INTERNATIONAL COMET QUARTERLY

Whole Number 97 | JANUARY 1996 | Vol. 18, No. 1

— *Table of Contents* —

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

The International Comet Quarterly (*ICQ*) is a journal devoted to news and observation of comets, published by the Smithsonian Astrophysical Observatory in Cambridge, Massachusetts. Regular issues are published 4 times per year (January, April, July, and October), with an annual *Comet Handbook* of ephemerides published normally in the first half of the year as a special fifth issue. An index to each volume normally is published in every other 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. An asterisk after these numbers indicates credit for the next annual Comet Handbook.] 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) 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.

++++++++++++

This issue is No. 97 of the publication originally called *The Comet* (founded March 1973) and is Vol. 18, No. 1, of the *ICQ*. *[ISSN 0736-6922]*

****

NOTICE TO CONTRIBUTORS

Contributors of data (or queries) via e-mail should always provide their full Internet e-mail address at the end of their message. E-mail software frequently provides ambiguous information regarding the origin of a message, and it is sometimes difficult (or impossible) to reach the originators of messages with only the header information. — Ed.

◇ ◇ ◇

ICQ ARCHIVE

We are no longer be able to produce 9-track magnetic tapes containing the *ICQ* Photometric Archive of Comets. We have developed a new policy for researchers who would like to access *ICQ* archival data in machine-readable form. On a comet-by-comet basis, interested individuals should contact the Editor [email green@cfa.harvard.edu], who will then e-mail files containing the requested data. We will provide this service free of charge, though speedier service may be given to *ICQ* subscribers. — The Editor

Comet D/1993 F2 (Shoemaker-Levy 9) as the Culprit of a Revived Controversy?

Zdenek Sekanina

Jet Propulsion Laboratory, California Institute of Technology
Pasadena, California 91109

1. The Early History.

In a strange way, the case of comet D/1993 F2 (Shoemaker-Levy 9), and the kind of attention its breakup near Jupiter in July 1992 receives in today's journals, provoke one to reminisce about what can appropriately be called the most celebrated controversy in the history of cometary science — that of the structure of a cometary nucleus.

Newton's (1687) notion that the nucleus of a comet is a single body *"heated by the Sun"* apparently prevailed for a long time. More than half of a century later, Hill (1754) was convinced that comets *"abound with watery matter"* and that a comet *"is a firm, solid, and durable body"* emitting water vapor, which is observed as a tail. Another half a century later, similar ideas were expressed by Laplace (1808). Ever since the telescope was first pointed at a comet (e.g., Pingré 1783, 1784), the term *nucleus* has been used by observers purely phenomenologically, as this was the brightest spot, tacitly assumed to define the comet's position. It appears from the literature that the observed nucleus — nowadays often referred to as the *central* or *nuclear condensation* — was identified with the true, solid nucleus in all hypotheses proposed up to the early 19th century. I am aware of no published explanation for ubiquitously observed major rapid variations in the brightness of this "nucleus", sometimes to the point of disappearance in smaller instruments.

The controversy involving the structure of cometary nuclei can be traced back to the first half of the 19th century, and one obvious source was J. F. Encke's discovery of the nongravitational acceleration in the orbital motion of his celebrated comet. Encke (1823) knew that from *"Newton to Laplace, numerous astute mathematicians were busy with [studies of] the influence of matter populating outer space on the motions of celestial bodies"*. He added that these investigations had resulted in the finding that interplanetary matter exerts a resistance, whereby the semimajor axis of the orbiting planet is reduced, its eccentricity decreases, and the orientation of its line of apsides is slightly changed. Encke also noticed that since no resistance effects had been detected by anyone before him in the motion of any object in space, the interplanetary resisting medium had only been perceived as an interesting mathematical subject. It is certain that this issue was extensively discussed between Encke and W. Olbers, but it is not entirely clear who of the two was the first to link this concept to the anomalous motion of Encke's comet. In either case, the opinion of Olbers — who was 33 years senior — was profoundly imprinted in Encke's memory, as in one of his last papers nearly 40 years later (Encke 1858), he remarked that *"Olbers subscribed to [the theory of resisting medium] the moment I told him of my suspicion about the shortening of this comet's orbital period"*. Both Encke and Olbers affirmed (cf. Encke 1823) that the density of comets is so low that it may be compared with that of the zodiacal light. They maintained that what holds for the solid, high-density planets does not apply to comets. Since this idea could now arguably be supported by orbital evidence, its status was elevated to that of a scientific hypothesis; the concept's detailed description was published by Encke (1831) on the occasion of the comet's fourth predicted return.

The glaring incompatibility of the theory of resisting medium with the concept of a solid nucleus could not escape the attention of Bessel (1836a), who pointed out that only the acceleration of Encke's comet, not its *cause*, was observationally demonstrated. He argued that effects of the resisting medium had never been detected in the motions of planets and the moon and that no other phenomena were known to require its existence. Bessel's (1836b) detailed observations of the appearance of Halley's comet in 1835 convinced him of the presence, near the nucleus, of distinct emanations of matter spewn from it preferentially in the sunward direction. His physical insight led Bessel (1836c) to conclude that the mass ejected from the comet exerted a recoil force on the nucleus, as dictated by the conservation of momentum law, and that a nongravitational perturbation of the comet's orbital motion was a necessary consequence of the ejection, if it proceeded asymmetrically with respect to perihelion. Thus, the critical issue behind the Encke-Bessel controversy was indeed the fundamental difference in their perception of the nature of the cometary nucleus. In the 1830s, Bessel was among the few vocal critics of the hypothesis of resisting medium, which suggests that the concept of a solid nucleus was not deeply rooted in the minds of cometary astronomers of that era. Unfortunately, Bessel's arguments had no effect on Encke, who never entertained the slightest doubt about the legitimacy of his hypothesis and who only seldom found it compelling to defend it (e.g., Encke 1836, 1858). Yet, across the Atlantic, another scientist was about to begin his work that closely paralleled Bessel's.

In a series of studies between 1844 and 1878, W. A. Norton often referred to Bessel and made significant contributions to what today could be described as basic concepts of cometary physics. Unfortunately, Norton appears to have a sad distinction of a comet scientist who has been completely forgotten — his name seldom, if ever, mentioned in comet monographs and his work totally ignored nowadays. Yet, a number of Norton's statements dating from the 1840s-1860s are plainly valid by modern standards. To illustrate this, it is appropriate to quote some of his conclusions. For example, in reference to the solar repulsive force on cometary particles, Norton (1844) considered it "*an impulsive action of the sun's rays*" (attributing this suggestion to L. Euler; p. 109) and further noted that "*particles . . . are first repelled outward from the nucleus, and then driven away from the sun . . . they acquire an initial velocity in leaving the nucleus and subsequently . . . move off in hyperbolas, having the sun in their remote focus, and concave towards the axis of the tail*" (p. 124). Concluding that same paper, Norton stated (p. 129) that "*comets must be wasting away by reason of the continual escape of the matter of which they are composed, during each period of their approach to the sun*". Elsewhere he remarked that "*the nucleus . . . is a body of solid matter, like the earth, more or less covered with water, of which the greater portion is ordinarily in the condition of ice*" (Norton 1859, p. 99). Furthermore, commenting in the first of a series of related papers on the striated structure of comet Donati's tail, Norton (1860) offered — as the most probable explanation — a conjecture that "*the nucleus turns about an axis, and so presented periodically different sides to the sun, which were unequally influenced by [the sun's] inciting action . . . we have in the observed distance between contiguous bright bands, the means of determining the period of rotation; or, at least, the shortest interval of time in which the rotation can be completed*" (p. 81). Again, for the time, these were very innovative ideas, whose conceptual equivalents have much more recently been incorporated into modern comet models.

