			MOD
1995 07 03.40		S	12.2	AC	41	L	4	72					HAL
1995 07 04.25		S	12.0	NP	25.6	L	4	111	2.0	1/			MOR
1995 07 05.92		S	12.2	HS	25	L	4	58	4	2			KRY01
1995 07 07.97		S	11.4	HS	25	L	4	58	4	2/			KRY01
1995 07 07.99		S	12.5:	AC	50.0	L	5	100	1.5	1			MOE
1995 07 08.00		S	11.2	AC	25.4	J	6	72	2.2	0/			BOU
1995 07 08.02		C	13.3	HS	65	L	4		+ 2.0		2.3m	230	PRA01
1995 07 08.02		M	13.8	HS	35	L	5	207	0.6	2/			HOR02
1995 07 08.02		S	12.1	AC	30.5	L	5	117	2.5	3			VIC
1995 07 08.02		c	15.7	HS	65	L	4		6		2.3m	230	PRA01
1995 07 08.03		M	13.7	HS	35	L	5	207	1.3	2			PLS
1995 07 08.44		M	11.5	AC	41	L	4	72	3	3			HAL
1995 07 08.95		B	12.4	HS	35	L	5	50	5	1/			KRY01
1995 07 09.00		M	13.7	HS	20	R	17	140	2.5	1/			LEH
1995 07 09.04		C	13.3	HS	65	L	4		+ 2.0		2.5m	235	PRA01
1995 07 09.04		c	15.6	HS	65	L	4		5.2		2.5m	235	PRA01
1995 07 09.10		B	12.9	HS	28.0	T	10	93	2	3			BIV
1995 07 09.30		S	10.7	AC	40.6	L	5	70	4.2	2			BOR
1995 07 09.46		M	11.4	NP	25.6	L	4	111	3.0	3			MOR
1995 07 09.78		C	12.1	GA	60.0	Y	6		3.6				NAK01
1995 07 10.03		M	13.5	HS	35	L	5	207	0.8	2			HOR02
1995 07 19.92		S	11.1	GA	20.0	L	4	47	& 4	1			MIK
1995 07 19.92		S	11.5	GA	44.0	L	5	100	1.2	3			HAS02
1995 07 19.98	!	V	12.8	L	65	L	4		+ 2.0		2 m	235	PRA01
1995 07 19.98	!	v	15.2	L	65	L	4		6		2 m	235	PRA01
1995 07 20.28		S	9.9	AC	40.6	L	5	70	3	2			BOR
1995 07 20.31		S	9.1	AA	8.0	B		20	11.5	1/			MOR
1995 07 20.94		S	10.3	GA	20.0	L	4	40	& 8	2			MIK
1995 07 20.99	!	V	12.5	L	65	L	4		+ 2.0		0.06	245	PRA01
1995 07 20.99	!	v	15.1	L	65	L	4		6.5		0.06	245	PRA01
1995 07 22.00		S	9.8	AC	10	B		14	2.5	2			SHA02
1995 07 22.00	!	V	12.0	L	65	L	4		+ 2.0		0.05	240	PRA01
1995 07 22.00	!	v	15.0	L	65	L	4		6		0.05	240	PRA01
1995 07 22.32		S	8.9	AA	8.0	B		20	15	2			MOR
1995 07 22.33		M	9.3	AA	25.6	L	4	45	3.0	3			MOR
1995 07 22.95		S	9.7	AC	25.0	L	4	53	11	1			LOO01
1995 07 22.99		S	10.2:	S	11.0	B		20	& 9	2			PLE01
1995 07 23.00		S	10.1	AC	20	R	14	40	2.4	2			SHA02
1995 07 23.01		S	10.5	AC	33.3	L	5	85	3.2	2			SHA02
1995 07 23.34		M	10.3	AC	41	L	4	72					HAL
1995 07 23.39		M	8.8	AA	8.0	B		20	15	2/			MOR
1995 07 23.98		S	9.9	L	25.4	J	6	58	4.5	0/			BOU
1995 07 23.98		S	10.0:	S	11.0	B		20	&11	2			PLE01
1995 07 23.99		M	11.5:	TI	35	L	5	92	1.2	2/			HOR02
1995 07 24.02	!	V	12.2	L	65	L	4		+ 2.0		0.05	240	PRA01
1995 07 24.02	!	v	14.9	L	65	L	4		6		0.05	240	PRA01
1995 07 24.30		S	8.8	AA	8.0	B		20	15	2/			MOR
1995 07 24.95	!	V	9.4	GA	20.0	T	2		&15	6			MIK
1995 07 24.96		S	9.5	AC	25.0	L	4	53	10	3			LOO01
1995 07 24.97		M	11.8	TI	35	L	5	92	1.7	3			HOR02
1995 07 24.99		S	9.5	AC	13.0	L	6	36	& 4.5	1			MEY
1995 07 25.00		S	9.8	L	25.4	J	6	58	5	1			BOU
1995 07 25.02		S	9.7	AC	10	B		14	8.3	1			SHA02
1995 07 25.06		S	9.9	AA	8.0	B		15	7	1/			HAV
1995 07 25.40		M	9.7	AC	41	L	4	72	5				HAL
1995 07 25.93		S	11.0	AC	30.5	L	5	117	1.5	4			VIC
1995 07 25.98		S	10.8	GA	11	L	7	40	3	3			BAR06
1995 07 26.00		M	11.5	TI	35	L	5	92	2.3	3			PLS
1995 07 26.00		S	9.6	L	25.4	J	6	58	6	1			BOU

Comet 6P/d'Arrest [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 07 26.00		S	10.5	HS	15.0	L	5	42	3	3			BEC01
1995 07 26.01		M	11.2	TI	35	L	5	92	2.5	3/			HOR02
1995 07 26.01		S	9.5	AC	13.0	L	6	36	4.5	1/			MEY
1995 07 26.01		S	9.9	AC	10	B		14	6.3	1			SHA02
1995 07 26.05		S	10.4	GA	44.5	L	5	75	8	3			SAR02
1995 07 26.63		M	10.5:	HS	16.0	W	4	49	1.5				TSU02
1995 07 26.85		S	10.9	GA	11	L	7	40	2	2			BAR06
1995 07 26.90		M	11.3	TI	20	R	17	140	10	3			LEH
1995 07 26.95		S	9.4	AC	15.2	L	5	42	6	1			MOE
1995 07 26.96		S	10.0:	AA	12.0	R	5	57	5.3	1			CHE03
1995 07 26.97		M	11.1	TI	35	L	5	92	3.5	3/			PLS
1995 07 26.98		M	10.6	TI	35	L	5	92	2.9	3			HOR02
1995 07 26.99		S	9.8:	S	11.0	B		20	&13	2			PLE01
1995 07 27.04		S	10.6	GA	44.5	L	5	75	6	2/			SAR02
1995 07 27.70		C	10.1	GA	8.0	R	6		9.7				NAK01
1995 07 27.95		S	9.9	AA	12.0	R	5	27	6.7	3			CHE03
1995 07 27.96		E	11.7	PA	20	L	10	80	2.3	0			NEV
1995 07 27.96		S	9.5	PA	18.7	L	5	38	4.5	3			SHU
1995 07 27.96		S	9.8:	S	11.0	B		20	&12	2/			PLE01
1995 07 27.98		S	9.1:	S	6.0	B		20	&11	1/			SCI
1995 07 27.98		S	9.7	AA	11	L	7	32	8	2/			BAR06
1995 07 28.56		S	8.6	AA	10.0	B		25					SEA
1995 07 28.94		S	9.7	AA	11	L	7	32	7	2			BAR06
1995 07 28.96		E	11.7	PA	20	L	10	80	2	0			NEV
1995 07 28.98		S	9.0	S	6.0	B		20	&10	1/			SCI
1995 07 28.98		S	10.0:	S	25	L		54	& 2	1			CHO01
1995 07 28.99		S	9.5	S	11.0	B		20	&14	2/			PLE01
1995 07 29.02		S	9.4	AA	8.0	B		15	9	1/			HAV
1995 07 29.13		B	8.8	S	8.0	B		11	10				BIV
1995 07 29.14		B	10.4	HS	22.5	C	12	54	4	5			BIV
1995 07 29.18		S	9.4	AA	20.0	L	4	35	8	6			DES01
1995 07 29.19		S	8.0	AC	10.0	B	4	20	15	1			NOW
1995 07 29.35		S	8.7	AA	8.0	B		20	15	2		330	MOR
1995 07 29.38		S	9.6	NP	5.0	B		10					HAL
1995 07 29.64		M	8.6:	S	10.0	R	6	20	4.0				TSU02
1995 07 29.93		S	10.8	PA	18.7	L	5	38	5.5	2			SHU
1995 07 29.96		B	10.5:	S	20.0	L	5	53	7.0				DEM01
1995 07 29.96		M	8.6	S	10.0	B	4	25	13.5	3			LEH
1995 07 29.96		S	8.7	S	6.0	B		20	& 8	1			SCI
1995 07 29.97		E	11.6	PA	20	L	10	80	2	0			NEV
1995 07 29.97		S	9.2	AC	15.2	L	5	42	6	1			MOE
1995 07 29.98		M	8.6	TI	20	L	5	48	4.8	3			PLS
1995 07 29.98		S	9.2	S	11.0	B		25	&14	2/			PLE01
1995 07 29.99		M	8.6	TI	20	L	5	48	8	2/			HOR02
1995 07 30.00		S	8.4	TI	8.0	B		10	6	2			KYS
1995 07 30.01		S	9.2	AA	8.0	B		15	9.5	1/			HAV
1995 07 30.01		S	10.5	AC	30.5	L	5	117	2.0	6	3	320	VIC
1995 07 30.02		S	9.0	AC	13.0	L	6	36	6.5	2			MEY
1995 07 30.02		S	9.5	S	10	M	10	20	4.9	3			PAR03
1995 07 30.02		S	10.5	AC	44.5	L	5	230	3	3			SZA02
1995 07 30.03		S	9.5	S	10	M	10	40	3.7	3			PAR03
1995 07 30.03		S	10.0:	S	25.0	R	12	100	& 4	3			OLE
1995 07 30.19		S	8.2	AC	5.0	B		10	16	1			BOR
1995 07 30.33		S	8.7	AA	8.0	B		20	15	2			MOR
1995 07 30.34		M	11.1	GA	35.9	L	7	85	2.6	2/			MOD
1995 07 30.36		S	10.4	GA	20.0	L	5	35	3.3	2			MOD
1995 07 30.91		M	8.7	S	10.0	B	4	25	14	3			LEH
1995 07 30.96		S	8.9	S	6.0	B		20	& 8	1			SCI
1995 07 30.96		S	10.9	PA	18.7	L	5	38	5	3			SHU
1995 07 30.97		S	9.3	S	11.0	B		25	&14	2/			PLE01
1995 07 30.98		S	8.9	S	10.0	B		25	2.9	3			HAS02
1995 07 30.98		S	10.1:	GA	11	L	7	40	& 4	2/			BAR06
1995 07 30.99		S	9.1:	AC	15.2	L	5	42	6	2			MOE
1995 07 31.02		S	8.9	AC	13.0	L	6	36	7	2			MEY
1995 07 31.02		S	9.9	AC	10	B		14	5.0	1			SHA02
1995 07 31.03		M	8.8	TI	20	L	5	48	5.5	2/			KYS

Comet 6P/d'Arrest [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 07 31.03		S	9.3	HS	15.0	L	5	42	4.5	2			BEC01
1995 07 31.04		M	8.5	TI	20	L	5	48	7.5	3			HOR02
1995 07 31.30		S	8.1	AC	5.0	B		10	16	1			BOR
1995 07 31.93		M	8.6	S	10.0	B	4	25	12	3			LEH
1995 07 31.94		S	10.1	GA	11	L	7	40	5	3			BAR06
1995 07 31.98		S	8.4:	S	6.0	B		20	&10	1			SCI
1995 07 31.98		S	9.0	AA	25.0	L	4	53	11	2			LOO01
1995 07 31.98		S	9.1	HS	15.0	L	5	42	5	3			BEC01
1995 07 31.99		S	9.2	S	10.0	B		25	&15	2/			PLE01
1995 07 31.99	a	S	8.7	L	8.0	B		15	10	0/			BOU
1995 08 01.01		S	9.2	AC	10	B		14	5.0	1			SHA02
1995 08 01.03		S	8.8	AC	13.0	L	6	36	6	2			MEY
1995 08 01.04		S	8.7	AC	6.0	B		20	12	3			SAR02
1995 08 01.22		S	8.0	GA	20	L	8	47	10	1		275	DID
1995 08 01.31		S	8.0	AC	5.0	B		10	15	1			BOR
1995 08 01.97		S	9.0	S	10.0	B		25	&12	2/			PLE01
1995 08 01.99		S	8.9	AC	15.2	L	5	42	7	2			MOE
1995 08 02.01		S	11.0	AC	33.4	L	5	61	5	5/			SZE02
1995 08 02.01	a	S	8.6	L	8.0	B		15	10	1			BOU
1995 08 02.05		S	9.0	AA	25.0	L	4	53	7	2			LOO01
1995 08 02.08		S	9.3	AA	8.0	B		11	5				DES01
1995 08 02.25		S	8.8	GA	25.4	L	4	91	10	0/			DID
1995 08 02.34		S	9.8:	S	20	T	10	100	3.9	2			PRY
1995 08 02.98		S	9.1	S	10.0	B		25	&14	2/			PLE01
1995 08 02.98	a	S	8.6	L	8.0	B		15	10	1			BOU
1995 08 02.99		S	8.7	AC	5.0	B		10	7	2			MOE
1995 08 02.99		S	10.6:	GA	11	L	7	40	4.5	1/			BAR06
1995 08 03.00		S	7.9	AA	8.0	B		20	12	2/			MIL02
1995 08 03.02		S	9.0	AC	6.0	B		20	10	2/	0.4	310	SAR02
1995 08 03.02		S	9.5	S	10	M	10	20	& 4	2			PAR03
1995 08 03.04		B	10.6	HS	20.3	T	10	67	6	3/			BIV
1995 08 03.08		B	8.6	S	8.0	B		11	12				BIV
1995 08 03.36		S	9.7:	S	20	T	10	100	3.9	2			PRY
1995 08 03.38		S	9.2:	NP	5.0	B		10					HAL
1995 08 03.65		C	9.8	GA	8.0	R	6		13.3				NAK01
1995 08 03.93		S	8.7	S	10.0	B		25	3.1	3			HAS02
1995 08 03.96		S	8.7:	S	6.0	B		20	& 8	1			SCI
1995 08 03.99		S	8.9	S	10.0	B		25	&12	3			PLE01
1995 08 04.00		B	10.8:	HS	28.0	T	11	93	6	3			BIV
1995 08 04.03		S	9.5:	S	25.0	R	12	100	& 5	4			OLE
1995 08 04.10		S	9.0	AA	25.0	L	4	53	11	1			LOO01
1995 08 04.75		S	9.7	NP	15.0	R	5	25	6	2			NAG02
1995 08 04.94		S	8.7:	S	6.0	B		20	& 7	1			SCI
1995 08 04.95		M	8.8	S	10.0	B	4	25	12	3			LEH
1995 08 04.96		S	9.5:	AA	25.0	T	5	54	7.0	1			CHE03
1995 08 04.97		S	8.6	S	10.0	B		25	&15	2/			PLE01
1995 08 04.97		S	9.7:	S	25.0	R	12	100	& 4	4/			OLE
1995 08 04.98		S	8.6	AC	5.0	B		10	6	2			MOE
1995 08 04.98		S	9.6	GA	11	L	7	40	8.6	2			BAR06
1995 08 05.00		S	8.4	AA	8.0	B		15	10	1/			HAV
1995 08 05.02		S	9.5	AA	11	L	7	32	8	2/			BAR06
1995 08 05.04		S	8.7	AC	10	B		14	11	1			SHA02
1995 08 05.04		S	9.2	HS	15.0	L	5	42	10	3			BEC01
1995 08 05.06		S	8.5	AC	13.0	L	6	36	8	2/			MEY
1995 08 05.41		S	8.6	AA	8.0	B		20	17	2/	1.0		MOR
1995 08 05.43		S	7.9	AA	5.0	B		10	25	1/			MOR
1995 08 05.95		S	9.4	AA	25.0	T	5	54	7.5	3			CHE03
1995 08 05.96		S	8.9	S	6.0	B		20	&11	1			SCI
1995 08 05.97		M	8.7	S	10.0	B	4	25	15	3			LEH
1995 08 05.98		S	9.2	AA	11	L	7	32	9	4			BAR06
1995 08 05.98		S	9.7:	S	25.0	R	12	100	& 3	4			OLE
1995 08 05.99		S	8.5	S	10.0	B		25	&14	2/			PLE01
1995 08 05.99	!	V	9.1	GA	20.0	T	2		&16	6			MIK
1995 08 06.02		S	8.5	AC	10	B		14	11	1			SHA02
1995 08 06.02		S	9.1	S	10	M	10	20	& 8	2			PAR03
1995 08 06.03		S	8.4	AC	13.0	L	6	36	8	2/			MEY

Comet 6P/d'Arrest [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 08 06.96		M	8.4	S	10.0	B	4	25	15	2/			LEH
1995 08 06.97		S	10.0	PA	18.7	L	5	38	5.5	4			SHU
1995 08 06.98		E	10.9	PA	20	L	10	80	4	1			NEV
1995 08 06.98		S	9.5	AA	11	L	7	32	10	3			VEL03
1995 08 06.98		S	9.6	PA	10	R	5	28	6	3			SHU
1995 08 06.99		S	8.9	S	6.0	B		20	&10	1			SCI
1995 08 06.99		S	9.1	AA	11	L	7	40	9	3/			BAR06
1995 08 07.00		S	10.7:	GA	24	L	6	32	4	3			MAI
1995 08 07.01		S	9.0	AA	25.0	T	5	54	6.5	3			CHE03
1995 08 07.02		S	9.1	S	10	M	10	20	& 8	2			PAR03
1995 08 07.41		S	8.8	NP	5.0	B		10					HAL
1995 08 07.98		E	10.9	PA	20	L	10	80	4	1			NEV
1995 08 08.02		S	9.3	AA	11	L	7	32	8	3			BAR06
1995 08 08.32		S	7.8	AC	5.0	B		10	13	0			BOR
1995 08 08.33		S	9.2	GA	25.4	L	4	91	5	1			DID
1995 08 09.02		S	9.0:	AA	25.0	T	5	54	7.0	1			CHE03
1995 08 09.04		S	9.6:	AA	11	L	7	32	8	2			BAR06
1995 08 09.06		S	8.8	S	6.0	B		20	& 9	1			SCI
1995 08 10.93		S	8.2	S	10.0	B		25	&10	3			PLE01
1995 08 14.99		S	8.2	S	6.6	B		20	& 8	3			PLE01
1995 08 15.73		M	10.5:	HS	20.3	T	6	71	3	3			YUS
1995 08 15.98		S	8.0	S	6.6	B		20	&10	3			PLE01
1995 08 16.11		S	8.5	AA	8.0	B		20	10	3			LOU
1995 08 16.53		S	8.5	AA	10.0	B		25	12	3			SEA
1995 08 16.98		S	7.9	S	6.6	B		20	&12	3			PLE01
1995 08 17.06		S	8.3	AA	8.0	B		11	12	5			DES01
1995 08 17.57		S	8.3:	AA	10.0	B		25					SEA
1995 08 18.08		S	8.2	AA	8.0	B		11	15	4/			DES01
1995 08 18.31		S	7.9	AA	5.0	B		10	18	2			MOR
1995 08 18.53		S	8.3	AA	10.0	B		25					SEA
1995 08 19.10		S	8.1	AA	8.0	B		11	14	4/			DES01
1995 08 19.23		S	9.7	GA	25.4	L	4	91	5	1			DID
1995 08 19.30		S	8.6:	NP	5.0	B		10					HAL
1995 08 19.35		S	7.6	AA	5.0	B		10	19	2			MOR
1995 08 19.60		M	8.3	S	16.0	W	4	19					TSU02
1995 08 19.66		M	7.7	S	12.5	L	6	23	12	3			TSU02
1995 08 19.88		B	8.6	S	25	L	4	33	7	4/			KRY01
1995 08 19.93		M	9.9	GA	11	B	4	20	15	2/			BAR06
1995 08 19.93		S	9.6	AA	34.0	L	4	44	10.5	3			CHE03
1995 08 19.97		S	7.5	AA	8.0	B		15	18	1			BOU
1995 08 20.02		S	9.8:	AA	25.0	T	5	54	10	1			CHE03
1995 08 20.15		S	8.1	AA	8.0	B		11	12	4/			DES01
1995 08 20.18		S	8.6	HI	25.4	L	4	44	& 8.1	3			GRE
1995 08 20.21		S	7.0	AC	10.0	B	4	20	30	2			NOW
1995 08 20.26		S	9.5	GA	25.4	L	4	91	5	3			DID
1995 08 20.30		S	7.3	HR	5.0	B		10	11	0			BOR
1995 08 20.56		S	8.2	AA	10.0	B		25	10	4			SEA
1995 08 20.92		B	8.6	S	15	L	4	20	15	3			KRY01
1995 08 20.93		M	9.0:	GA	11	B	4	20	&10	2			BAR06
1995 08 20.99		S	7.3	AA	8.0	B		15	18	1			BOU
1995 08 21.00		S	7.2	AA	5.0	B		7	20	0/			BOU
1995 08 21.06		B	10.4:	HS	20.3	L	6	40	5	3/			BIV
1995 08 21.10		S	8.0	AA	8.0	B		11	12	4			DES01
1995 08 21.31		S	7.2	HR	5.0	B		10	13	1			BOR
1995 08 21.33		S	7.9	NP	5.0	B		10	18				HAL
1995 08 21.95		M	8.8	GA	11	B	4	20	12	3			BAR06
1995 08 21.98		B	8.0	S	6	R	5	20	16	4			KRY01
1995 08 22.06		B	8.4	S	5.0	B		7	14				BIV
1995 08 22.08		B	9.4	HS	20.3	L	6	40	8	3			BIV
1995 08 22.12		S	8.2	AA	8.0	B		20	15	5			LOU
1995 08 22.12		S	8.4	S	7.0	B		10	10.8	3			DEA
1995 08 22.15		S	8.0	AA	8.0	B		11	12	5			DES01
1995 08 22.27		S	9.3	GA	20.0	L	5	35	3.5	2/			MOD
1995 08 22.96		S	10.1	PA	18.7	L	5	38	5	3			SHU
1995 08 22.99		S	7.3	AA	8.0	B		15	18	1/			BOU
1995 08 23.00		S	7.2	AA	5.0	B		7	20	1			BOU

Comet 6P/d'Arrest [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 08 23.03		S	9.0	S	11	L		32	& 8	1			CHO01
1995 08 23.11		S	8.0	AA	8.0	B		11	15	5			DES01
1995 08 23.11		S	8.6	AA	8.0	B		20	10	3			LOU
1995 08 23.32		S	9.5	GA	20.0	L	5	35	4.0	2/			MOD
1995 08 23.34	s	S	8.6	GA	5.0	B		10	10	1			MOD
1995 08 23.78		S	8.8	S	15.0	R	5	25	8	2/			NAG02
1995 08 23.86		S	8.0	S	6	R	5	20	16	4			KRY01
1995 08 24.02		S	9.2:	TB	44.5	L	5	75	8	4/			SAR02
1995 08 24.11		S	9.2	GA	8.0	B		15	&12	1			MIK
1995 08 24.29		S	9.7	GA	25.4	L	4	91	5	3			DID
1995 08 24.99		S	8.1	AA	8.0	B		11	12	6			DES01
1995 08 24.99		S	8.4	S	25	L	4	33	12	S5			KRY01
1995 08 25.01		S	8.6	S	25	L	4	33	14	4/			BAR06
1995 08 25.08		S	8.2	AA	8.0	B		11	12	6			DES01
1995 08 25.30		S	9.5	GA	25.4	L	4	47	5	3			DID
1995 08 25.39		S	8.2	AA	5.0	B		10	19	2			MOR
1995 08 25.87		B	8.0	S	25	L	4	33	12	S5			KRY01
1995 08 25.92		S	8.2	S	25	L	4	33	12	S7			BAR06
1995 08 26.00		S	7.2	AA	5.0	B		7	20	1/			BOU
1995 08 26.00		S	8.1	S	25	L	4	33	13	S6/			BAR06
1995 08 26.09		S	8.2	AA	8.0	B		11	10	6			DES01
1995 08 26.09		S	8.6	AA	8.0	B		11	8	3			LOU
1995 08 26.11		B	7.7	S	7.0	B		10	15.2	5			DEA
1995 08 26.16		S	8.2	S	25.4	L	4	44	& 8	6/			GRE
1995 08 26.16		S	8.3	HI	25.4	L	4	44					GRE
1995 08 26.16		S	8.6	HJ	25.4	L	4	44					GRE
1995 08 26.17		S	7.5	HI	8.0	R	3	20	&12	3			GRE
1995 08 26.17		S	7.7	HJ	8.0	R	3	20					GRE
1995 08 26.17		S	7.7	S	8.0	R	3	20	&12	3			GRE
1995 08 26.18		S	7.5	HI	5.0	B		12	& 9.5	3/			GRE
1995 08 26.18		S	7.7	HJ	5.0	B		12					GRE
1995 08 26.18		S	7.7	S	5.0	B		12	& 9.5	3/			GRE
1995 08 26.27	a	S	6.9	HR	5.0	B		10	16	3			BOR
1995 08 26.29		S	8.1	GA	25.4	L	4	47	8	3/			DID
1995 08 26.37		S	7.6	AA	5.0	B		10	19	2			MOR
1995 08 26.37		S	7.7	NP	5.0	B		10	18				HAL
1995 08 26.54		M	7.8	AA	10.0	B		25	8	5			SEA
1995 08 26.77		S	8.4	S	15.0	R	5	25	10	3			NAG02
1995 08 26.86		S	7.9	S	25	L	4	33	15	D6/			BAR06
1995 08 26.87		B	7.8	S	25	L	4	33	15	6			KRY01
1995 08 27.00		B	8.2	S	10.0	B		25	&14	2			RES
1995 08 27.00		S	7.2	AA	5.0	B		7	23	1/			BOU
1995 08 27.00		S	7.3	AA	8.0	B		15	18	2			BOU
1995 08 27.03		M	8.1	HS	5.0	B		7	> 0.5	3			OFE
1995 08 27.10		S	8.2	AA	8.0	B		11	10	6/			DES01
1995 08 27.10		S	8.6	AA	8.0	B		20	8	3			LOU
1995 08 27.12		B	7.6	S	7.0	B		10	19	4			DEA
1995 08 27.14		S	7.7	S	8.0	B		11	12	4	0.7	275	GAR02
1995 08 27.21		B	7.8	S	7.0	B		10	15	4			ROD01
1995 08 27.22	a	S	6.9	HR	5.0	B		10	16	2			BOR
1995 08 27.37		S	7.2	AA	5.0	B		10	24	2			MOR
1995 08 27.38		S	7.0:	AA	20.0	T	10	50	3.2	3/			SHA04
1995 08 27.88		B	7.7	S	25	L	4	33	12	5			KRY01
1995 08 27.95		S	8.2	S	25	L	4	33	14	5			BAR06
1995 08 27.98		B	9.4	S	20.0	L	5	53	4.2				DEM01
1995 08 28.00		B	8.5	S	10.0	B		25	&12	3			RES
1995 08 28.00		S	7.4	AA	8.0	B		15	15	2			BOU
1995 08 28.09		S	7.8	AA	10	B		14	5.0	2			SHA02
1995 08 28.10		S	8.3	AA	8.0	B		11	12	6			DES01
1995 08 28.12		S	7.7	S	7.0	B		10	15	4			DEA
1995 08 28.30		S	8.1	GA	25.4	L	4	47	5	3			DID
1995 08 28.51		S	7.8	AA	10.0	B		25					SEA
1995 08 28.92		B	8.3	S	35	L	5	70	16	5			BAR06
1995 08 29.00		B	8.6	S	10.0	B		25	&14	2			RES
1995 08 29.00		S	7.2	AA	5.0	B		7	18	1			BOU
1995 08 29.01		S	8.4	AA	8.0	B		11	10	6			DES01