2. The Great Confusion: Comets and Meteor Streams.

Probably the single main reason for the pioneering research by Bessel and by Norton having been all but forgotten or ignored was Schiaparelli's (1867) major discovery that 109P/Swift-Tuttle (old-style designation 1862 III) and the Perseid meteor stream revolved about the Sun in a common orbit. This discovery marked the beginning of an era in which meteor astronomy flourished tremendously. Further strengthened by subsequently recognized associations between other comets and meteor showers [such as 55P/Tempel-Tuttle (O.S. 1866 I) and the Leonids, or C/1861 G1 (Thatcher; O.S. 1861 I) and the Lyrids], this discovery also had a strong influence on the general perception of the structure of cometary nuclei and thereby affected the long-term development of cometary science. The obvious dynamical relationship between comets and meteor streams was misinterpreted to indicate that comets *were identical* with meteor streams. Encke's mistake was once again repeated and his old hypothesis thereby reinforced.

It is hard to imagine how much more rapidly cometary science would have been evolving in the last century if Bessel's and Norton's ideas were more influential than the accepted ones. Instead, the inevitable result of the prevailing consensus in the 1860s and 1870s was a virtually universal recognition of the *sand-bank model* as the preferred paradigm for cometary nuclei, as documented time and again by numerous statements published by reknown astronomers of the late 19th and the early 20th centuries.

3. Sand-Bank Model and Halley's Comet in 1910.

In retrospect, it is interesting to record the state of scientific opinion with regard to the nuclear structure of Halley's comet, based on observations made during its 1910 apparition and on the sand-bank model then generally accepted. A distinct regress is noticed in comparison with Bessel's ideas, expressed three quarters of a century earlier.

Barnard (1914), one of the most respected observers of the period, was noncommittal in his description of 1P/Halley's nucleus. He noticed that visually the comet's nuclear brightness was strongly instrument dependent (the larger the telescope, the fainter the nucleus) and that sometimes one could see *a nucleus within a nucleus*. Curtis (1914) reported that photographically-determined dimensions of the nucleus likewise depended on the conditions of observation, showing a high degree of correlation with the comet's geocentric distance. These and numerous other observations led Bobrovnikoff (1931) to conclude that "*even under the most favorable assumptions the diameter of the nucleus comes out too small* (sic!) *to be a single mass*" and that "*the nucleus consisted of a large number of bodies the diameters of which were small in comparison with the distances between them*" (p. 472). Considering that the minimum diameter measured by Curtis was ~500 km and that the smallest diameter that could have been noticed during the comet's transit across the Sun was estimated by Bobrovnikoff at ~50 km, his conclusions are puzzling to the present-day scientist. Some 15 years later, a more compact — yet morphologically similar — agglomerate model was independently proposed by Vorontsov-Velyaminov (1946), who maintained that the nucleus of Halley's comet is 30 km in diameter and consists of a cluster of meteoric blocks, each ~150 meters across and nearly in contact — yet another variation on Encke's same old idea. . .

4. The Modern Controversy: Sand Bank versus Icy Conglomerate.

An extreme version of the sand-bank hypothesis — a diffuse swarm of orbitally-independent dust particles — was proposed by Lyttleton (1953) soon after Whipple (1950, 1951) had introduced his novel, *icy conglomerate model* and about the same time that Schatzman (1953) expressed doubts on whether a compact sand-bank assemblage has enough time to collapse, even when it is protected against dispersive forces. From the 1950s until the 1980s, the nature of cometary nuclei was one of the major issues debated, with the sand-bank model clearly on the losing side.

The sand-bank model was criticized by Whipple (1961, 1963) on several grounds. In the first place, it could not explain the fairly large amounts of gas, relative to refractory materials, observed to be released from comets at small heliocentric distances. Another major flaw of a sand-bank model was found to be its inability to explain why cometary nuclei can hold together over long periods of time and why their motions are either purely Keplerian or display the kind of nongravitational effects that are observed, including secular accelerations as well as decelerations. Whipple maintained that the compact sand-bank model encounters most of the difficulties of the diffuse-swarm model and that self-gravity alone is highly unlikely to keep the nucleus intact over extended periods of time. His arguments had nearly universally been accepted by the comet science community even before 1P/Halley's 1986 return to the Sun.

Growing evidence for nucleus rotation and for the presence of discrete emission sources on the nucleus surface was another factor that contributed to the general acceptance of the icy-conglomerate model already in the 1970s. Curiously, these pioneering efforts were based in part on 19th-century visual observations of the nearly concentric halos in the head of comet C/1858 L1 (Donati, O.S. 1858 VI; cf. Whipple 1978). Although Schmidt (1863) was the first to notice the halo-formation periodicity of some 4 to 5 hours, and although Norton — as already mentioned — offered some interesting ideas (also around 1860) on other aspects of this comet, the uniform spacing of the halos was not explicitly recognized as a product and measure of the rotation period until more than a century later! By that time, Larson and Minton (1972; cf. also Larson 1978) had already derived the rotation period of comet C/1969 Y1 (Bennett; O.S. 1970 II) from the positional spacing of a system of spiral jets, observed photographically in its coma. In addition, independent efforts were in progress, aimed at determining the position of the nuclear spin axis from projected orientations of dust features (such as jets, fans, or spirals) and their motions in the coma (Sekanina 1979, 1981a). An attempt was even made to establish precession in Encke's comet (Whipple and Sekanina 1979). A review of the morphological investigations of cometary dust (Sekanina 1981b) confirmed that outgassing from many, particularly short-period, comets is largely confined to discrete areas on the sunlit side of their rotating nuclei and that the appearance of the observed features is determined by the surface distribution of the sources and by the emission mode. Limited initially to mere dynamical *fitting of outer boundaries* of the observed features (Sekanina and Larson 1984, 1986a,b), this modelling gradually evolved into a successful dynamical *Monte Carlo image simulation*, which allows one to compare synthetic, computer-generated images with observed ones. The quality of the synthetic images improved especially after the relevant computer code was expanded to include *imperfect collimation* of the dust-particle velocity-vector field (Sekanina 1991), to accommodate diurnal variations in the dust-production rate, and to account for a great diversity of particle-size distribution (Sekanina 1993). The existence of a solid nucleus (whether or not of aggregate structure) — which rotates and has limited, nonzero strength — is the conceptual premise on which these continuing efforts are based and whose validity they strongly corroborate.

The controversy surrounding the nature of the nucleus finally seemed to be settled in favor of a single dominant mass when the closeup images of Halley's comet, especially those taken with the Halley Multicolour Camera onboard the Giotto spacecraft (Keller *et al.* 1987), became available. While the results of the spacecraft experiments may not have left the icy-conglomerate model entirely unscathed (e.g., Keller 1989), the chances of the sand-bank model's survival were absolutely shattered. But now, contrary to all expectations, yet another variation of the failed and discredited sand-bank model has once again emerged on the scene to become a center of attention within the scientific comet community.

5. Comet D/1993 F2 (Shoemaker-Levy 9): Its Appearance, and Constraints on Models.

In order for the reader to understand arguments and counter-arguments regarding the various models for the nucleus of comet D/1993 F2 (Shoemaker-Levy 9) and the constraints implied as a result, I first summarize basic information on the comet's appearance and its temporal evolution.

It is not an overstatement to say that the appearance of comet D/1993 F2 was unique, at least in the sense that no other comet has ever been observed to display so many distinct condensations at the same time. For some time after the comet's discovery, the condensations were all aligned in an essentially rectilinear configuration, which extended almost perfectly along a great circle of the projected orbit from the east-northeast to the west-southwest and is often compared to a *string of pearls*. In the technical literature, the collection of the condensations is usually referred to as the *nuclear train*. The train was the most prominent part of the comet, but three other kinds of morphological features were also present. Extending from the train on either side were *trails* or *wings*, while a set of straight, narrow *tails*, whose roots coincided with the train's condensations, subtended a relatively small angle with the train, pointing generally to the west. The tails were immersed in — and on low-resolution images blended with — an enormous, completely structureless *sector of material* to the north of its sharp boundary delineated by the nucleus train and the trails.

The total projected cross-sectional area of the comet's particulate ejecta was huge. On the assumption of a geometric albedo of 0.04, visual-brightness observations showed this area to amount to ~400,000 km^2 at discovery, slowly decreasing with time (Sekanina *et al.* 1994). This quantity offers one of the major constraints on models, the additional conditions being provided primarily by the physical evolution of the nuclear train.