Comet 6P/d'Arrest [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 08 29.10		S	7.8	S	7.0	B		10	11.4	3			DEA
1995 08 29.30		S	6.8	HR	5.0	B		10	16	3			BOR
1995 08 29.30		S	8.5	GA	25.4	L	4	91	5	3			DID
1995 08 29.57		C	10.4	HS	20.3	T	6		3.3				YUS
1995 08 29.57		M	8.5:	HS	8.0	B		20	10				YUS
1995 08 29.97		S	7.8	S	8.8	B		12	16	4/			BAR06
1995 08 29.99		S	7.3	AA	5.0	B		7	18	1			BOU
1995 08 30.00		B	8.6	S	10.0	B		25	&12	4			RES
1995 08 30.03		S	8.6	S	10	B		14	10	2			SHA02
1995 08 30.05		S	8.5	AA	8.0	B		11	12	6			DES01
1995 08 30.10		S	7.7	S	7.0	B		10	11.4	3			DEA
1995 08 30.56		S	7.8	AA	10.0	B		25	8				SEA
1995 08 30.98		S	8.5	AA	25.2	L	4	53	9	2			LO001
1995 08 31.10		S	8.5	AA	8.0	B		11	10	6			DES01
1995 08 31.19		S	8.4	S	25.4	L	4	44	&10	4/			GRE
1995 08 31.19		S	8.7	HI	25.4	L	4	44					GRE
1995 08 31.20		S	8.1	S	8.0	R	3	20	&10	2/			GRE
1995 08 31.20		S	8.6	HI	8.0	R	3	20					GRE
1995 08 31.25		S	7.0	HR	5.0	B		10	16	2			BOR
1995 08 31.31		S	8.5	GA	25.4	L	4	91	7	2/			DID
1995 08 31.37		S	10.3:	S	20	T	10	100	4.1	2			PRY
1995 08 31.98		S	7.5	AA	8.0	B		15	15	2/			BOU
1995 09 01.08		S	8.6	AA	8.0	B		11	8	6			DES01
1995 09 01.14		S	7.6	S	7.0	B		10	11.4	4			DEA
1995 09 01.34		S	7.8	SC	5.0	B		10	18				HAL
1995 09 01.65		M	9.2:	HS	8.0	B		20	10				YUS
1995 09 02.00		S	7.4	AA	5.0	B		7	19	1/			BOU
1995 09 02.08		S	8.2	S	8.8	B		12	15	4			BAR06
1995 09 02.08		S	8.4	S	35	L	5	50	10	5	0.2	290	BAR06
1995 09 02.10		S	8.6	AA	8.0	B		11	10	6			DES01
1995 09 02.22		S	7.7	SC	8.0	B		20	18	1			KR002
1995 09 02.32	a	S	9.5	GA	20.0	L	5	35	4.5	3			MOD
1995 09 02.34	a	S	8.6	NO	5.0	B		10	8.5	1			MOD
1995 09 03.02		S	7.5	AA	5.0	B		7	16	2			BOU
1995 09 03.08		S	8.6	AA	8.0	B		11	8	6			DES01
1995 09 03.23		S	7.8	SC	8.0	B		20	17	1			KR002
1995 09 03.25	a	S	7.0	HR	5.0	B		10	18	3			BOR
1995 09 03.29		S	8.5	GA	25.4	L	4	91	7	2			DID
1995 09 03.41		S	7.2	AA	5.0	B		10	22	2			MOR
1995 09 04.10		S	8.6	AA	8.0	B		11	8	6			DES01
1995 09 04.25		S	8.5	GA	25.4	L	4	91	6	2			DID
1995 09 04.40		S	7.2	AA	5.0	B		10	21	2			MOR
1995 09 05.12		S	8.7	AA	8.0	B		11	8	6/			DES01
1995 09 05.67		C	10.8	HS	20.0	L	4		4.5				OOY
1995 09 05.73	a	C	9.1	GA	8.0	R	6		16.5				NAK01
1995 09 05.98	&	S	8.2	S	35	L	5	70	9	4			BAR06
1995 09 07.03	&	S	8.4	S	35	L	5	70	12	4/			BAR06
1995 09 07.06	&	S	8.1	S	8.8	B		12	15	4			BAR06
1995 09 13.47		S	8.1	AA	10.0	B		25	10	4			SEA
1995 09 15.92	&	S	10.0:	S	35	L	5	70	& 5	2/			BAR06
1995 09 16.28		S	7.6	AA	5.0	B		10	20	1/			MOR
1995 09 17.25		S	8.4	NP	5.0	B		10	11				HAL
1995 09 17.28		S	7.8	AA	5.0	B		10	20	1			MOR
1995 09 18.67		S	9.9	AA	10.0	R	5	18	11	2			KOB01
1995 09 19.26	a	S	10.1	GA	20.0	L	5	35	3.5	1			MOD
1995 09 20.95	&	B	8.8	S	35	L	5	50	5	3/			BAR06
1995 09 20.97	&	K	8.4	S	8.8	B		12	6	3			BAR06
1995 09 21.28		S	8.0	AA	5.0	B		10	20	1			MOR
1995 09 21.45	!	S	8.5	NP	5.0	B		10					HAL
1995 09 21.94	&	S	8.6	S	35	L	5	50	11	3/			BAR06
1995 09 21.99		S	9.1	AA	8.0	B		11	5	5			DES01
1995 09 22.44		S	8.3	AA	10.0	B		25					SEA
1995 09 23.29		S	8.1	AA	5.0	B		10	20	1			MOR
1995 09 24.28		S	10.0	GA	20.0	L	5	35	3.3	1			MOD
1995 09 24.35		S	8.2	AA	5.0	B		10	18	1/			MOR
1995 09 25.13		S	8.4	AA	7.0	B		10	11	3			DEA

Comet 6P/d'Arrest [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 09 26.96		B	10.2	GA	20.3	T	10	67	8	2			BIV
1995 09 26.99		B	8.8	S	5.0	B		7	10				BIV
1995 09 27.02	c	C	9.8	LB	20.3	T	10		7		>0.18	330	GAR02
1995 09 27.28		S	8.7	NP	5.0	B		10	8				HAL
1995 09 28.00		B	8.7	S	5.0	B		7	10				BIV
1995 09 28.02		B	10.1	GA	20.3	T	10	67	8	2			BIV
1995 09 29.03		B	8.7	S	5.0	B		7	10				BIV
1995 09 29.05		B	10.3	GA	20.3	T	10	67	7	2			BIV
1995 09 30.04		S	7.8	S	7.0	B		10	9	1			MAR02
1995 09 30.29		S	8.4	AA	8.0	B		20	18	1/			MOR
1995 10 01.85		B	9.4	S	12	R	5	27	5.9	3/			CHE03
1995 10 02.83		B	9.5:	S	12	R	5	27	6.1	3/			CHE03
1995 10 03.41	!	S	8.9	NP	5.0	B		10					HAL
1995 10 03.90		B	9.2	S	12	R	5	27	6.9	3/			CHE03
1995 10 04.93		B	9.4	S	12	R	5	27	6.5	3/			CHE03
1995 10 06.90		S	9.5:	S	48	L	5	65	& 7	3			CHE03
1995 10 13.51		C	12.6	HS	20.3	T	6		2.2				YUS
1995 10 20.73	a	C	10.8	GA	8.0	R	6		8.2				NAK01

Comet 9P/Tempel 1

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1994 04 14.90		S	10.0	AA	8.0	B		15	3	2/			HAV
1994 06 02.89		S	9.3	AA	8.0	B		15	5	1			HAV
1994 06 07.88		S	9.3	AA	8.0	B		15	5	2			HAV
1995 08 30.48		k	20.8	EB	154.9	L	3		0.07	9	4.0m	242	HER02

Comet 18P/Perrine-Mrkos

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 08 26.95	l	C	[18.5	LB	20.3	T	10						GAR02
1995 09 01.98	l	C	[19.0	LB	20.3	T	10						GAR02

Comet 19P/Borrelly

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1994 12 12.01		S	8.6	AA	10	B		14	4.7	S4			SHA02
1994 12 30.81		S	8.9	AA	13.0	L	6	36	6	3			MEY
1995 01 23.21		S	10.2	HS	33.3	L	4	56	3.8	4			KRO02
1995 01 24.24		S	10.2	HS	33.3	L	4	56	4.1	3			KRO02
1995 01 25.13		S	10.4	HS	33.3	L	4	56	3.5	3			KRO02
1995 01 26.15		S	10.3	HS	33.3	L	4	56	3.9	3			KRO02
1995 03 21.17		S	12.4	HS	33.3	L	4	122	1.3	2			KRO02
1995 04 01.21		S	12.6	HS	33.3	L	4	122	1.2	2			KRO02
1995 04 22.22		S	13.5	NP	25.6	L	4	156	0.75	2			MOR
1995 04 23.18		S	13.5	NP	25.6	L	4	156	0.75	2			MOR
1995 07 26.48	a	C	15.7	GA	60.0	Y	6		1.2			302	NAK01
1995 07 31.48	a	C	15.9	GA	60.0	Y	6		1.0		2.6m	305	NAK01

Comet 23P/Brorsen-Metcalf

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1989 08 13.10		S	6.3	AA	5.0	B		10	7	2			VAN06
1989 08 16.01		S	6.3	AA	5.0	B		10	6	3			VAN06
1989 08 17.10		S	5.8	AA	5.0	B		10	6	3			VAN06

Comet 29P/Schwassmann-Wachmann 1

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 03 22.17		S	13.4	CA	41	L	4	183					HAL
1995 03 23.17		S	13.3	CA	41	L	4	72					HAL
1995 04 01.17		S	13.4	HS	33.3	L	4	200	0.5	1			KRO02
1995 04 01.20		S	13.3	CA	41	L	4	183					HAL
1995 04 02.16		S	13.3	CA	41	L	4	183					HAL
1995 04 22.18		S	12.6	NP	25.6	L	4	111	2.6	1			MOR
1995 04 22.19		I	[13.5:		41	L	4	183					HAL

Comet 29P/Schwassmann-Wachmann 1 [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 04 23.16		S	12.5	NP	25.6	L	4	111	2.4	1			MOR
1995 04 25.17		I	[13.5:		41	L	4	183					HAL
1995 05 25.17		I	[13.5:		41	L	4	183					HAL
1995 10 05.49		I	[12.5:		41	L	4	183					HAL
1995 10 12.81		C	14.2	GA	28.0	T	6		0.8				KIN
1995 10 13.81		C	13.7	HS	20.3	T	6		0.5				YUS
1995 10 18.81		C	13.2	HS	20.0	L	4		0.9				OOY
1995 10 27.16	!	V	13.4	YF	20.0	T	2		& 2.5	6			MIK
1995 10 28.81		C	13.8	HS	20.0	L	4		0.9				OOY
1995 10 31.16	!	V	13.3	YF	20.0	T	2		& 2	7			MIK

Comet 31P/Schwassmann-Wachmann 2

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 05 23.62	a	C	17.4	GA	60.0	Y	6		0.4			260	NAKO1
1995 05 31.60	a	C	17.7	GA	60.0	Y	6		0.35				NAKO1
1995 06 29.56	a	C	17.8	GA	60.0	Y	6		0.35				NAKO1
1995 07 04.22		k	18.1	EB	154.9	L	3		0.13				HERO2

Comet 32P/Comas Solá

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 08 01.44		c	21.9	FA	91.4	L	5		0.10		0.6m	254	SCO01
1995 08 02.44		C	19.8	FA	91.4	L	5						SCO01
1995 08 03.75		C	19.0	GA	60.0	Y	6		0.2			245	NAKO1
1995 08 07.75		C	19.0	GA	60.0	Y	6		0.25			245	NAKO1
1995 08 23.76		C	18.1	GA	60.0	Y	6		0.25		2.2m	248	NAKO1
1995 08 30.45		k	18.0	EB	154.9	L	3						HERO2
1995 08 30.46		k	18.6	EB	154.9	L	3		0.20	6	1.2m	250	HERO2
1995 08 30.47		k	17.6	EB	154.9	L	3						HERO2
1995 09 05.77		C	17.5	GA	60.0	Y	6		0.35		1.5m	252	NAKO1
1995 09 18.66		C	16.8	GA	28.0	T	6		0.4				KIN
1995 09 20.69		C	17.0	GA	60.0	Y	6		0.4		1.5m	249	NAKO1
1995 09 27.09		C	16.3	LB	20.3	T	10		0.3		0.5m	277	GARO2
1995 09 27.09		c	17.0	LB	20.3	T	10						GARO2
1995 10 13.57		C	15.9	HS	20.3	T	6		0.3				YUS
1995 10 17.62		C	15.7	GA	60.0	Y	6		0.7				NAKO1
1995 10 20.62		C	15.7	GA	60.0	Y	6		0.7				NAKO1
1995 10 26.63		C	15.5	GA	60.0	Y	6		0.85				NAKO1