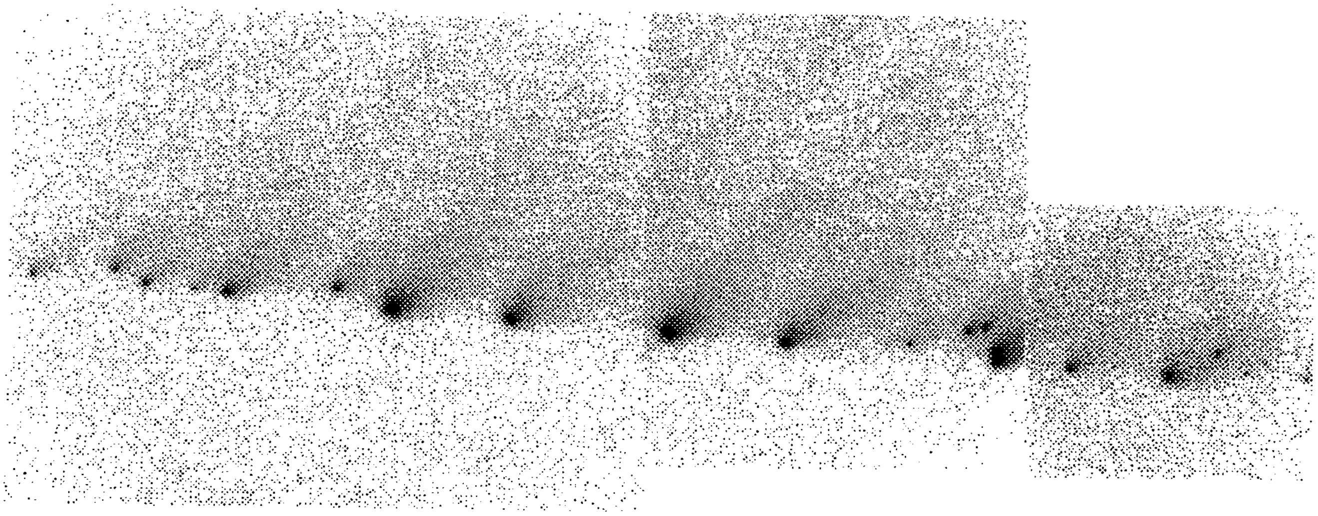
In the almost universally accepted notation for the individual condensations, the letter A was assigned to the easternmost component, which crashed first, and W to the westernmost component. (The letters I and O were not used in order to avoid confusion with digits.) A detailed analysis of the alignment of the condensations indicated that five of them — B, J, M, P (resolved into P_1 and P_2 on images of very high resolution), and T — exhibited barely detectable off-train deviations already soon after discovery. Subsequent images showed the deviations much more clearly, and it became apparent that this group of *off-train* condensations also included F, N, Q_2, U, and V, bringing their total to 10. The final number of the off-train condensations may still become higher by one or two. The other condensations that never displayed a distinct deviation from the train are often called the *on-train* condensations. They include A, E, G, H, K, L, Q_1, R, S, W, and possibly one or two more.

Two of the off-train condensations, J and M, disappeared during 1993. The first signs of the impending dramatic changes in the train's appearance became evident on the July 1993 images (Weaver *et al.* 1994) obtained with the Hubble Space Telescope (HST). The condensation Q, the brightest at the time, seemed double and so did the condensation P. By late January 1994, the P-Q region had developed considerably (Weaver *et al.* 1995): there were four fragments, Q_1, Q_2, P_1, and P_2, the latter two clearly elongated. The condensation S displayed a bright "spur" to the south (Weaver 1994). By the end of March 1994, P_2 had broken up into two (P_{2a} and P_{2b}), the spur of S had grown fainter, and P_1 and T had become barely discernible as virtually uncondensed masses. P_1 and P_{2b} later disappeared completely. The central region of each of the surviving condensations remained circularly symmetrical until one week or so prior to impact, at which time it began — except for its innermost core (cf. *Sec. 6*) — to grow strikingly elongated along the direction of the train.

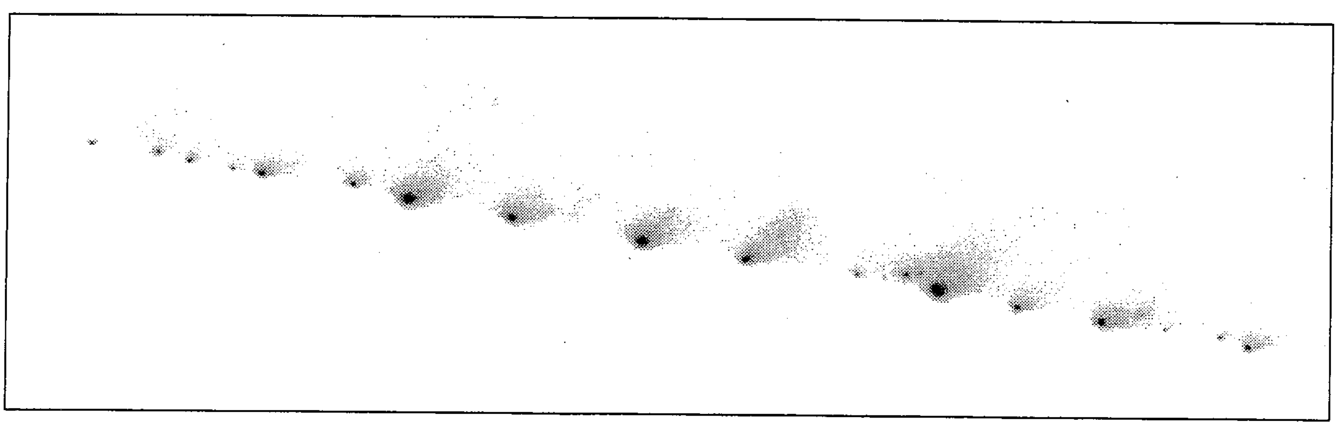
Analysis of the motions of the off-train condensations showed conclusively that these condensations were products of discrete events of ***secondary fragmentation***, which took place long after the 1992 tidal breakup at Jupiter (Sekanina *et al.* 1994, 1995; Sekanina 1995a). Hence, the total number of major fragments generated during the July 1992 breakup was not 21, but between 10 and 12. The true evolution of the nuclear train was more complex than shown by visual inspection of the HST images. A detailed analysis of the pixel-signal distribution in the innermost regions of the condensations revealed a much larger number of companions at least 1 km across, up to eight per condensation (Sekanina 1995b,c). Most of these companions continued to fragment spontaneously and did not survive as individually detectable objects until impact. Evidence for their existence is now unquestionable, including the separate pieces P_{2a} and P_{2b} already on the HST images from late January 1994. The comet's evolution was thus characterized by a continuing sequence of discrete events of gradual disintegration. This process was obviously still continuing at the time of collision with Jupiter. Yet, it is found that the projected cross-sectional areas of the largest fragments had not decreased substantially between July 1993 and July 1994. The minor companions appear to have been objects of a large area-to-mass ratio.

(text continued on next page)

◇ ◇ ◇



Above: ***Hubble Space Telescope image of D/1993 F2 (Shoemaker-Levy 9) taken in March 1994, four months before its collision with Jupiter.*** **Below:** ***HST image of the comet in red light, taken on 1994 May 17 with the Wide Field Planetary Camera-2 (WFPC-2) in wide-field mode. Six WFPC exposures were required to include all of the nuclei, which extended 1.1 million km from east to west at this time. All HST images with this article are published here courtesy of H. A. Weaver, T. E. Smith, and NASA.***



6. Comet D/1993 F2 (Shoemaker-Levy 9): Difficulties with a Strengthless Nucleus.

Less than a decade after the resounding success of the space missions to Halley's comet and the humiliating defeat of the sand-bank model, astronomical journals are suddenly bombarded with papers that stress the merits of strengthless agglomerate nuclei, as if this concept represented some new exciting ideas in cometary physics. Almost overnight, the old, failed sand-bank model was conveniently forgotten and the "new" models are ostensibly served in disguise as "rubble piles", as if the choice of words made any difference. The fact that these models once again offer just another variation of the same sand-bank paradigm is obvious from their basic premise: self-gravity is all one needs to hold the comet together. If this trend continues, we can look forward to a "garbage stack" model ten or twenty years from now, after the rubble pile is forgotten.