Comet 41P/Tuttle-Giacobini-Kresák

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 08 19.17		M	8.5:	AA	25.6	L	4	45	1.8	4	0.13	105	MOR
1995 08 19.36		M	7.7	AA	10.0	B		25		4			SEA
1995 08 19.47		M	8.5	S	16.0	W	4	19					TSU02
1995 08 19.93		S	8.7	AA	8.0	B		11	3	6			DES01
1995 08 20.05		S	8.7	S	25.4	L	4	44	& 4.0	3/			GRE
1995 08 20.17		M	8.3	S	25.6	L	4	45	2.8	4	0.13	110	MOR
1995 08 20.46		M	8.3	S	12.5	L	6	23	4.0	4			TSU02
1995 08 20.93		S	8.9	AA	8.0	B		11	3	6			DES01
1995 08 21.14	!	S	9.8	NP	20	L	6	49	4	3/			HAL
1995 08 23.39		S	8.1	AA	10.0	B		25					SEA
1995 08 25.16		M	9.0	AA	25.6	L	4	67	2.7	3	0.03	110	MOR
1995 08 25.47		C	10.9	HS	28.0	T	6		3.2		>7.2 m	108	KIN
1995 08 25.83		S	9.5:	GA	45.0	L	4	74	4	1			BOU
1995 08 26.17		M	9.0	AA	25.6	L	4	67	2.7	3/			MOR
1995 08 26.74	&	S	9.2	S	35	L	5	70	&12	3/			BAR06
1995 08 26.82	c	C	10.4	LB	20.3	T	10		3.0				GARO2
1995 08 27.16		M	9.1	S	25.6	L	4	67	3.1	3/			MOR
1995 08 29.13	!	S	10.0:	NP	20	L	6	49		1			HAL
1995 08 29.74	&	S	11.6:	HS	35	L	5	70	& 4	2			BAR06
1995 08 31.16		S	10.0:	AA	25.6	L	4	67	2.3	2/			MOR
1995 09 15.71	&	S	[13.5	HS	35	L	5	70	! 0.5				BAR06
1995 09 17.11		I	[12.0:		20	L	6	122					HAL
1995 09 19.05		S	[9.5	GA	20.0	L	5	68	! 2.0				MOD

Comet 41P/Tuttle-Giacobini-Kresák [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 09 24.05		S	[9.5	GA	20.0	L	5	68	! 2.0				MOD
1995 09 26.79		C	12.6	LB	20.3	T	10		2.0		2.4m	81	GAR02
1995 09 26.82		B	12.6	HS	20.3	T	10	133	1	3			BIV
1995 10 12.42		C	13.2:	GA	28.0	T	6		1.6				KIN

Comet 58P/Jackson-Neujmin

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 07 07.98		S	14.3	HS	35	L	5	197	1.3	2/			KRY01
1995 07 08.96		C	18.1	HS	65	L	4		< 0.2				PRA01
1995 07 08.96		c	18.3	HS	65	L	4		< 0.2				PRA01
1995 07 09.77		C	17.7	GA	60.0	Y	6		0.3				NAK01
1995 07 09.98		C	18.0	HS	65	L	4		< 0.2				PRA01
1995 07 09.98		c	18.1	HS	65	L	4		< 0.2				PRA01
1995 07 19.92		C	17.1	L	65	L	4		0.4				PRA01
1995 07 19.92		c	17.6	L	65	L	4		0.4				PRA01
1995 07 21.97		C	17.1	L	65	L	4		0.3				PRA01
1995 07 21.97		c	17.5	L	65	L	4		0.3				PRA01
1995 07 23.95		C	17.1	L	65	L	4		0.3				PRA01
1995 07 23.95		c	17.5	L	65	L	4		0.3				PRA01
1995 07 25.28		I	[13.5:		41	L	4	183					HAL
1995 07 25.96		C	16.9	L	65	L	4		0.3				PRA01
1995 07 25.96		c	17.3	L	65	L	4		0.3				PRA01
1995 07 27.65		C	16.7	GA	60.0	Y	6		0.35				NAK01
1995 07 30.27		S	[13.9	GA	35.9	L	7	164	! 0.5				MOD
1995 07 30.96		C	16.0	L	65	L	4		0.35		30 s	230	PRA01
1995 07 30.96		c	16.9	L	65	L	4		0.35		30 s	230	PRA01
1995 07 31.65		C	15.9	GA	60.0	Y	6		0.9				NAK01
1995 07 31.93		C	16.2	L	65	L	4		0.35				PRA01
1995 07 31.93		c	16.8	L	65	L	4		0.35				PRA01
1995 08 01.64		C	15.8	GA	60.0	Y	6		0.85				NAK01
1995 08 02.41		c	19.8	FA	91.4	L	5						SCO01
1995 08 02.42		C	17.7	FA	91.4	L	5		0.43				SCO01
1995 08 04.93		S	15.0	HS	44.0	L	5	222	0.2	4			HAS02
1995 08 06.93		C	16.4	HS	65	L	4		0.3				PRA01
1995 08 06.93		c	16.8	HS	65	L	4		0.3				PRA01
1995 08 16.56		C	15.2	GA	60.0	Y	6		0.7				NAK01
1995 08 16.98		c	16.4	L	65	L	4		0.4				PRA01
1995 08 18.58		C	15.0	GA	60.0	Y	6		0.95				NAK01
1995 08 19.28		I	[13.0:		41	L	4	183					HAL
1995 08 20.04		C	15.2	L	65	L	4		0.55				PRA01
1995 08 20.04		c	16.3	L	65	L	4		0.55				PRA01
1995 08 20.28		S	14.8	NP	50.8	L	4	275	0.7	2			MOR
1995 08 21.27		I	[13.5:		41	L	4	183					HAL
1995 08 22.25		S	[12.5	GA	20.0	L	5	68	! 1.0				MOD
1995 08 23.28		S	14.7	GA	45.7	L	4	135	0.5	4			MOD
1995 08 23.99		C	15.0	L	65	L	4		0.6				PRA01
1995 08 23.99		R	14.6	L	65	L	4		0.6				PRA01
1995 08 23.99		V	15.1	L	65	L	4		0.6				PRA01
1995 08 23.99		c	16.1	L	65	L	4		0.6				PRA01
1995 08 23.99		r	15.8	L	65	L	4		0.6				PRA01
1995 08 23.99		u	16.3	L	65	L	4		0.6				PRA01
1995 08 25.92		S	[15.6	HS	35	L	5	160	! 0.5				BAR06
1995 08 26.00	c	C	13.8	LB	20.3	T	10		1.3				GAR02
1995 08 26.26		S	13.4	NP	50.8	L	4	195	1.0	2/			MOR
1995 08 26.27		S	13.6	NP	25.6	L	4	156	0.8	2			MOR
1995 08 26.58		C	14.6	GA	60.0	Y	6		1.0				NAK01
1995 08 26.93		S	[15.8	HS	35	L	5	197	! 0.5				BAR06
1995 08 27.28		S	13.4	NP	50.8	L	4	195	1.0	2/			MOR
1995 08 27.93		S	[15.8	HS	35	L	5	197	! 0.5				BAR06
1995 08 28.92		S	[15.3	HS	35	L	5	160	! 0.5				BAR06
1995 08 29.23		I	[13.5:		41	L	4	183					HAL
1995 08 31.92		S	13.7	AC	25.4	J	6	143		1			BOU
1995 09 02.04	c	C	14.3	LB	20.3	T	10		0.8		0.9m	67	GAR02
1995 09 02.98		S	13.5	AC	25.4	J	6	143		1/			BOU
1995 09 03.01		S	13.5	AC	45.0	L	4	115		3			BOU

Comet 58P/Jackson-Neujmin [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 09 04.39		S	13.5	NP	25.6	L	4	156	1.0	2/			MOR
1995 09 16.23		S	13.4	NP	25.6	L	4	156	1.1	2/			MOR
1995 09 17.23		S	13.4	NP	25.6	L	4	156	1.2	2			MOR
1995 09 17.24		S	12.9	AC	41	L	4	72					HAL
1995 09 17.84	!	V	12.4	GA	36.0	T	7		0.8	8			MIK
1995 09 17.88		S	13.5	HS	44.0	L	5	156	0.7	2			HAS02
1995 09 18.56		C	14.2	GA	60.0	Y	6		1.3				NAK01
1995 09 19.19		S	[12.4	GA	20.0	L	5	68	! 1.0				MOD
1995 09 21.21		S	13.0	NP	25.6	L	4	156	1.5	2			MOR
1995 09 21.22		S	12.7	AC	41	L	4	183					HAL
1995 09 22.96		S	12.7:	HS	35	L	5	207	1.2	1/			KYS
1995 09 22.97		S	12.2	HS	35	L	5	207	1.0	2			HOR02
1995 09 23.19		S	13.5	NP	25.6	L	4	156	1.4	1			MOR
1995 09 23.91		S	12.7	AC	44.5	L	5	230	2	2			BAK01
1995 09 23.91		S	12.8	AC	44.5	L	5	230	1.2	3			SAR02
1995 09 24.23		S	14.2	GA	45.7	L	4	135	0.7	2			MOD
1995 09 24.26		S	13.3	NP	50.8	L	4	120	2.5	2			MOR
1995 09 24.82		M	11.7:	HS	35	L	5	207	1.9	1/			PLS
1995 09 24.82		S	12.2	HS	35	L	5	207	1.5	1/			HOR02
1995 09 26.92		C	13.6	LB	20.3	T	10		1.6		2.2m	348	GAR02
1995 09 26.92		c	15.3	LB	20.3	T	10						GAR02
1995 09 27.21		S	13.0	AC	41	L	4	72					HAL
1995 10 12.79		M	11.2	HS	30	L	15	40	1.5				POP
1995 10 13.49		C	14.7	HS	20.3	T	6		1.0				YUS
1995 10 13.51		C	13.5:	GA	60.0	Y	6		1.9				NAK01
1995 10 20.49	a	C	13.1	GA	60.0	Y	6		2.3				NAK01
1995 10 25.53	a	C	13.0	GA	60.0	Y	6		2.5				NAK01

Comet 67P/Churyumov-Gerasimenko

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 07 03.41		k	17.1	EB	154.9	L	3		0.23		124 s	247	HER02
1995 07 27.73	a	C	16.6:	GA	60.0	Y	6		0.45				NAK01
1995 08 01.71	a	C	16.0	GA	60.0	Y	6		0.7		1.2m	255	NAK01
1995 08 02.43		C	17.3	FA	91.4	L	5		0.40		69 s	255	SCO01
1995 08 02.43		c	19.3	FA	91.4	L	5		0.40		69 s	255	SCO01
1995 08 18.62	a	C	15.4	GA	60.0	Y	6		0.5			250	NAK01
1995 08 26.05	c	C	14.2	LB	20.3	T	10		0.8				GAR02
1995 09 01.62		C	15.0	HS	20.3	T	6		0.9				YUS
1995 09 05.67	a	C	14.4	GA	60.0	Y	6		0.85				NAK01
1995 09 18.58		C	14.3	GA	60.0	Y	6		1.1			30	NAK01
1995 09 23.22		S	13.7	NP	25.6	L	4	156	1.1	3			MOR
1995 09 24.34		M	13.8	NP	50.8	L	4	195	1.0	3			MOR
1995 09 26.94		C	13.4	LB	20.3	T	10		1.0		3.2m	15	GAR02
1995 09 26.94		c	14.9	LB	20.3	T	10						GAR02
1995 10 13.80	!	V	14.2	YF	19.0	T	4		& 1	8	& 5 m	52	MIK
1995 10 18.83	!	V	14.3	YF	19.0	T	4		& 1	8	& 4 m	45	MIK
1995 10 20.80		S	14.2	AC	44.5	L	5	230	0.5	D6			BAK01
1995 10 20.80		S	14.2	AC	44.5	L	5	230	0.7	D6/			SAR02
1995 10 20.80		S	14.3	AC	44.5	L	5	230	0.8	D6/			SAR02
1995 10 22.80		S	14.1	AC	44.5	L	5	230	0.7	D6/			BAK01
1995 10 23.79		S	14.3	AC	44.5	L	5	230	0.7	D5/			SAR02

Comet 71P/Clark

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 04 01.47	!	S	13.5	AC	41	L	4	183					HAL
1995 04 08.48		S	13.5:	AC	41	L	4	183					HAL
1995 04 23.45	a	S	12.9	NP	25.6	L	4	156	0.9	2			MOR
1995 04 25.45	!	M	12.4	AC	41	L	4	72					HAL
1995 05 06.46		S	11.7:	AC	41	L	4	183					HAL
1995 05 10.44		M	11.6	AC	41	L	4	183					HAL
1995 05 25.57		S	11.4	AC	25.4	L	4	71	3				SEA
1995 05 27.57		S	11.4	GA	25.4	L	4	114	3	5			SEA
1995 05 28.44		M	11.3	AC	41	L	4	183					HAL
1995 06 03.40		M	11.2	AC	41	L	4	72					HAL