If 1P/Halley's nucleus and the original nucleus of this comet had at least approximately similar mechanical properties, no strengthless assemblage can be an acceptable working model. Nearly all comets display the type of behavior similar to Halley's, regardless of whether they are a little more or a little less active. However, there exists an extremely small group of anomalous comets, whose total known number was seven a decade ago (Sekanina 1984) and is not more than ~10 today, that disappear near perihelion (usually inside of 1 AU) on a time scale of only days to weeks, literally before the eyes of the observers. Two examples are comets C/1925 X1 (Ensor; O.S. 1926 III) and C/1953 X1 (Pajdušáková; O.S. 1954 II). There is no compelling evidence that the nuclei of these objects were strengthless, but they unquestionably were more poorly cemented than nuclei of the great majority of comets. It should be remembered that the sublimation pressure of water vapor is on the order of 0.0001 bar at 0.1 AU from the Sun and 0.01 bar at 0.01 AU. Strengthless comets in sungrazing orbits, such as the orbits of the Kreutz group's members, would all dissipate into small fragments by virtue of merely being active; in reality, all the group's bright members have survived, even though some of them split near perihelion, presumably due to the Sun's tidal forces (*Sec. 7*). What was the chance that the original nucleus of comet D/1993 F2 (Shoemaker-Levy 9) resembled structurally the nuclei of such comets as Ensor or Pajdušáková? The *a priori* probability of this being the case is extremely small. More importantly, there are crucial questions — some concerning D/1993 F2 itself — to which the models of a strengthless agglomerate nucleus have no satisfactory answers.

First of all, the basic assumption for the strengthless models — the complete absence of material cohesion — is unphysical. Greenberg *et al.* (1995) showed that aggregate structures possess a tensile strength that is significantly lower than that for compact solids, but *by no means zero*! For example, considerations of molecular interactions at the contact interfaces in aggregates of submicron-sized interstellar dust particles, whose outer mantles are dominated by water ice, imply according to Greenberg *et al.* a tensile strength of 0.0027 bar, about 10,000 times lower than the tensile strength of solid ice, but nearly comparable with the net tidal stresses to which a cometary nucleus is subjected along the 1992 trajectory of comet D/1993 F2.

The existing models of a strengthless nucleus for D/1993 F2 (Shoemaker-Levy 9), such as Asphaug and Benz's (1994) or Solem's (1994, 1995), consistently present the comet's breakup scenario in terms that can crudely be summarized as follows. In the immediate proximity of the comet's 1992 perijove, the tidal forces broke up the original nucleus into a train of its individual "building blocks" or "cometesimals". As this elongated cloud of particulates began to recede from the planet, the tidal forces gradually decreased and the gravitational interaction of the cometesimals led locally to their partial reassembling into larger clumps, which eventually became the observed fragments. This process depends rather critically on a number of circumstances, including the bulk density and the spin vector of the nucleus, and the perijove distance. Such supersensitivity to the parameters already represents a weakness, but probably the greatest flaw of the proposed strengthless models is the premise that all the cometesimals that made up the original nucleus were of *equal mass* (and size). This assumption, necessary to avoid a prohibitive computer-time consumption, is bound to have a dramatic effect on the gravity field of the assemblage during the coagulation phase. If this inappropriate constraint is relaxed and the fragments are allowed to possess a broad mass (and size) distribution, the numerical results obtained for the unrealistic special case are no longer applicable. With such a distribution, it is easy to see that the number of massive (large) cometesimals could, in an extreme case, be equal to the number of the observed fragments. The rest of the mass would be contained in small particles and no gravitational clumping would even have to be considered. An added bonus of such a model, in spite of its extreme properties, would be the ability to explain the enormous observed cross-sectional area of the condensations, which represents yet another major stumbling block for all the strengthless agglomerate models based on the assumption of equal-mass cometesimals.

Very damaging to the reputation of the proposed strengthless agglomerate models is their motivation of grossly incorrect predictions for the impact phenomena (e.g., Weissman 1994). Indeed, the collisions were anything but the predicted "big fizzle", indicating that in the center of most of the condensations was *one* dominant fragment, whose *residual* mass penetrated — in spite of enormous aerodynamic pressures to which it was subjected during atmospheric flight — down into the Jovian lower stratosphere, or perhaps deeper still. Also troublesome for models of a strengthless nucleus is the sharp contrast between the dramatically increasing extension of each condensation, which became clearly noticeable a week or so before impact (*Sec. 5*), and the bright center, observed to remain pointlike, with no elongation whatsoever and continuing to move in a Keplerian orbit all the way to Jupiter. To avoid this inconsistency of behavior, the proponent of a strengthless agglomerate model must argue that the building blocks were close enough to each other to be *gravitationally stable*. But if so, then why did most of the nuclei show unquestionable evidence of secondary fragmentation — a continuing sequence of discrete breakup events into distinct condensations long after the tidal disruption — when the clumping of cometesimals by self-gravity had dominated their dissipation already several hours after perijove? The proponent of the model would now have to argue that the building blocks were far enough apart so as to be *gravitationally quasi-stable*. The model's arbitrary manipulation of this kind has nothing to do with science and the resulting *ad hoc*, inconsistent explanations are unmistakable signs of the difficulties encountered by the concept. So are the major problems that the model of a strengthless nucleus has with addressing broader issues, such as why were the cometesimals themselves cohesive to the extent that their strength is not even questioned, while the dynamical behavior of their assemblage was governed by self-gravity alone? Not to mention the omnipresent doubts on the long-term dynamical stability and the survival of strengthless bodies.

7. Models for a Discrete Mass of Limited Mechanical Strength.

There is only one advantage that the proposed strengthless models enjoy. The unrealistic assumption of equal-mass cometesimals renders the problem mathematically tractable with relative ease in the age of high-speed computers. This circumstance obviously can neither remove the grave doubts about the validity of these models, nor can it lessen the extreme caution that needs to be exercised in judging the heralded conclusion of the proponents of these models, namely, that the *string-of-pearls* appearance of D/1993 F2 (Shoemaker-Levy 9) implies a bulk density of $\sim$0.5 g/cm^3 for its parent nucleus.

Tidal splitting of a discrete nucleus that possesses some, however limited, strength is governed by conditions that differ from those applicable to strengthless agglomerates. First, one must realize that cohesion of the nucleus of aggregate structure is bound to vary significantly with location due to unevenly strong mechanical bonds among its building blocks or due to uneven cementing of the interiors of the individual blocks, or both. The conditions for critical stresses that cause the body's tidal fracture are known (e.g., Aggarwal and Oberbeck 1974, Dobrovolskis 1990) and, regardless of the details of the proposed scenarios, the limiting tensile strength varies as the square of the body's size. Hence, other things being equal, *the larger a comet's nucleus of the given nonzero strength is, the easier it is to split it tidally*. This is an extremely important property, which sets the coherent models apart from the strengthless models, the latter ones scaling with simple similarity and thus independent of the nuclear size.

The advantages of the models that allow for limited material strength of the nucleus are plainly illustrated on the sungrazing comets of the Kreutz group. Two of these objects, C/1882 R1 (O.S. 1882 II) and C/1965 S1 (Ikeya-Seki; O.S. 1965 VIII), had a virtually identical perihelion distance of 1.67 solar radii, but C/1882 R1 — the much brighter (and almost certainly much larger) of the two — was observed after perihelion to have split into six major pieces (Kreutz 1888), whereas C/1965 S1 split into only two pieces (e.g., Sekanina 1977). Evidence for tidal breakups of three additional well-observed members of the group is marginal to negative, even though their perihelia were still closer to the Sun, in complete contradiction to expectations based on a strengthless agglomerate model. Indeed, since all the sungrazers have a single common parent (Marsden 1967, 1989), major variations in their effective bulk density are highly unlikely. In contrast, the observed behavior of the various sungrazers can readily be understood in terms of their uneven nuclear sizes that correlate well with the observed brightness.

Asphaug and Benz (1994) argued that a body of any realistic density could not have been broken up into 21 pieces by the tidal forces regardless of its strength. This argument has three weak points: (i) it does not apply to irregular bodies and/or to bodies of nonuniform strength; (ii) it does not consider other forces, such as rotational stresses, that can assist the tides in breaking the body up; and (iii) D/1993 F2 (Shoemaker-Levy 9) did not split near Jupiter in 1992 into 21 fragments, but only into 10-12, the remaining ones having been products of subsequent *secondary fragmentation* events (*Sec. 5*).