Comet 71P/Clark [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 06 03.41		S	11.6	AC	25.6	L	4	111					MOR
1995 06 03.41	a	S	11.4	NP	25.6	L	4	111	2.1	2			MOR
1995 06 05.59		S	10.9	GA	25.4	L	4	71	6				SEA
1995 06 20.53		S	10.5	GA	25.4	L	4	71					SEA
1995 06 20.55		S	10.7	GA	10.0	B		25	4				SEA
1995 06 21.36		M	11.3	AC	41	L	4	72					HAL
1995 06 22.97		S	11.9	HS	25	L	4	33	3.5	2/			KRY01
1995 06 25.56		S	10.4	AC	10.0	B		25	6				SEA
1995 06 27.55		S	10.5	AC	10.0	B		25					SEA
1995 06 29.55		S	10.4	AC	10.0	B		25					SEA
1995 07 01.53		S	10.8	AC	10.0	B		25					SEA
1995 07 02.38		S	11.0	AC	25.6	L	4	111	2.1	2			MOR
1995 07 04.38		S	11.0	AC	25.6	L	4	111	2.4	2/			MOR
1995 07 04.57		S	10.6	AC	10.0	B		25					SEA
1995 07 06.43	!	M	11.4	AC	41	L	4	72					HAL
1995 07 09.75	a	C	10.7	GA	60.0	Y	6		4.1				NAK01
1995 07 18.48		S	11.1	AC	25.4	L	4	71					SEA
1995 07 19.52		S	11.4	AC	10.0	B		25					SEA
1995 07 20.58		S	11.2	GA	25.4	L	4	71					SEA
1995 07 22.38		M	11.0	AC	25.6	L	4	67	1.9	4			MOR
1995 07 22.53		S	11.5	GA	25.4	L	4	71					SEA
1995 07 23.25	!	M	11.7	AC	41	L	4	72					HAL
1995 07 23.34		S	11.6	AC	25.6	L	4	111	1.9	3			MOR
1995 07 24.31		S	11.8	AC	25.6	L	4	111	1.9	2			MOR
1995 07 27.64	a	C	12.1:	GA	60.0	Y	6		2.7				NAK01
1995 07 28.45		S	11.7	GA	25.4	L	4	71					SEA
1995 07 29.27	!	M	11.5	AC	41	L	4	72					HAL
1995 07 29.37		S	11.9	AC	25.6	L	4	156	1.7	2			MOR
1995 07 29.48		S	11.6	GA	25.4	L	4	71					SEA
1995 07 30.30		M	11.9	AC	25.6	L	4	111	1.7	2/			MOR
1995 07 31.61	a	C	12.0	GA	60.0	Y	6		2.5				NAK01
1995 08 04.35		M	11.8	AC	41	L	4	72		1/			HAL
1995 08 18.26		S	12.0	AC	25.6	L	4	111	1.9	1/			MOR
1995 08 18.56	a	C	12.4	GA	60.0	Y	6		2.2				NAK01
1995 08 19.25		S	12.1	AC	25.6	L	4	111	1.9	1			MOR
1995 08 20.25		S	12.3	AC	25.6	L	4	111	1.9	1			MOR
1995 08 25.22		S	13.0	AC	25.6	L	4	156	1.5	1			MOR
1995 08 25.57		C	13.4	HS	28.0	T	6		1.9				KIN
1995 08 26.22		S	13.0	AC	25.6	L	4	156	1.5	1			MOR
1995 08 27.25		S	13.1	AC	25.6	L	4	156	1.5	1			MOR
1995 09 15.78		S	[14.0	HS	35	L	5	70	! 0.5				BAR06
1995 09 18.56		C	14.3	GA	28.0	T	6		1.2				KIN
1995 09 26.90	c	C	13.8	LB	20.3	T	10		0.8		0.9m	111	GAR02
1995 09 26.90	c	c	16.3	LB	20.3	T	10						GAR02
1995 10 12.47		C	14.9	GA	28.0	T	6		1.1				KIN
1995 10 13.47		C	16.5	HS	20.3	T	6		0.5				YUS
1995 10 13.48		C	14.5	GA	60.0	Y	6		1.5				NAK01
1995 10 20.43	a	C	14.8	GA	60.0	Y	6		1.2			65	NAK01
1995 10 25.43	a	C	15.2:	GA	60.0	Y	6		1.0				NAK01

Comet 73P/Schwassmann-Wachmann 3

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 05 18.51		C	18.4	GA	60.0	Y	6		0.35				NAK01
1995 05 23.51		C	18.2	GA	60.0	Y	6		0.35			110	NAK01
1995 06 20.51		C	16.5:	HS	60.0	Y	6		0.45				NAK01
1995 08 19.46		C	12.9	HS	28.0	T	6		1.1				KIN
1995 09 18.43		S	8.3	HS	41.0	L	5	80	4	6	0.11	131	KOB01
1995 09 20.09	!	M	8.8:	NP	20	L	6	49					HAL
1995 09 21.14		M	8.3:	S	25.6	L	4	45	2.9	7	0.5	110	MOR
1995 09 22.40		M	8 :	AA	10.0	B		25	& 1.5		>0.5		SEA
1995 09 23.13		M	8.4	S	25.6	L	4	45	2.1	7	0.5	110	MOR
1995 09 24.03		S	8.3	SC	33.3	L	4	58	1.5	7			KRO02
1995 09 24.13		M	8.4	S	25.6	L	4	45	2.1	7	0.5	110	MOR
1995 09 26.09	!	M	8.4:	NP	20	L	6	49					HAL
1995 09 26.80		B	8.1	S	20.3	T	10	67	3	8	&0.20	108	BIV

Comet 73P/Schwassmann-Wachmann 3 [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 09 27.03		S	8.2	SC	33.3	L	4	58	1	4			KR002
1995 09 27.38		M	7.2	AA	10.0	B		25	& 1	7	0.67	98	SEA
1995 09 27.80		B	8.1	S	20.3	T	10	67	3	7	&0.20	117	BIV
1995 09 28.80		B	7.9	S	20.3	T	10	67	3	7	&0.17	118	BIV
1995 09 29.38		M	7.2	AA	10.0	B		25			&1		SEA
1995 09 30.12		M	7.4	AA	25.6	L	4	45	2	8	0.5	110	MOR
1995 10 01.04		B	7.7:	SC	8.0	B		10	& 3	3			ROB03
1995 10 02.02		S	6.6	SC	8.0	B		20	1	8			KR002
1995 10 02.02		S	6.8	SC	33.3	L	4	58	1.1	8	0.03	46	KR002
1995 10 02.04		B	5.8	SC	8.0	B		10	< 5	S9			ROB03
1995 10 03.08		M	5.8	SC	5.0	B		10					HAL
1995 10 03.12		M	6.5	AA	8.0	B		20		7/			MOR
1995 10 04.04		B	7.1	SC	8.0	B		10	& 5	6	1	110	ROB03
1995 10 05.04		B	7.0	SC	8.0	B		10	& 5	s5	1	110	ROB03
1995 10 05.12		S	7.1	S	8.0	B		20					MOR
1995 10 06.39		M	6.3	AA	10.0	B		25			0.42	120	SEA
1995 10 06.40		M	6.0:	AA	16.0	W	4	19					TSU02
1995 10 06.41		M	6.1:	SC	12.0	B		20	& 4	7			NAK01
1995 10 06.92		S	6.1	AA	8.0	B		20	7	8	<1.0	110	LOU
1995 10 07.38		B	6.5	AA	10.0	B		25		8	0.67	115	SEA
1995 10 09.38		B	6.4	AA	10.0	B		25		8	0.67	118	SEA
1995 10 09.91		S	5.8	AA	8.0	B		11	5	7/	1.0	90	DES01
1995 10 10.38		B	6.4	AA	10.0	B		25		7			SEA
1995 10 10.41		S	5.8	AA	12.5	B		25	4	6	0.2	105	KOB01
1995 10 10.92		S	5.8	AA	8.0	B		11	5	7	1.0	90	DES01
1995 10 11.38		B	6.4	AA	10.0	B		25			&1		SEA
1995 10 11.40		S	5.8	AA	12.5	B		25	4	5	0.2	110	KOB01
1995 10 11.90		S	6.0	AA	8.0	B		11	5	7	>1.0	95	DES01
1995 10 11.92		B	6.3	S	7.0	B		10		9	37.2m	110	DEA
1995 10 12.39		B	5.4	AA	10.0	B		25		8			SEA
1995 10 12.91		S	5.9	AA	8.0	B		11	7	7/	1.25	100	DES01
1995 10 12.93		B	5.8	S	7.0	B		10	0.5	9	51.9m	105	DEA
1995 10 12.94		S	5.7	AA	8.0	B		20	7	7	>1.0	100	LOU
1995 10 12.97	&	B	6.3:	HI	25.4	L	4	44					GRE
1995 10 12.97	&	S	6.5	HI	25.4	L	4	44	& 2.5	7			GRE
1995 10 13.39		B	5.4	AA	5.0	B		10			1.7	105	SEA
1995 10 13.39		C	6.7	HS	20.3	T	6		3		0.13	100	YUS
1995 10 13.40		M	5.4	AA	12.5	L	6	23		6			TSU02
1995 10 13.41		M	5.6	AA	6.5	R	8	16	& 4	7		85	NAK01
1995 10 13.42		S	5.5	AA	7.0	B		10	5	7	0.3	110	KOB01
1995 10 14.39		B	5.3	AA	8.0	B		15		8	2.0		SEA
1995 10 15.40		B	5.6	AA	5.0	B		10			2.0		SEA
1995 10 19.92		S	5.9	AA	8.0	B		11	8	7	1.5	110	DES01
1995 10 20.37		S	6.8	SC	10	L	5	16	5	5	0.3	120	SHI
1995 10 22.92		S	6.2	AA	8.0	B		11	8.0	6/	1.5	85	DES01
1995 10 22.97		S	5.9	AA	5.0	B		7		6	2.0	115	LOU
1995 10 23.94		S	6.4	AA	8.0	B		20		5	1.5	113	LOU
1995 10 23.95		S	6.5	AA	8.0	B		11	5.0	5/	1.0	85	DES01
1995 10 24.93		S	6.8	AA	8.0	B		11	& 4.0	7	0.5	85	DES01
1995 10 24.94		S	6.8	AA	8.0	B		20		5/			LOU
1995 10 25.94		S	7.1	AA	8.0	B		20		4/	0.5		LOU
1995 10 25.95		S	7.0	AA	8.0	B		11	& 4.0	7/	0.6	95	DES01
1995 10 26.94		S	7.2	AA	8.0	B		11	& 4.0	7/	0.5	98	DES01

Comet 74P/Smirnova-Chernykh

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 05 08.78	a	C	18.0	GA	60.0	Y	6		0.3				NAK01
1995 05 23.76	a	C	18.0	GA	60.0	Y	6		0.4				NAK01
1995 06 01.73	a	C	17.6:	GA	60.0	Y	6		0.35				NAK01
1995 07 27.60	a	C	17.4	GA	60.0	Y	6		0.35		2.1m	266	NAK01
1995 08 16.54	a	C	17.6	GA	60.0	Y	6		0.3			250	NAK01
1995 08 30.26		k	17.2	EB	154.9	L	3		0.18	5			HER02
1995 08 30.27		k	17.6	EB	154.9	L	3						HER02

Comet 95P/Chiron

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 04 01.37		I	15.1	NP	41	L	4	183	0.0	9			HAL
1995 04 24.24		I	15.2	NP	41	L	4	183	0.0	9			HAL
1995 04 25.21		I	15.2	NP	41	L	4	183	< 0.1	9			HAL

Comet 109P/Swift-Tuttle

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1992 10 24.78		S	6.9	SC	8.0	B		20	4	3			VAN06
1992 10 25.78		M	6.7	SC	8.0	B		20	4	4			VAN06
1992 10 26.77		M	6.9	SC	8.0	B		20	4	4			VAN06
1992 11 14.76		B	6.1	SC	8.0	B		20	6	5			VAN06
1992 11 18.75		B	5.5	SC	8.0	B		20	8	5	0.3	55	VAN06
1992 11 18.76		B	5.4	SC	3.0	B		8					VAN06
1992 11 19.75		B	5.5	SC	3.0	B		8	4	5	1.1	45	VAN06
1992 11 20.74		M	5.8	AA	3.0	B		8	4	5	0.6	41	VAN06
1992 11 21.73		M	5.7	AA	3.0	B		8	5	5	0.7	41	VAN06
1992 12 11.72		M	5.6	AA	3.0	B		8	3	7	0.7	55	VAN06
1992 12 13.72		M	5.5	SC	3.0	B		8	3	7	1.25	51	VAN06
1992 12 15.72		B	5.2	SC	3.0	B		8	2	7	0.8	54	VAN06

Comet 116P/Wild 4

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 09 07.13	!	V	17.9	GA	36.0	T	7		0.1	8			MIK
1995 09 20.80		C	17.8	GA	60.0	Y	6		0.3				NAK01
1995 10 12.74		C	16.7	GA	28.0	T	6		0.3				KIN
1995 10 22.80		C	17.0	GA	60.0	Y	6		0.35		1.1m	295	NAK01
1995 10 27.78		C	16.8	GA	60.0	Y	6		0.4		1.3m	300	NAK01

Comet 117P/Helin-Roman-Alu 1

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 02 27.78		C	18.9	GA	60.0	Y	6		0.25		0.8m	297	NAK01
1995 04 07.71		C	18.2	GA	60.0	Y	6		0.35			290	NAK01
1995 04 26.58		C	18.3	GA	60.0	Y	6		0.3			315	NAK01
1995 05 23.56		C	18.2	GA	60.0	Y	6		0.35				NAK01

Comet 119P/Parker-Hartley

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 08 01.72		C	18.0	GA	60.0	Y	6		0.3		1.3m	245	NAK01
1995 08 07.72		C	18.2	GA	60.0	Y	6		0.25		1.1m	242	NAK01
1995 08 27.06	c	C	16.8	LB	20.3	T	10		0.6		1.9m	240	GAR02
1995 08 27.06	c	c	18.3	LB	20.3	T	10						GAR02
1995 09 02.12	c	C	16.6	LB	20.3	T	10		0.3		1.3m	239	GAR02
1995 09 02.12	c	c	17.7	LB	20.3	T	10						GAR02
1995 09 05.70		C	17.4	GA	60.0	Y	6		0.3		1.2m	242	NAK01
1995 09 18.62		C	17.0	GA	60.0	Y	6		0.4		2.0m	244	NAK01
1995 09 27.05		C	15.5	LB	20.3	T	10		0.5		1.0m	242	GAR02
1995 09 27.05		c	17.1	LB	20.3	T	10						GAR02
1995 10 12.57		C	16.2	GA	28.0	T	6		0.6		1.7m	228	KIN
1995 10 17.55		C	16.5	GA	60.0	Y	6		0.5		2.1m	245	NAK01
1995 10 20.61		C	16.6	GA	60.0	Y	6		0.4		1.3m	239	NAK01

Comet 120P/Mueller 1

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 08 30.37		k	21.4	EB	154.9	L	3		0.13	3			HER02

Comet 122P/de Vico

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 09 18.50		M	6.5	AA	8.0	B		20	4	8	1.17	290	MOR
1995 09 18.81		S	7.1	SC	10.6	R	5	30	4	6/			TAR
1995 09 18.82		S	6.8	SC	12.5	B	5	25	5.0	7	0.25	262	KOB01

Comet 122P/de Vico [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 09 18.83		M	6.8	AA	6.5	R	8	16					NAK01
1995 09 18.83	a	C	7.2	GA	8.0	R	6		10.1		>0.76	261	NAK01
1995 09 19.38		B	6.4	AA	5.0	B		12	& 8	7/			GRE
1995 09 19.38	a	B	6.6	HR	5.0	B		10					BOR
1995 09 19.38	a	S	6.5	HR	5.0	B		10	5	7/			BOR
1995 09 19.39		S	6.7:	AA	5.0	B		12					GRE
1995 09 19.42		S	7.6	SC	20.0	R	15	50	1.2	7			DAH
1995 09 19.51		M	6.2	AA	8.0	B		20	4	8	1.0	285	MOR
1995 09 19.82		M	6.0	AA	3.5	B		7					TSU02
1995 09 20.09		B	6.7	S	12	R	5	22	5.0	6	0.2		CHE03
1995 09 20.38	a	B	6.4	HR	5.0	B		10					BOR
1995 09 20.38	a	S	6.4	HR	5.0	B		10	5	7			BOR
1995 09 20.51		M	6.2	AA	8.0	B		20	4	8	1.0	283	MOR
1995 09 20.78		M	6.1	AA	10.0	B		25			0.3	286	SEA
1995 09 20.81		M	6.0	AA	8.0	B		11	3.5	7	?		WAT01
1995 09 21.15		M	6.2	AA	8.0	B		15	4	7			BOU
1995 09 21.15		S	5.6	AA	5.0	B		7	6	6/			ZAN
1995 09 21.16	!	S	6.3	AA	8.0	B		15	3.5	6/			HAV
1995 09 21.47		S	6.3	SC	5.0	B		10		7			HAL
1995 09 21.76		M	5.9	AA	10.0	B		25	4	7	0.5	277	SEA
1995 09 21.81		M	6.1	AA	8.0	B		11	4.1	7	0.2	270	WAT01
1995 09 22.14	&	S	6.3	AA	5.0	B		10	7				DIM
1995 09 22.35		S	6.2	AA	8.0	B		11	5	5			DES01
1995 09 22.43		S	6.2	SC	8.0	B		20	4	7			KRO02
1995 09 22.77		M	5.8	AA	10.0	B		25			0.3	277	SEA
1995 09 23.11		S	6.2	AA	12	L		20	3	5			SKO02
1995 09 23.11		S	6.4	AA	6.0	B		20	5	6/			KIS02
1995 09 23.11		S	6.4	AA	6.0	B		20	5	6/	0.8	270	SAR02
1995 09 23.14		S	6.4:	HI	20.3	T	10	80	3	6/			GRA04
1995 09 23.15		S	6.0	HI	5.0	B		10					GRA04
1995 09 23.16		S	6.2	AA	5.0	B		7	6	6			ZAN
1995 09 23.17		S	5.9	AA	8.0	B		20	3.1	6	0.3	5	SHA02
1995 09 23.18		S	5.9	AA	10	B		14	3.1	6			SHA02
1995 09 23.42	a	B	6.2	SC	5.0	B		10	& 5	6			MOD
1995 09 23.44		S	6.2	SC	8.0	B		20	5	7			KRO02
1995 09 23.46		S	6.4	SC	5.0	B		7					DIL
1995 09 23.50		S	6.1	AA	8.0	R	4	19	5.5	7			SPR
1995 09 23.50	a	M	5.8	AA	5.0	B		10		9			MOR
1995 09 23.50	a	M	5.8	AA	8.0	B		20		8	1.5	270	MOR
1995 09 24.11		S	6.2	AA	6.0	B		20	5	7	0.6	290	SAR02
1995 09 24.12		B	5.0	AA	10.0	B		25	3.5	5	1.0	260	HAS02
1995 09 24.12		I	4.9	AA	0.8	E		1					HAS02
1995 09 24.12		S	5.2	AA	10.0	B		25	3.5	5	1.0	260	HAS02
1995 09 24.21		B	5.8	S	15.0	L	4	40	15	7	2	270	ROD01
1995 09 24.39					12.0	B		20	5.0	8	0.85	267	BOR
1995 09 24.39	a	B	6.0	HR	5.0	B		10					BOR
1995 09 24.39	a	S	5.9	HR	5.0	B		10	5.5	8			BOR
1995 09 24.42	a	B	6.2	SC	5.0	B		10	4.5	6			MOD
1995 09 24.50	a	M	5.8	AA	5.0	B		10		9			MOR
1995 09 24.52		S	6.0	AA	10.0	R	4	17	5.5	7	0.05	255	SPR
1995 09 24.79		S	5.9	AA	8.0	B		20	5.0	7	0.75	265	YUS
1995 09 25.01		B	6.0:	AA	12	R	5	27	& 5.5	5/	&0.5		CHE03
1995 09 25.14		M	5.8	AA	8.0	B		15	4	7			BOU
1995 09 25.15		S	5.7	HI	5.0	B		10	4	6			GRA04
1995 09 25.16		S	5.7	HI	20.3	T	10	80	2.5	6			GRA04
1995 09 25.17		S	5.9	AA	5.0	B		7	3.1	8			SHA02
1995 09 25.17		S	6.0	AA	10	B		14	3.1	7	0.6	270	SHA02
1995 09 25.19		B	5.8	SC	5.0	B		7					BIV
1995 09 25.20		B	5.4	AA	5.0	B		10	2.2	8			KEI
1995 09 25.20		S	5.7	SC	6.0	R	13	40	4	8	>0.25	280	BIV
1995 09 25.48		M	5.8	SC	5.0	B		10			0.75	275	HAL
1995 09 25.98		B	5.7	AA	3	R	4	6	6.2	6	1.1		CHE03
1995 09 26.12		S	5.6	HI	5.0	B		10	3.5	6			GRA04
1995 09 26.14		M	5.7	HI	20.3	T	10	80	3.1	7	0.25	290	GRA04

Comet 122P/de Vico [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 09 26.14	&	S	5.7	AA	5.0	B		10	7				DIM
1995 09 26.16		S			15.0	B		25	7	6	1.5	270	ZAN
1995 09 26.16		S	6.0	AA	5.0	B		7	6	6			ZAN
1995 09 26.16		S	6.0	AA	8.0	B		20	6	6	0.5	290	BAR
1995 09 26.20		B	5.9	SC	5.0	B		7	6	8	&1.0	282	BIV
1995 09 26.21	a	B	5.7	AA	3.4	B		9	& 4	S8			PER01
1995 09 26.42	s	B	6.1	SC	5.0	B		10	4.2	6			MOD
1995 09 26.44		S	5.9	SC	8.0	B		20	5	7			KRO02
1995 09 26.44		S	5.9	SC	33.3	L	4	58	3.8	6			KRO02
1995 09 26.98		B	5.7	AA	8	R	4	11	6.3	6	1.2		CHE03
1995 09 27.13	!	S	5.6	AA	8.0	B		15	4.5	7	1.3	288	HAV
1995 09 27.14		M	5.5	HI	20.3	T	10	80	2.9	7	0.20	290	GRA04
1995 09 27.14	a	M	5.7	AA	8.0	B		20	6	6/	1.5		MIL02
1995 09 27.15		S	5.5	HI	5.0	B		10	3				GRA04
1995 09 27.15	!	I	5.3	AA	0.0	E		1					HAV
1995 09 27.16		S			15.0	B		25	7	6	1.5	270	ZAN
1995 09 27.16		S	5.9	AA	5.0	B		7	6	6			ZAN
1995 09 27.17		B	5.7	S	5.0	R		8	3	7			GAR02
1995 09 27.17		S	5.9	AA	8.0	B		20	7	6	0.5	280	BAR
1995 09 27.20		B	5.2	SC	0.0	E		1					BIV
1995 09 27.20		B	5.6	SC	5.0	B		7	5	8	>1.0	281	BIV
1995 09 27.21	a	B	5.6	AA	3.4	B		9	& 4	S8			PER01
1995 09 27.42	a	B	6.1	SC	5.0	B		10	4.6	6/			MOD
1995 09 27.43		S	5.8	SC	8.0	B		20	5	7			KRO02
1995 09 27.50	a	M	5.4	AA	5.0	B		10		8	4.0	277	MOR
1995 09 28.14		S	5.3	S	35	L	5	97	9	9	20 s	245	VAN04
1995 09 28.17		S	5.5	AA	5.0	B		7	3.1	8	0.75	280	SHA02
1995 09 28.17		S	5.6	AA	10	B		14	3.1	7	1.0	280	SHA02
1995 09 28.19		M	5.6	AA	5.0	B		10	2.2	8	0.26	263	KEI
1995 09 28.20		B	5.4	SC	0.0	E		1					BIV
1995 09 28.20		B	5.7	SC	5.0	B		7	5	8	&2.0	278	BIV
1995 09 28.21		B	5.5	AA	5.0	B		12	10	9			SAI
1995 09 28.35		S	5.0	SC	25.4	L	4	47	8	7/	1.5	274	DID
1995 09 28.39					8.0	B		20	3.9	7/	0.7	288	BOR
1995 09 28.39	a	B	5.8	HR	5.0	B		10					BOR
1995 09 28.39	a	S	5.7	HR	5.0	B		10	7	7/			BOR
1995 09 28.41	a	B	6.1	SC	5.0	B		10	4.1	6/			MOD
1995 09 28.43		S	5.8	SC	8.0	B		20	6	7			KRO02
1995 09 28.47		M	5.6	SC	5.0	B		10			1.15	272	HAL
1995 09 29.01		B	5.5	AA	8	R	4	11	5.5	6	1.5		CHE03
1995 09 29.15		S			15.0	B		25	7	6	2.5	260	ZAN
1995 09 29.15		S	5.5	AA	15.0	R	8	75	6	8			DIE02
1995 09 29.15		S	5.6	AA	5.0	B		12	3.0	6			TAN02
1995 09 29.15		S	5.7	AA	5.0	B		7	7	7	1.5	260	ZAN
1995 09 29.17		S	5.6	AA	10	B		14	2.5	8	1.9	278	SHA02
1995 09 29.18		B	5.3	SC	0.0	E		1					BIV
1995 09 29.18		B	5.7	SC	5.0	B		7	5	8	&2.0	276	BIV
1995 09 29.18		S	5.4	AA	0.0	E		1	3	8			SHA02
1995 09 29.18		S	5.6	AA	5.0	B		7	3.1	8	1.5	278	SHA02
1995 09 29.18		S	5.8	AA	7.0	B		15	4	8			PAN
1995 09 29.19					35	L	5	49	& 3.0	7/	&28 m	270	BRO04
1995 09 29.19		S	5.7	AA	5.0	B	5	10					BRO04
1995 09 29.20		S	5.6	AA	8.0	B		15	5.0	3			HUR
1995 09 29.30		S	6.2	AA	8.0	B		11	7	6	>0.5		DES01
1995 09 29.37		B	5.5	AA	3.5	B		7	& 6	8			GRE
1995 09 29.38		S	5.3	SC	25.4	L	4	47	7	7/	0.5	275	DID
1995 09 29.39	a	B	5.8	HR	5.0	B		10	6.5	8			BOR
1995 09 29.43	s	B	6.0	SC	5.0	B		10	4.4	6/			MOD
1995 09 29.97		B	5.6	AA	8	R	4	11		6	&1.5		CHE03
1995 09 30.12		M	5.6	TI	8.0	B		10	4.5	6	1		HOR02
1995 09 30.13		B	5.3	AA	10.0	B		25	4.0	5	1.0	260	HAS02
1995 09 30.13		S	5.4	AA	5.0	B		10	7	8	2.5	290	MOE
1995 09 30.14		S	5.6:	HI	5.0	B		10	3				GRA04
1995 09 30.15		M	5.6	AA	5.0	B		12	3.0	7	1.10	280	TAN02