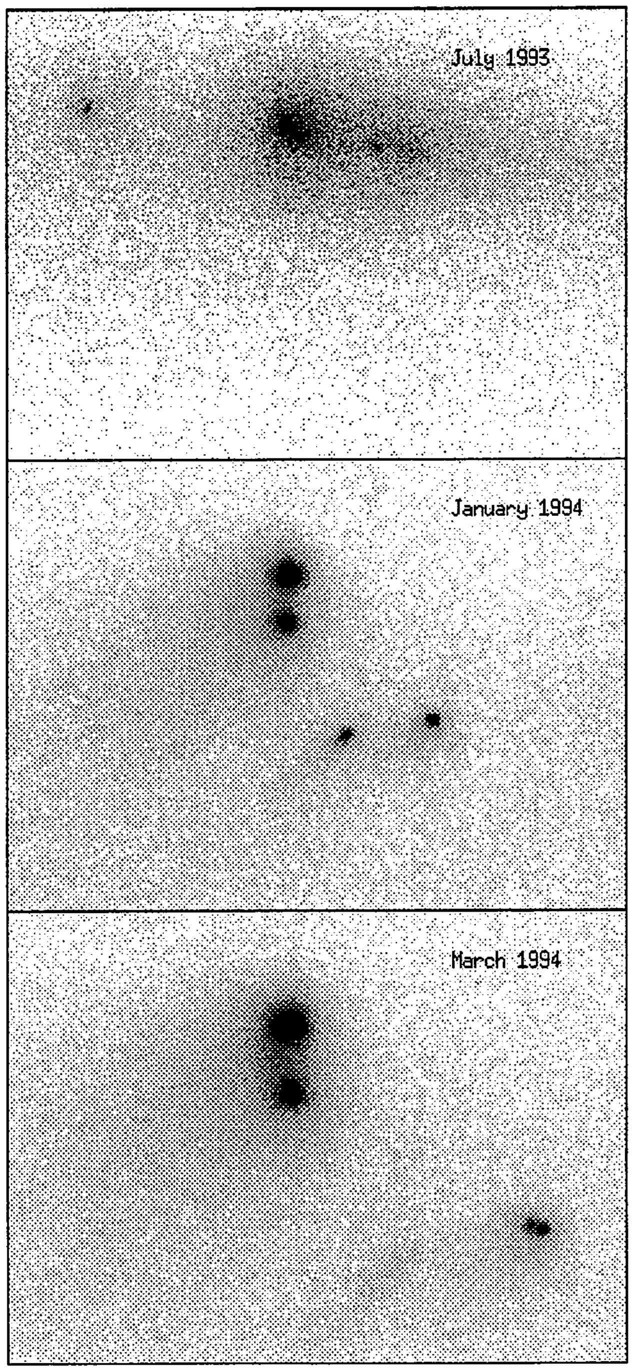
With Asphaug and Benz's objections invalidated, one can proceed with a conceptual explanation of the events of secondary fragmentation, one of the stumbling blocks for the models of a strengthless agglomerate nucleus. These events can readily be understood in the framework of a gradual fissure propagation in the primary fragments of the original nucleus (i.e., the fragments generated during the perijove event in 1992). It is inevitable that, after termination of the tidal disruption, *there existed large fragments that had survived the Jovian encounter cracked but not completely broken* and that *some of the cracks would gradually be extended to the point of fracture at later times* in those among the fragments that happened to be subjected to large enough forces of whatever nature (e.g., spun up as a result of the collisional angular momentum redistribution in the cloud of debris). It is unnecessary to argue that secondary fragmentation events were products of residual local activity, since no signs of outgassing were ever detected, even though at the time of at least one major event of secondary fragmentation (separation of fragment Q_2) the comet was already under observation. The orientation of the parallel tails, which extended from the individual condensations in the generally westerly direction, indicates that they contained particulates ejected during, or shortly after, the tidal breakup of the parent comet in July 1992 and that under no circumstances could they be interpreted as signs of the fragments' continuing activity in 1993-1994.

The plausibility of the concept of discrete nuclei of limited and variable strength is also illustrated by other idiosyncrasies of the condensations of D/1993 F2. An important phenomenon is the gradual disappearance of a condensation, a process which is well documented on a series of the HST images of the fragment P_1, as seen in the figure on page 9 [and in Fig. 2 of Weaver *et al.* (1995)]. This process was obviously also experienced by the "lost" fragments J and M, and later by P_{2b}. Common to these condensations, apparently, was the existence in them of fragments that were extremely poorly cemented on scales smaller than about 1 km, the critical limit on an object at the comet's distance to be detectable individually by the HST. The disappearance of these condensations does not therefore provide a very strong constraint on sizes of the largest surviving fragments within them, but at least a superficial similarity of behavior to the dissipating comets — such as C/1925 X1 (Ensor) or C/1953 X1 (Pajdušáková) [*Sec. 6*] — is obvious.

The next group includes some other off-train condensations, such as B, F, *etc.* — the central fragments of which did not disintegrate in interplanetary space into objects below the detection limit, but generated no detectable ejecta upon impact. Since stresses acting on comets and their fragments in interplanetary space are lower than the tidal forces very close to Jupiter, it appears that lines of major structural weakness were less densely distributed in the fragments of this category, or that their "average" strength was greater than that of the fragments that had disappeared.

(text continued on page 10)

Below: *HST image of comet D/1993 F2 (Shoemaker-Levy 9) in visible light, taken on 1993 July 1 (prior to the HST servicing mission), 1994 Jan. 24 (after the servicing mission), and 1994 Mar. 30. The images are inverted compared with those on page 6. In the first image below, the brightest two nuclei, Q_1 and Q_2 (top center) are 0″.3 apart; in the middle frame, they are ~ 1″ apart. In the Jan. 1994 image, nuclei P_1 (left) and P_2 (right) are seen below Q_1 and Q_2; by March 1994, P_2 has split into two more pieces, while P_1 is all but gone.*



(text continued from page 8)

Finally, we have evidence that the on-train condensations contained fragments a few kilometers across (Weaver *et al.* 1994; Sekanina 1995b, 1995c), in which extended areas of high structural weakness were still less common, so that these fragments survived all the way back to Jupiter relatively undamaged.

These groups of fragments clearly correlate with the classes introduced by Hammel *et al.* (1995), and it may be suggested that the degree of structural weakness can effectively be identified as the criterion for Hammel *et al.*'s empirical classification. However, one should not think strictly in terms of discrete categories; instead, each fragment is likely to have its own position in the hierarchy of structural strength. The conclusion that the off-train condensations contained structurally weaker fragments explains why they appeared to be relatively bright, yet their impacts were mostly nonevents: a greater susceptibility to early spontaneous fragmentation led to a larger fraction of their mass being concentrated in particulates near the lower end of the mass (and size) spectrum, which in turn resulted in the higher apparent cross-sectional area per unit mass of these off-train condensations compared with the on-train condensations.

To summarize, the model of a discrete nucleus of limited but variable strength avoids conceptual pitfalls of the strengthless agglomerates. The aggregate structure itself, implied by the presumably dominant role of accretion processes during the formation of comets, is not an issue, even though the single-mass model of limited strength does not critically depend on this premise. The results are now less sensitive to the bulk density, for which values significantly lower than 0.5 g/cm^3 are preferred. The model of a nucleus with limited strength also explains the 1886 breakup of periodic comet 16P (Brooks 2) at a distance of 2 Jovian radii from the planet's center, offers logical interpretations both for the process of secondary fragmentation and for the observed great diversity in the behavior of the various condensations of comet D/1993 F2, and is consistent with the long-term dynamical stability and survival of most comets.