Comet 122P/de Vico [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 09 30.16		S			15.0	B		25	7	6	2.7	260	ZAN
1995 09 30.16		S	5.7	AA	5.0	B		7	7	7	2.0	260	ZAN
1995 09 30.19		M	5.4	S	7.0	B		10	15	8	1.5	280	MAR02
1995 09 30.19		M	5.5	S	7.0	B		10		8	1.5		SAN04
1995 09 30.19		S	5.2	AA	7.0	B		16	15	4		280	TAY
1995 09 30.19		S	5.6	AA	7.0	B		15	4	8			PAN
1995 09 30.21		B	5.6	SC	5.0	B		7	5	7	>1.0	279	BIV
1995 09 30.30		S	6.1	AA	8.0	B		11	10	5/	>0.5		DES01
1995 09 30.38		S	5.3	SC	25.4	L	4	47	7	7	1.5	265	DID
1995 09 30.39	a	B	5.4	HR	5.0	B		10					BOR
1995 09 30.39	a	S	5.5	HR	5.0	B		10	7	7/	1.75	280	BOR
1995 09 30.42	s	B	5.8	SC	5.0	B		10	3.8	7/	0.9	274	MOD
1995 09 30.49		I	5.4	AA	0.7	E		1		9			MOR
1995 09 30.50		M	5.4	AA	5.0	B		10		8	3.5	282	MOR
1995 09 30.82		M	5.2	AA	8.0	B		11	> 5	6			WAT01
1995 10 01.13		S	5.3	AA	5.0	B		10	6	7	2.8	290	MOE
1995 10 01.14		S	5.4	HI	5.0	B		10	4	7	0.8	290	GRA04
1995 10 01.15		M	5.5	HI	20.3	T	10	50	3.9	7/	0.65	295	GRA04
1995 10 01.16		S	5.6	AA	15.0	R	8	75	6	8			DIE02
1995 10 01.20		B	5.4	AA	31.0	L	5	75	12	9	3.0		SAI
1995 10 01.21		B	5.6	SC	5.0	B		7	5	7	>1.0	275	BIV
1995 10 01.29		S	6.1	AA	8.0	B		11	10	5	>0.6		DES01
1995 10 01.32		B	5.5	AA	7.0	B		10	6	7			DEA
1995 10 01.42	s	B	5.8	SC	5.0	B		10	3.4	7/			MOD
1995 10 01.45		B	5.4	SC	8.0	B		10	& 8	s8	5.0		ROB03
1995 10 01.47		M	5.3	SC	5.0	B		10			1.5	271	HAL
1995 10 01.50		M	5.4	AA	5.0	B		10		8	5.5	285	MOR
1995 10 01.52		S	5.5	AA	10.0	R	5	27	6.5	7	1.5	260	SPR
1995 10 01.97		B	5.5	AA	8	R	4	11		6	&2.0		CHE03
1995 10 01.98		B	5.8	AA	12	R	4	27	5.2	6			CHE03
1995 10 02.11		S	5.9	S	6.0	R	7	20	4	7			THO03
1995 10 02.15		M	5.4	AA	5.0	B		10		7			BOU
1995 10 02.15		M	5.5	AA	8.0	B		15	3	7/	2.0	290	BOU
1995 10 02.17		S	6.2	AA	10	B		14	3.1	7	0.5	280	SHA02
1995 10 02.20		B	5.2	AA	5.0	B		12	12	8			SAI
1995 10 02.30		S	6.0	AA	8.0	B		11	11	5	>0.7		DES01
1995 10 02.31		B	5.5	AA	7.0	B		10	5.5	8			DEA
1995 10 02.42		S	5.6	SC	8.0	B		20	6	7	1.9	280	KRO02
1995 10 02.51		M	5.5	AA	5.0	B		10		8			MOR
1995 10 02.83		S	5.5	AA	5.0	B	5	7	5	6	2.0	285	KOB01
1995 10 02.99		B	5.7	AA	8	R	4	11	5.2	6	&2.0		CHE03
1995 10 03.13		B	5.8	AA	10.0	B		25	4.5	5	1.8	285	HAS02
1995 10 03.13		S	5.8:	S	15.0	L	8	32	8	7			THO03
1995 10 03.15		S	5.7	HS	5.0	B		5		5			BEC01
1995 10 03.16		M	5.4	AA	8.0	B		15	3.5	7	2.5	282	BOU
1995 10 03.32		S	5.9	AA	8.0	B		11	12	4/	1.0		DES01
1995 10 03.35		S	5.4	SC	25.4	L	4	47	7	8	0.5	280	DID
1995 10 03.49		B	5.2	SC	0.0	E		1					HAL
1995 10 03.52		M	5.3	AA	5.0	B		10		8	3.5	283	MOR
1995 10 03.98		B	5.6	AA	8	R	4	11	5.0	6	2.7		CHE03
1995 10 04.18		M	5.1	S	7.0	B		10	15	8	3.0		SAN04
1995 10 04.31		S	6.2	AA	8.0	B		11	10	5	<1.0		DES01
1995 10 04.44		S	5.3	SC	0.0	E		1					KRO02
1995 10 04.44		S	5.4	SC	8.0	B		20	6	7	1.9	292	KRO02
1995 10 04.45		B	5.3	SC	8.0	B		10	&10	s6	3.5		ROB03
1995 10 04.51		S	5.5	AA	8.0	B		11	7	6	2.0	270	SPR
1995 10 04.51		S	5.5	AA	8.0	B		11	7	6	2.0	270	SPR
1995 10 04.52		M	5.4	AA	5.0	B		10		8			MOR
1995 10 04.99		B	5.5	AA	8	R	4	11	4.8	6	4.1	290	CHE03
1995 10 05.00		S	5.1	AA	0.0	E		1			&3.5		CHE03
1995 10 05.10		S	5.7:	S	15.0	L	8	32	10	6	0.4	305	THO03
1995 10 05.17		S	4.7	AA	0.0	E		1	& 3	8			SHA02
1995 10 05.17		S	5.2	AA	5.0	B		7	3.1	8	1.6	289	SHA02
1995 10 05.17		S	5.3	AA	10	B		14	3.1	7	1.6	289	SHA02

Comet 122P/de Vico [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 05.17		S	5.4	S	3.0	B		8	& 4	7	0.5	293	ALD01
1995 10 05.21	a	B	5.2	Y	5.0	B		7					GON03
1995 10 05.31		S	6.3	AA	8.0	B		11	8	4/	>0.9		DES01
1995 10 05.46		S	5.5	SC	5.0	B		7					DIL
1995 10 05.48		B	5.1	SC	0.0	E		1					HAL
1995 10 05.51		S	5.2	AA	8.0	B		11	7	7/	2.25	270	SPR
1995 10 05.52		M	5.2	AA	5.0	B		10		8	5.0	288	MOR
1995 10 06.01		B	5.4	AA	8	R	4	11	4.8	6	3.8	291	CHE03
1995 10 06.01		S	5.0	AA	0.0	E		1			&3.5		CHE03
1995 10 06.11		S	5.3	HI	5.0	B		10	4	7	0.8	291	GRA04
1995 10 06.15					15.0	R	8	75	& 6	7	&40 m	307	DIE02
1995 10 06.15		M	5.3	AA	5.0	B		10	3.5	8	3.7	291	BOU
1995 10 06.15		S	5.6	AA	5.0	B		8					DIE02
1995 10 06.16		M	5.5	HI	20.3	T	10	50	4.2	7	0.65	292	GRA04
1995 10 06.17					35	L	5	49	& 3.0	8	&40 m	280	BRO04
1995 10 06.17		S	5.4	AA	5.0	B	5	10					BRO04
1995 10 06.18		M	5.5	TI	5.0	B		7	5		1		POD
1995 10 06.20		B	5.5	SC	5.0	B		7	4	7	>0.5	305	BIV
1995 10 06.45		B	5.4	SC	8.0	B		10	&10	s7	3.5		ROB03
1995 10 06.52	a	M	5.2	AA	5.0	B		10		8			MOR
1995 10 06.78		M	5.4	AA	13.0	L	8	50	8	6	3		AIZ
1995 10 06.78		S	5.2	AA	8.0	B		20	6.0	5/	2.5		YUS
1995 10 06.83		S	5.6	S	15.0	R	5	25	5	7	1.6		NAG02
1995 10 06.98		B	5.7	AA	12	R	5	27	& 4.5	6	2.5		CHE03
1995 10 07.21		B	5.6	SC	5.0	B		7	4	7	>0.4	305	BIV
1995 10 07.32		S	5.8	AA	8.0	B		11	6	6	1.5		DES01
1995 10 07.80		C	5.8	HS	20.0	L	4		5.1				OOY
1995 10 07.97		B	5.8	AA	12	R	5	27	4.1	6	&1.0		CHE03
1995 10 07.98		B	5.6	AA	8	R	4	11		6			CHE03
1995 10 08.17		N	8.8:	HI	20.3	T	10	80	3.9	7	0.2	305	GRA04
1995 10 08.18		S	5.4	HI	5.0	B		10	4	7	0.4	300	GRA04
1995 10 08.20		B	5.6	SC	5.0	B		7	4	7	>0.3	313	BIV
1995 10 08.32		B	5.6	AA	8.0	B		11	8	6/	>1.5		DES01
1995 10 09.17		M	5.4	AA	8.0	B		15	4	7			BOU
1995 10 09.17		S	5.4	HI	5.0	B		10	4	7			GRA04
1995 10 09.18		M	5.4	HI	20.3	T	10	80	4.0	7	0.3	310	GRA04
1995 10 09.18		S	5.5	AA	10	B		14	3.8	7	0.5	280	SHA02
1995 10 09.19		M	5.3	AA	8.0	B		20	4	6/			ZAN
1995 10 09.35		S	5.3	SC	25.4	L	4	47	8	7	0.75	270	DID
1995 10 09.80		S	5.6	AA	8.0	B		20	5	6	3		YUS
1995 10 09.81		S	5.2	S	15.0	R	5	25	3	6/	>1		NAG02
1995 10 09.83		S	5.7	AA	7.0	B		10	5	6	>0.3	315	KOB01
1995 10 09.96		B	5.8	S	12	R	5	27	& 4.5	5	&1.0		CHE03
1995 10 09.97		B	5.5	S	8	R	4	11		5			CHE03
1995 10 10.12		M	5.6	TI	8.0	B		10	4	6	0.17		HOR02
1995 10 10.13		M	5.8	TI	30	L	15	40	4		0.15		POP
1995 10 10.14		M	5.6	TI	8.0	B		10	3.7	6/			PLS
1995 10 10.18		M	5.6	TI	8.0	B		10	5		1		POD
1995 10 10.19		B	5.9:	SC	6.2	R	5	16	4	6/	>0.2	324	BIV
1995 10 10.32		B	5.6	AA	8.0	B		11	6	6	>1.5		DES01
1995 10 10.36		S	5.3	SC	25.4	L	4	47	6	5	0.75	323	DID
1995 10 10.83		S	5.6	AA	7.0	B		10	5	6	>0.6	315	KOB01
1995 10 10.99		B	5.8	S	12	R	5	27			&1.0		CHE03
1995 10 11.12		S	5.4	HI	5.0	B		10	4	7			GRA04
1995 10 11.14		S	5.7	AC	6.0	B		20	2	D7			LAN02
1995 10 11.17		M	5.4	HI	20.3	T	10	80	4.3	7	0.5	315	GRA04
1995 10 12.12		M	5.5	TI	8.0	B		10	4	6/			HOR02
1995 10 12.38		S	5.3	SC	25.4	L	4	47	6	5	0.5	325	DID
1995 10 12.81		C	5.9	HS	20.0	L	4		4.5				OOY
1995 10 12.81		S	5.6	S	15.0	R	5	25	5	6/	1		NAG02
1995 10 12.83		C	6.3	GA	8.0	R	6		14.9		>0.93	318	NAK01
1995 10 12.84		M	5.5	AA	6.5	R	8	16	& 5	6/			NAK01
1995 10 13.09		S	5.3	SC	5.0	B		10	4	6	0.5	325	GRA04
1995 10 13.12		M	5.5	TI	8.0	B		10	4	6/	0.17		HOR02

Comet 122P/de Vico [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 13.22	a	B	5.7	AA	3.4	B		9	& 4	S7/			PER01
1995 10 13.35		S	5.3	SC	25.4	L	4	47	8	5	1.5	300	DID
1995 10 13.79		S	5.6	AA	8.0	B		20	5	6	0.8		YUS
1995 10 13.83		C	5.9	HS	6.0	A	3		12.5		>1.8	318	OOY
1995 10 13.83		M	5.5	AA	5.0	B		7		7	0.5		KAT01
1995 10 13.84		S	5.5	AA	7.0	B		10	6	6	>2	320	KOB01
1995 10 14.15		S	5.6	AA	5.0	B		7	& 6	8			MIK
1995 10 14.21		B	5.7:	SC	5.0	B		7	5	7			BIV
1995 10 14.38		S	5.2	SC	25.4	L	4	47	8	5/	0.5	335	DID
1995 10 14.38		S	5.2	SC	25.4	L	4	126					DID
1995 10 14.83		M	5.7	AA	5.0	B		7		7	0.4		KAT01
1995 10 15.11		S	5.4	HD	6.0	B		20	5	7			KIS02
1995 10 15.23	a	B	5.4	Y	5.0	B		7					GON03
1995 10 16.16		S	5.4	AA	5.0	B		7	7	7			ZAN
1995 10 16.35		S	5.2	SC	25.4	L	4	47	8	6	1.5	320	DID
1995 10 17.22		B	6.0	AA	3.4	B		9	& 4	S7			PER01
1995 10 17.38		S	5.5	SC	25.4	L	4	47	8	6	1	330	DID
1995 10 17.81		M	5.7	AA	3.5	B		7					TSU02
1995 10 17.83		S	6.1	S	15.0	R	5	25	5	7	0.5		NAG02
1995 10 18.12		S	5.7	HI	5.0	B		10	5	6	1.3	335	GRA04
1995 10 18.18		M	6.0	HI	20.3	T	10	50	4.8	6/	0.7	335	GRA04
1995 10 18.38		S	5.5	SC	25.4	L	4	47	7	6	1	325	DID
1995 10 18.76		M	6.0	HI	7.6	R	13	25	5.1	6			GRA04
1995 10 18.83		C	6.9	HS	20.0	L	4		5.3		>0.6	330	OOY
1995 10 19.07		S	6.0	HI	5.0	B		10	5	5/			GRA04
1995 10 19.11		M	6.0	HI	20.3	T	10	50	5.5	6/	0.40	335	GRA04
1995 10 19.23		B	6.3	AA	3.4	B		9					PER01
1995 10 19.23		M	6.2	AA	3.4	B		9	& 4	S7			PER01
1995 10 19.38		S	5.5	SC	25.4	L	4	47	7	6	0.5	343	DID
1995 10 19.78		S	6.4:	HI	7.6	R	13	25	6.0	6	0.3	345	GRA04
1995 10 19.84	a	C	6.7	GA	8.0	R	6		14.2		>0.77	337	NAK01
1995 10 20.75		S	6.1	HI	5.0	B		10	4.5	5/			GRA04
1995 10 20.76		B	6.3	HI	20.3	T	10	50	5.0	6/	0.50	350	GRA04
1995 10 20.80		S	5.5	SC	10	L	5	16	11	7	1.2	340	SHI
1995 10 20.80		S	6.3	S	15.0	R	5	25	5	6/	0.33		NAG02
1995 10 21.12		S	6.4	AC	5.0	B		12	10	9			SZA03
1995 10 21.15		S	5.5	AA	10	B		14	4.7	7	0.9	336	SHA02
1995 10 21.18		M	6.0	HI	5.0	B		10	5	6	0.8	350	GRA04
1995 10 21.72		M	5.9	TI	10	B		25	4	7	0.8		ZNO
1995 10 22.09		S	6.3	HD	6.0	B		20	4	7/	1.5	300	SAR02
1995 10 22.12		S	6.1	HD	11	L	7	32	3.5	6			KER
1995 10 22.13		S	6.3	HD	6.0	B		20	4	7	0.5	0	KIS02
1995 10 22.17					15.0	R	8	75	& 6	7	&20 m	345	DIE02
1995 10 22.17		S	6.3	AA	5.0	B		8					DIE02
1995 10 22.36		S	5.8	SC	25.4	L	4	47	7	5	0.5	340	DID
1995 10 22.66		B	6.5	S	6.0	B		20	& 6	5	&0.5		CHE03
1995 10 23.12		S	6.3:	HD	6.0	B		20	5	6/	2	310	SAR02
1995 10 23.21		S	6.0	AA	10	B		14	5.0	7	0.33	335	SHA02
1995 10 23.22		S	6.3	AA	5.0	B		7	4.0	8			SHA02
1995 10 23.65		B	6.4	S	6.0	B		20	& 6	5	&0.5		CHE03
1995 10 24.12		S	6.5	HD	6.0	B		20	5	7/	2.5	320	SAR02
1995 10 24.14		S	6.7:	HD	44.5	L	5	72	4	6/	1	340	SAR02
1995 10 24.19		S	5.7	AA	10	B		14	3.8	7	0.15	325	SHA02
1995 10 25.13		S	6.6	AA	6.0	B		20					KIS02
1995 10 25.65		M	6.5	S	6.0	B		20	& 6	5			CHE03
1995 10 28.13		S	6.6	HI	5.0	B		10	5	6			GRA04
1995 10 28.18		M	6.7	HI	20.3	T	10	50	5.3	6/	0.4	345	GRA04
1995 10 28.78		M	6.9	S	15.0	L		90	6	5			SAN04
1995 10 29.19		S	6.9	HI	5.0	B		10	5	5/			GRA04
1995 10 29.51		S	6.6	AA	8.0	B		11	5.5	6/	0.25	355	SPR
1995 10 29.76		S	7.1	HI	7.6	R	13	25	4.7	5			GRA04
1995 10 30.10		S	6.8	AA	8.0	R	4	19	5	6			SPR
1995 10 31.10		S	6.6	AA	10.0	R	5	27	5	5/			SPR

Comets for the Visual Observer in 1996

Alan Hale

Southwest Institute for Space Research

The recently-discovered Comet C/1995 O1 (Hale-Bopp), which — according to the latest orbit available at this writing (*MPC* 25714; T = 1997 Apr. 1.1 TT, q = 0.91 AU) — may become a bright naked-eye object during the first few months of 1997, should be easily observable throughout most of 1996. Near conjunction in early January, it emerges into the morning sky by late February or early March, is at opposition (still at r = 3.9 AU) in early July, and remains in the evening sky thereafter, until being in conjunction again (28° north of the sun) at the very end of the year. While an accurate brightness forecast is not possible at this time, under the assumption that the comet will brighten somewhat "normally," it should remain bright enough for observation in small telescopes throughout the entire period of its visibility in 1996. By mid-year it should be visible in small binoculars (m_1 perhaps ~ 6-8) and be bright enough for naked-eye visibility (m_1 ~ 3-5) by November or December.

In addition to this object, several short-period comets are expected to be visible during 1996. Two of these should become bright enough for observation in ordinary binoculars, with the remainder requiring small- to medium-aperture telescopes. Ephemerides for all the following objects are given in the ***1996 Comet Handbook*** (Nakano and Green 1995).

The Brighter Comets

45P/Honda-Mrkos-Pajdušáková

Passing perihelion on 1995 December 25 (q = 0.53 AU), this comet should be visible in the evening sky during December 1995 near m_1 ~ 7-8, although it will enter the solar glare around year's end. Following inferior conjunction in mid-January 1996, it emerges into the morning sky about two weeks later. At that time the comet will be rapidly approaching the earth, passing at a minimum geocentric distance of 0.170 AU on February 4; it will then be traveling to the northwest at a rate of 4° per day. Observations at previous returns indicate this comet has a steep light curve with respect to perihelion, and thus it is unlikely to be any brighter than m_1 ~ 8-10 while at perigee. Fading will be rapid thereafter, and visual observations will probably not be possible after late February or early March.

22P/Kopff

The 1996 return of this object is especially favorable, with perihelion occurring on July 2 (q = 1.58 AU) and opposition being less than two weeks later. According to the brightness formula derived by Bortle (1984) from the comet's well-observed 1983 return, it should become visually observable at m_1 ~ 12-13 around February, reach binocular visibility at m_1 ~ 8-9 by the end of April, and remain at a peak brightness of m_1 ~ 7 throughout June and July. Although the 1983 observations suggest that the comet will fade rapidly and grow diffuse after perihelion, visual observations should continue to be possible until about October.

The Fainter Comets

29P/Schwassmann-Wachmann 1

This object emerges into the morning sky about October 1995, where it remains until opposition near the end of February 1996, after which it is visible in the evening sky before entering the solar glare about July. It again becomes visible in the morning sky about November, enroute to its next opposition in March 1997. During recent years the comet has consistently exhibited 1-2 outburst events per viewing season, and thus continued monitoring for such occurrences is appropriate throughout its period of visibility in 1996.

67P/Churyumov-Gerasimenko

This comet passes perihelion on January 17, at q = 1.30 AU. Opposition will have already occurred in August 1995, thus the comet remains in the evening sky throughout its expected period of visual observability. Bortle's (1983) analysis of the favorable 1982 return suggests the comet will begin the year near m_1 ~ 12.5, and will gain about a half-magnitude by February. It may remain near 12th magnitude through most of March, but will probably fade beyond the range of visual observations by the end of April.

95P/Chiron

Some 18.5 years after its discovery by Charles Kowal in 1977, this unusual object finally passes perihelion on 1996 February 14, at q = 8.45 AU; the 1996 opposition thus presents the best possible opportunities for observation. 95P/Chiron emerges into the morning sky by the end of November 1995, is at opposition at the end of March 1996, and is accessible in the evening sky until about August. A second viewing opportunity occurs toward the end of the year, as 95P/Chiron again emerges into the morning sky, enroute to another opposition in mid-April 1997.

Visual observations obtained during 95P/Chiron's 1995 opposition suggest that it may be near mag 15.5 at the beginning of 1996, at or slightly brighter than mag 15.0 while at opposition, and fading back to near 15.5 by the time it enters the solar glare. Visually, it will very probably appear entirely stellar, although a very small and faint coma may possibly be seen in larger telescopes. 95P/Chiron has also exhibited occasional brightness outbursts (1-2 magnitudes) during the past, and potential observers may wish to monitor it for such events during this perihelic opposition.

32P/Comas Solá

This comet's 1996 return is rather unfavorable (perihelion June 10, $q = 1.85$ AU) and visual observations will be quite difficult. It will have already been at opposition in mid-October 1995, and may be near $m_1 \sim 14$ by the beginning of 1996. A peak brightness of $m_1 \sim 13.5$ may be achieved near the end of March, but by then the comet's elongation will be only 40°, and decreasing; observations will almost certainly not be possible after the end of April.

65P/Gunn

Perihelion for this comet occurs on July 24, at $q = 2.46$ AU. The viewing circumstances in 1996 are rather favorable, with opposition occurring at the end of May, although due to its rather large perihelion distance the comet will remain quite faint. Observations at previous returns suggest that the comet will become visually observable at $m_1 \sim 13$ around March or April, and will reach a peak brightness near $m_1 \sim 12.5$ during May and June. Visual observations will probably be possible until about the end of August.

121P/Shoemaker-Holt 2

This comet was originally discovered in March 1989, having passed perihelion the previous August. It makes its first predicted return in 1996, and was recently recovered in August 1995 by J. Scotti at Kitt Peak. The viewing circumstances in 1996 are very similar to those in 1988-89; the current return's perihelion date is only two weeks later than that of the previous one. The geometry of this return is not especially good; its elongation (in the morning sky) at perihelion (August 19, at $q = 2.66$ AU) is only 30°, and it is not at opposition until late February 1997. Under the assumption that its discovery brightness in 1989 is indicative of its true brightness and not the result of an outburst, it should be visible in the morning sky during late 1996 near $m_1 \sim 13.5$.

116P/Wild 4

Discovered in 1990, this comet makes its first predicted perihelion passage on 1996 August 31, at $q = 1.99$ AU; the recovery has already been made by J. Scotti at Kitt Peak in November 1994. The comet is at opposition in mid-January 1996 and should be accessible in the evening sky until about June. If its brightness behavior in 1996 is similar to that exhibited in 1990, the comet should remain near a peak brightness of $m_1 \sim 13.5$ throughout most of this period.

96P/Machholz 1

This unusual comet, originally discovered in 1986, then observed through the subsequent aphelion and then at its next perihelion passage in 1991, passes perihelion again on 1996 October 15, at $q = 0.125$ AU. Prior to perihelion the comet is well-placed for observation from the southern hemisphere, being as far south as declination (δ) $-89°$ in early August (although probably too faint for visual observations then). Visual observations may be possible by late August or early September, and should remain so up through the first week of October. After perihelion the comet will be north of the sun but will remain too close to it for observations to be possible.

Some evidence from the 1991 return suggests that P/Machholz 1 remains relatively inactive until after perihelion passage. If this is true, the comet may be much fainter than is suggested here, and visual observations may not be possible at all. Southern hemisphere observers are thus particularly encouraged to attempt observations of this comet in order to better define its pre-perihelion light curve.

P/1983 M1 (IRAS)

Like several of the other comets discussed here, this object is making its first predicted return in 1996, having originally been discovered by the Infrared Astronomical Satellite in June 1983. Perihelion in 1996 is predicted to occur on October 31, at $q = 1.70$ AU. Due to a relatively high orbital inclination of 46°, the comet spends most of 1996 south of $\delta = -60°$, being as far south as $\delta = -64°$ in mid-August, and still at $\delta = -59°$ when at opposition in early September. The comet should become accessible to the northern hemisphere by early October, although it will remain south of the equator until the end of November. If its brightness behavior in 1996 is similar to that exhibited in 1983, the comet should remain visually observable from about July until about December, with a peak brightness of $m_1 \sim 12$ occurring in September and October.

81P/Wild 2

Although not at perihelion until 1997 May 6 ($q = 1.58$ AU), this comet has, for a short-period comet, a relatively high intrinsic brightness, and has a history of maintaining its brightness for several months on either side of perihelion. Observations at previous returns suggest the comet may become visually observable at $m_1 \sim 13$ as early as November 1996, and may be as bright as $m_1 \sim 11$-12 by the end of the year. The comet is at opposition in mid-January 1997.

(continued on next page)

The following two comets were both discovered in 1991, each one being a faint object several months past perihelion passage at discovery. Each is making its first predicted return to perihelion in 1996-97, under circumstances favorable enough to suggest observations may be possible. Observers with larger instruments may wish to attempt observations of these objects in order to better define their brightness parameters.

P/1991 R2 (Spacewatch)

This comet was described as an extremely faint object of 21st magnitude when discovered 8.5 months after perihelion. The predicted perihelion date in 1996 is July 16 ($q = 1.54$ AU); according to the predicted elements the comet will be at opposition in mid-March and its minimum geocentric distance will be 0.89 AU in early April. Theoretically, the comet will be accessible in the evening sky until November, although by then it may well be two or more magnitudes fainter than it was at perihelion.

118P/Shoemaker-Levy 4

This object has already been recovered, this having been accomplished in June 1995 by J. Scotti at Kitt Peak. Perihelion occurs on 1997 January 12, at $q = 2.02$ AU. The comet is especially well placed for observation during this return, being at opposition in mid-December 1996, and theoretically may be visually accessible for one or more months on either side of that time.

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Bortle, J. E. (1983). *Sky Tel.* **66**, 84.
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Perturbed ephemeris for C/1995 O1 (Hale-Bopp), from orbital elements on MPC 25932 ($H_{10} = -2.0$)

1995/96	α_{2000}	δ_{2000}	Δ	r	ϵ	β	m_1
Oct. 10	18h16m.66	−28°52'.7	6.618	6.474	77°.4	8°.7	10.2
20	18 18.26	−28 25.4	6.693	6.386	67.9	8.3	10.2
30	18 20.87	−27 58.6	6.758	6.297	58.6	7.7	10.1
Nov. 9	18 24.38	−27 32.2	6.807	6.208	49.4	7.0	10.1
19	18 28.67	−27 05.9	6.838	6.118	40.3	6.0	10.0
29	18 33.64	−26 39.4	6.848	6.028	31.4	4.9	10.0
Dec. 9	18 39.16	−26 12.6	6.835	5.937	22.5	3.6	9.9
19	18 45.10	−25 45.0	6.796	5.845	13.8	2.3	9.8
29	18 51.37	−25 16.5	6.731	5.753	5.3	0.9	9.7
Jan. 8	18 57.82	−24 46.8	6.640	5.660	4.4	0.8	9.6
18	19 04.35	−24 15.8	6.522	5.567	12.7	2.2	9.5
28	19 10.85	−23 43.2	6.379	5.473	21.3	3.7	9.4
Feb. 7	19 17.17	−23 09.1	6.211	5.378	29.9	5.2	9.3
17	19 23.20	−22 33.4	6.020	5.283	38.5	6.7	9.1
27	19 28.81	−21 56.0	5.808	5.186	47.2	8.1	9.0
Mar. 8	19 33.84	−21 17.1	5.578	5.090	56.0	9.3	8.8
18	19 38.16	−20 36.7	5.333	4.992	64.9	10.4	8.6
28	19 41.59	−19 54.8	5.076	4.894	73.9	11.3	8.4
Apr. 7	19 43.95	−19 11.4	4.812	4.795	83.1	12.0	8.2
17	19 45.05	−18 26.7	4.543	4.695	92.5	12.3	8.0
27	19 44.67	−17 40.4	4.276	4.594	102.2	12.4	7.8
May 7	19 42.58	−16 52.6	4.014	4.493	112.2	12.0	7.5
17	19 38.59	−16 03.1	3.763	4.391	122.5	11.2	7.3
27	19 32.50	−15 11.6	3.529	4.287	133.3	9.9	7.1
June 6	19 24.24	−14 17.8	3.317	4.183	144.3	8.1	6.8
16	19 13.82	−13 21.7	3.133	4.078	155.4	5.9	6.6
26	19 01.50	−12 23.5	2.981	3.973	165.4	3.7	6.4

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DEEP-SKY OBJECTS

In the October 1994 issue (p. 129), magnitude estimates were requested by experienced observers of several galaxies and nebulae. Some observations have been received, but we encourage others to try observing the eight objects mentioned in that issue, and to report them in the standard ICQ format to the Editor. The results will be published, probably toward the end of 1996. – Ed.

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LIST OF ARTICLES, COLUMNS, NOTES, ETC., BY TITLE:

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Note: The traditional accompanying index of individual references to individual comets will not be published with this index. It is anticipated that it will be incorporated into the next bi-annual index. – Ed.