Why then has comet D/1993 F2 (Shoemaker-Levy 9) revived the old controversy? The answer, it appears, is obvious. With modern computers, it is relatively easy to solve the *classical n-body problem*, as long as unrealistic simplifying assumptions (such as equal masses of the components) are retained and the number of these components is severely constrained. The resulting mathematical solutions are superficially attractive, because they are formally pleasing and elegant. However, since the restrictions that are necessary to keep the problem tractable are physically unacceptable, they lead to fundamentally flawed solutions that cannot serve as valid, plausible models. Considering how long it took to settle the controversy of the sand-bank model versus the icy-conglomerate model, it is not surprising that no consensus on the problem of nucleus cohesion, as it pertains to comet D/1993 F2, has so far been reached. Yet, the sooner this comet's models of a strengthless agglomerate nucleus are abandoned, the better for cometary science.

Acknowledgements.

I thank D. W. E. Green and B. G. Marsden for their help in a search for information on the early hypotheses for cometary nuclei and for their comments on a draft of this paper. I also thank Ms. B. G. Corbin and Mr. G. Shelton, U. S. Naval Observatory, Ms. J. Gantz, Mount Wilson and Las Campanas Observatories, and Ms. H. Knudsen, California Institute of Technology, for their kind assistance in securing copies of W. A. Norton's publications. This research was carried out by the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.

REFERENCES

Aggarwal, H. R.; and V. R. Oberbeck (1974). *Astrophys. J.* **191**, 577.
Asphaug, E.; and W. Benz (1994). *Nature* **370**, 120.
Barnard, E. E. (1914). *Astrophys. J.* **39**, 373.
Bessel, F. W. (1836a). *Astron. Nachr.* **13**, 3.
— (1836b). *Astron. Nachr.* **13**, 185.
— (1836c). *Astron. Nachr.* **13**, 345.
Bobrovnikoff, N. T. (1931). *Publ. Lick Obs.* **17**, 309.
Curtis, H. D. (1914). *Publ. Astron. Soc. Pacific* **22**, 117.
Dobrovolskis, A. R. (1990). *Icarus* **88**, 24.
Encke, J. F. (1823). *Berlin. Astron. Jahrb. für 1826*, p. 124.
— (1831). *Astron. Nachr.* **9**, 317.
— (1836). *Astron. Nachr.* **13**, 263.
— (1858). *Berlin. Astron. Jahrb. für 1861*, p. 319. [For an English summary, see *Mon. Not. Roy. Astron. Soc.* **19** (1859), 70.]
Greenberg, J. M.; H. Mizutani; and T. Yamamoto (1995). *Astron. Astrophys.* **295**, L35.
Hammel, H. B. *et al.* (1995). *Science* **267**, 1288.
Hill, J. (1754). *A Dictionary of Astronomy*, in *Urania: A Compleat View of the Heavens.* (London: T. Gardner).
Keller, H. U. *et al.* (1989). In *Physics and Mechanics of Cometary Materials*, ESA SP–302 (eds. J. Hunt and T. D. Guyenne; Noordwijk: ESTEC), p. 39.
Keller, H. U. *et al.* (1987). *Astron. Astrophys.* **187**, 807.
Kreutz, H. (1888). *Publ. Sternw. Kiel* No. 3, 1.
Laplace, P. (1808). *Exposition du Système du Monde.* (3rd ed.), Paris.
Larson, S. M. (1978). *Bull. Amer. Astron. Soc.* **10**, 589.
Larson, S. M.; and R. B. Minton (1972). In *Comets: Scientific Data and Missions* (eds. G. P. Kuiper and E. Roemer; Tucson: University of Arizona Press), p. 183.

Lyttleton, R. A. (1953). *The Comets and Their Origin* (Cambridge University Press).
Marsden, B. G. (1967). *Astron. J.* **72**, 1170.
— (1989). *Astron. J.* **98**, 2306.
Newton, I. (1687). *Philosophiae Naturalis Principia Mathematica* (London).
Norton, W. A. (1844). *Amer. J. Sci. Arts* **46**, 104.
— (1859). *Amer. J. Sci. Arts* (Ser. 2) **27**, 86.
— (1860). *Amer. J. Sci. Arts* (Ser. 2) **29**, 79.
Pingré, A. G. (1783). *Comètographie ou Traité Historique et Théorique des Comètes* (Pt. 1), Paris.
— (1784). *Comètographie ou Traité Historique et Théorique des Comètes* (Pt. 2), Paris.
Schatzman, E. (1953). *Mém. 8° Soc. Roy. Sci. Liège* (Sér. 4) **13** (Fasc. 1–2), 313.
Schiaparelli, G. W. (1867). *Astron. Nachr.* **68**, 331.
Schmidt, J. F. J. (1863). *Astron. Nachr.* **59**, 97.
Sekanina, Z. (1977). *Icarus* **30**, 574.
— (1979). *Icarus* **37**, 420.
— (1981a). *Astron. J.* **86**, 1741.
— (1981b). *Ann. Rev. Earth Planet. Sci.* **9**, 113.
— (1984). *Icarus* **58**, 81.
— (1991). *Astron. J.* **102**, 350.
— (1993). In *Activity of Distant Comets* (eds. W. F. Huebner *et al.*), p. 166. Southwest Research Institute, San Antonio.
— (1995a). in West and Böhnhardt (1995), p. 43.
— (1995b). in West and Böhnhardt (1995), p. 29.
— (1995c). *Astron. Astrophys.* **304**, 296.
Sekanina, Z.; P. W. Chodas; and D. K. Yeomans (1994). *Astron. Astrophys.* **289**, 607.
— (1995). In preparation.
Sekanina, Z.; and S. M. Larson (1984). *Astron. J.* **89**, 1408.
— (1986a). *Astron. J.* **92**, 462.
— (1986b). *Nature* **321**, 357.
Solem, J. C. (1994). *Nature* **370**, 349.
— (1995). *Astron. Astrophys.* **302**, 596.
Vorontsov-Velyaminov, B. (1946). *Astrophys. J.* **104**, 226.
Weaver, H. A. (1994). *IAU Circ.* Nos. 5947, 5973.
Weaver, H. A. *et al.* (1994). *Science* **263**, 787.
— (1995). *Science* **267**, 1282.
Weissman, P. (1994). *Nature* **370**, 94.
West, R.; and H. Böhnhardt (1995). *European Shoemaker-Levy 9/Jupiter Workshop* (Garching bei München: European Southern Observatory).
Whipple, F. L. (1950). *Astrophys. J.* **111**, 375.
— (1951). *Astrophys. J.* **113**, 464.
— (1961). *Astron. J.* **66**, 375.
— (1963). In *The Moon, Meteorites, and Comets* (eds. B. M. Middlehurst and G. P. Kuiper; University of Chicago Press), p. 639.
— (1978). *Nature* **273**, 134.
Whipple, F. L.; and Z. Sekanina (1979). *Astron. J.* **84**, 1894.

Φ Φ Φ

The Great Comet of 1811

Gary W. Kronk

Troy, IL

Shortly after the discovery of comet C/1995 O1 (Hale-Bopp) last July, astronomers began to realize that the potential existed for this comet to become something out of the ordinary. As we wait for this comet to reach its perihelion during the spring of 1997, questions are now arising as to just how out of the ordinary it may become.

Back in 1973, another comet — C/1973 E1 (Kohoutek; O.S. 1973 XII) — sparked my initial interest in comets. With early predictions stating that the comet could reach the brightness of the half moon (mag ~ -10) at perihelion, I — a blossoming journalism student — did what I enjoyed doing: researching a story. I really dived into this research because I was already interested in astronomy, but the only comet I was then really familiar with was the famous Halley's comet. Was I in for a surprise! I quickly discovered that comets may be the most unpredictable objects studied by astronomers, and for my newspaper article on comet C/1973 E1 (Kohoutek), I mentioned that comets will sometime brighten or fade without warning and occasionally will even break up. Their tails may be long or short, narrow or fanned.

After comet C/1973 E1 (Kohoutek) was long gone, I continued to research comets. I had been hooked. The more I dug into the material at hand, the more I learned. The result was a published book entitled *Comets: A Descriptive Catalog* (Kronk 1984). But my ultimate dream of producing a work that rivaled that of Alexander Guy Pingré's *Cometographie*, which was published in 1783 and 1784, was still unrealized. I continued to do research — and found myself traveling out of town to other libraries, to find material that I had to have to fill in the vast puzzle before me.

I. A New Cometography

Although my new *Cometography* is still not complete, it is far enough along to be a research tool in itself. My most recent use of this tool was to help prepare myself for comet C/1995 O1 (Hale-Bopp). Not long after the first orbit had been computed, Brian G. Marsden (1995) wrote that this comet had many things in common with the Great Comet of 1811. In particular, he listed "early absolute brightness, perihelion distance, orbital inclination, 3000-year revolution period, [and] placement beyond the sun at perihelion." With these similarities, there seems a chance the Great Comet of 1811 could be a guide to predicting how comet C/1995 O1 might perform in 1997.

A quick look at my manuscript revealed that the Great Comet of 1811 had been most influential. Not only had later astronomers declared this comet among the most impressive in history, with its naked-eye visibility beginning in mid-April 1811 and lasting until the first week of January 1812, but its impact outside of the astronomical community was also noteworthy. Napoleon I (Emperor of the French) considered the comet's spectacular appearance as an omen indicating his success in his planned invasion of eastern Europe and Russia in 1812 (Brown 1974).

Even more interesting is the appearance of "comet wine" on the lists of wine merchants for several years following the appearance of the Great Comet of 1811. It seems that the year 1811 saw the appearance of several particularly good vintages of wine. According to *The Great Vintage Wine Book* by Michael Broadbent (1981), the red and white wines from Bordeaux, France were considered five-star vintages (on a five-star scale), with the 1811 Chateau Lafite "considered the finest red Bordeaux ever made." In addition, the Burgundy from the Côte d'Or region near Beaune, France, and the Port from the Douro region of Portugal were also rated as five-star wines in 1811.

Exactly what might be in store for us in 1997 is still somewhat uncertain at this time, but provided here are details of the appearance of the Great Comet of 1811, which might help in preparation for observing comet C/1995 O1 (Hale-Bopp). This material is largely taken from volume 2 of my unfinished *Cometography* manuscript.

II. Comet of 1811: Discovery and Early News

Honoré Flaugergues (1811) of Viviers, France, discovered this comet on the evening of 1811 March 25. He said it was situated in Argo Navis, a huge constellation that had actually been broken up during the previous century. An observation by Flaugergues the next night confirmed its cometary nature, and his estimated apparent position indicated that the comet was in Puppis. Flaugergues further observed the comet on the evenings of March 28-31, as well as on April 1.

The comet was situated 2.16 AU from Earth and 2.72 AU from the sun when discovered. Observations temporarily ceased after April 1, as the moon began interfering (full moon was on April 8), but resumed on April 11, when Jean Louis Pons (1811), of Marseille, France — not having received word of the discovery — accidentally found the comet on April 11.82 UT and determined a position on April 11.87. Meanwhile, Franz Xaver von Zach (1811a, 1811b), at the observatory of St. Peyre near Marseille, was able to confirm Flaugergues' discovery on April 11.83.

The comet was a naked-eye object during the remainder of April and was fairly easy to see without optical aid during May. During this time, its solar elongation was steadily decreasing. The comet's slow and mostly-northward motion finally took it out of Puppis on April 28, as it moved into Monoceros. It then entered Canis Minor on May 21, Hydra on June 5, and Cancer on June 8.

William J. Burchell (1822) was situated in Cape Town (South Africa) from late 1810 until mid-1811. On the evening of 1811 June 2, an earthquake hit the region, and Burchell wrote in his journal that many of the people "coupled the comet, which had been seen every night since the 12th of the foregoing month, and the earthquake together, and drew from this two-fold portentous sign, the certain prognostics of the annihilation of the Cape."

Johann Karl Burckhardt (1811a) computed the first orbit for this comet. Using three positions obtained between March 26 and April 19, he determined a parabolic orbit with a perihelion date of 1811 September 22.26, a perihelion distance of 1.768 AU, and an inclination of 114°.9.

By the end of May, observers were already finding this naked-eye object difficult to see because of its low altitude and entrance into twilight. Flaugergues last detected the comet on May 29, when it was 54° from the sun. Zach (1811b) last detected it on June 2, at an elongation of 52°. Don Jose Joaquin de Ferrer (1829), in Havana (Cuba), last determined the comet's position on June 11, and last saw the comet on June 15, by which time the elongation had decreased to 41°.

The comet's final observer before conjunction with the sun was Alexander von Humboldt (Paris). He last caught a glimpse of the comet in strong twilight on June 16.9, at which time the elongation was 40°.

III. Post-Conjunction

The Earth's steady motion away from the comet culminated on June 25 when their distance had increased to a maximum of 2.4142 AU. Thereafter, the distance between our planet and the comet decreased. Meanwhile, the comet's angular distance from the sun continued to decrease and reached a minimum of just under 10° during the last days of July and first days of August.

Burckhardt (1811b) computed a new orbit during June. Although still parabolic, it indicated that the comet would pass perihelion on September 15.91 at a heliocentric distance of 1.134 AU. From this orbit, Heinrich Wilhelm Matthäus Olbers of Bremen noted that the comet would become a very bright object during October 1811.

The comet entered Leo on August 2, and by mid-month was situated almost due north of the sun. The comet was a little less than 19° from the sun on the evening of August 18, and Flaugergues and Olbers were independently searching for the comet shortly after sunset. Olbers was unsuccessful, but Flaugergues was able to spot it very close to the horizon. The comet was then 2.03 AU from Earth and 1.12 AU from the sun.

The comet entered Leo Minor on August 21 and was still almost due north of the sun. Olbers (1811, 1814) made another attempt to see it on that evening, but was again unsuccessful, adding that his "horizon was not widely free enough"; however, just a few hours later (on the morning of the 22nd), the comet was found very near the horizon, situated near 20 LMi and 21° from the sun. Olbers said that the comet was visible before 20 Leo Minoris, which is listed as magnitude 5.36 in ***Sky Catalog 2000.0*** (Cambridge: Sky Publishing Corporation, 1982) and was visible at about the same time as α LMi, listed as magnitude 3.83. He added that the nebulosity "brightened toward the middle, but haze and twilight prevented me from distinguishing if it exhibited a nucleus and also something of a tail."

Johann Elert Bode (1814), in Berlin, independently recovered the comet with a telescope on the evening of August 22. It was then in the north-northwest and was bright enough to be seen for a short time before it sank below the horizon. A few hours later, on the morning of the 23rd, he saw the comet after it had risen above the horizon. It then appeared brighter to the naked eye. Bode also became the first person to detect the comet's tail on this morning, which he simply described as short.

Friedrich Wilhelm Bessel (1811a, 1814), at Königsberg (now Kaliningrad), independently recovered the comet on the evenings of August 22 and 23. He gave some interesting details about this comet in letters to the *Berliner Astronomisches Jahrbuch* (dated 1811 August 26) and the *Monatliche Correspondenz* (dated 1811 August 29). He said a Dollond telescope of focal length 7 feet failed to show a nucleus on the 23rd, but did reveal a very compact coma that allowed the comet to be seen with the naked eye without much trouble — despite an altitude of under 4°.

Olbers (1812a) obtained a good look at the tail during the last days of August, using a comet-seeker. On the evening of the 28th, he saw two rays which he said "formed a parabola, or even a hyperbola." They were separated by an angle of 80°-85°, and each extended 30′-40′. On the 29th, he saw a more distinct tail that was broad and 3° long. He added that he could still not distinguish a nucleus.

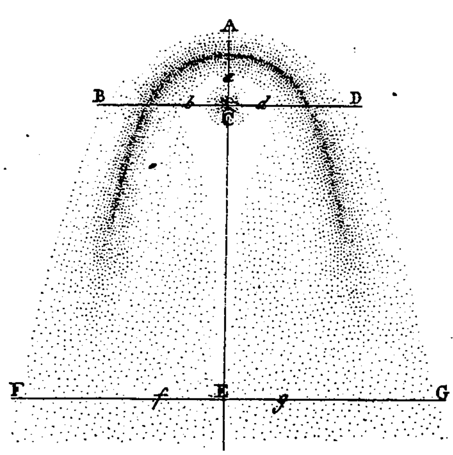
IV. The Great Comet of 1811 at its Best

As the comet began clearing evening twilight, its full splendor was seen by many for the first time. Alexander Ross (1904), a member of the John Jacob Astor expedition traveling down the Columbia River in Oregon, saw the comet on September 1. He "observed, for the first time, about 20 degrees above the horizon, and almost due west, a very brilliant comet, with a tail about 10 degrees long. The Indians at once said it was placed there by the Good Spirit — which they called Skom-malt-squisses — to announce to them the glad tidings of our arrival; and the omen impressed them with a reverential awe for us, implying that we had been sent to them by the Good Spirit, or Great Mother of Life."

The moon was full on September 2, and William Herschel (1812a) at Glasgow then observed the comet with a reflector of focal length 14 feet, but noted that its low altitude, moonlight, and hazy sky made the comet appear "like a very brilliant nebula, gradually brighter in a large place about the middle." He could detect no tail. The comet entered Ursa Major on September 7, and on the 8th Simeon Perkins (1978) — from Liverpool, Nova Scotia — wrote, "at Evening I observe a Comet or Some New appearance of a Star that has an appearance of a Light tail or Blaze it was Nearly in the N.N.W. about one Hour high at 8 o'clock and Set further Northward about —. there was a thin Cloud or haize about it So that I could Not discern the Body of the Star by the Naked Eye but I looked with a Glass and Saw it and an appearance of Light but could not discern any tail or Blaze. It has been observed by Several people for two or three Evenings past." On September 9, Herschel (now at Alnwick) saw the comet with a refractor at a magnification of 65× and noted, "the planetary disk-like appearance seen with the naked eye, was transformed into a bright cometic nebula, in which, with this power, no nucleus could be perceived." He estimated the conspicuous tail as 9° or 10° long and noted a "very considerable" curvature.

(text continued on next page)

◇ ◇ ◇



The Great Comet of 1811 as drawn by Olbers. [From Wilhelm Olbers: Sein Leben und Seine Werke, Vol. **1***; ed. by C. Schilling (Berlin: Verlag von Julius Springer, 1894), p. 326.]*

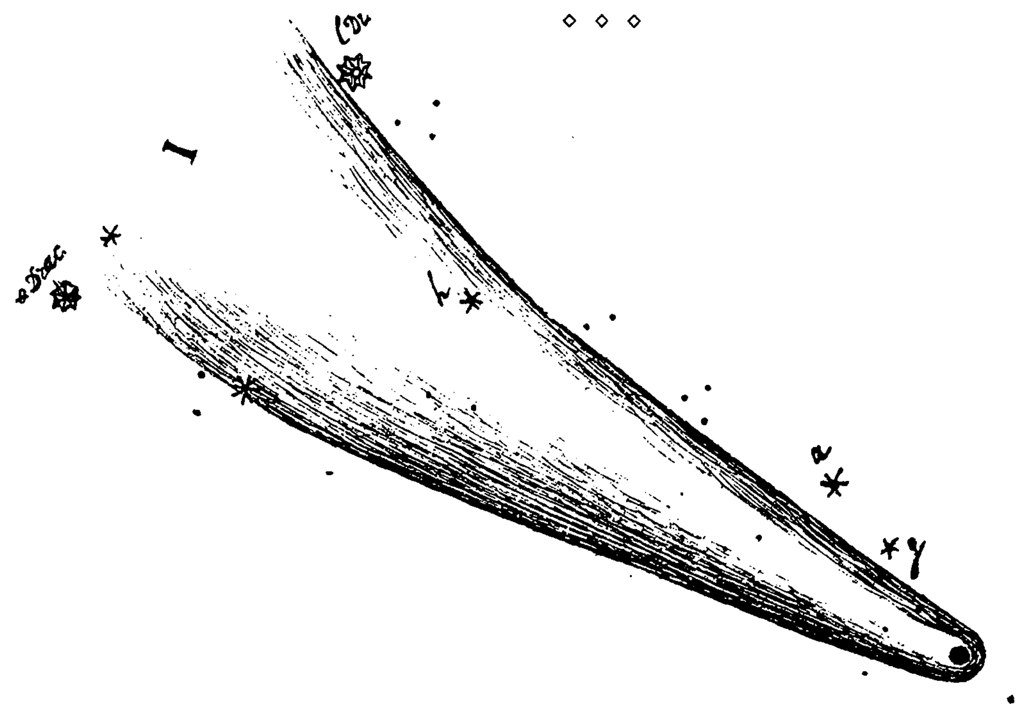
On September 13, Perkins and his daughters "were up at 3 o'Clock to observe a remarkable Star which they had been told rose towards morning they say it had the same appearance as that which it Seen in the Evening and as the motion of that when we See it in the Evening as it is Setting is to the Eastward. I conclude it is the Same it Sets by Nine So it is 5 or 6 Hours under the Horison." On September 17 Bode estimated the tail as 10° long in his Dollond telescope of focal length 3.5 feet, and by September 20, he said it was over 10° long. During the first half of the 19th century, Juan Pío Pérez (1979) of the Yucatan included a note in the *Codex Pérez* which stated that a comet was seen in the northeast on September 18. It was referred to as "God's sign."

Herschel was back in Glasgow on September 18 and obtained several detailed observations of the comet through the end of the month. With a reflector of focal length 10 feet, he noted on the evening of the 18th that the star-like head took on the appearance of a globular nebula when viewed at 110×. He estimated that its diameter was about 5′ or 6′, "of which one or two minutes about the centre were nearly of equal brightness." He added that the tail was 11° or 12° long and remarked "that towards the end of the tail its curvature had the appearance as if, with respect to the motion of the comet, that part of the tail were left a little behind the head." In addition, "The appearance of the nebulosity...perfectly resembled the milky nebulosity of the nebula in the constellation of Orion, in places where the brightness of the one was equal to that of the other." Using a night glass with a field-of-view of 4°41′, Herschel noted the tail was accompanied by a "stream" on each side. He noted "that the two streams or branches arising from the sides of the head scattered a considerable portion of their light as they proceeded towards the end of the tail, and were at last so much diluted that the while of the farthest part of the tail, contained only scattered light." On September 21, the comet entered Canes Venatici; on September 29, Herschel observed with the 10-foot reflector and noted the head was 3′00″ across.

The moon was full on October 2, and the comet then re-entered Ursa Major. The comet reached its most northerly apparent declination of +49°.5 on October 3, and then entered Bootes on October 5. October 3rd was also the first day on which Giuseppe Piazzi (1816) gave the measurement of a central "nucleus." He said it was 2′30″ across, but while this was not the real nucleus, it seems to have been the same bright center, or inner coma, noted by Herschel on September 18th. On October 6, Herschel observed with a 20-foot reflector and noted the head was 3′45″ across, while a fainter outer coma was estimated as 15′ across. He added that the tail was about 25° long. On October 8, Bode (1815) found the tail was 12° long in his telescope. On October 11, Olbers (1812b) said the tail was 12°51′ long. On October 12, Herschel estimated that the tail was 17° long. He added, "its breadth in the broadest part was $6\frac{3}{4}$ degrees, and about 5 or 6 degrees from the head it began to be a little contracted." Herschel observed with his night glass and remarked "that the two streams remained sufficiently condensed in their diverging course to be distinguished for a length of about six degrees, after which their scattered light began to be pretty equally spread over the tail." On October 13, Olbers measured the tail as 12°28′ long. On October 14, Herschel estimated the tail length as 17°.5 and Bode said the tail extended to Eta Draconis, which is about 17°. On October 15, the comet entered Hercules. Herschel commented, "in a very clear atmosphere, I found the tail to cover a space of $23\frac{1}{2}$ degrees in length." He added that his night glass showed the preceding branch of the tail was 7°01′ long, while the following one was only 4°41′ long.

(text continued on next page)

◇ ◇ ◇



Above: *The Great Comet on 1811 Oct. 11, as observed by Bernhard August von Lindenau (1780-1854), of Altenburg. [From Prof. Dr. Th. Bredichin's Mechanische Untersuchungen über Cometenformen, ed. by R. Jaegermann (St. Petersburn, 1903).]*

The comet passed closest to Earth (1.2215 AU) on October 16. That night, Herschel noted a well-defined luminous point in the center of the coma and measured its diameter as 0″.79. He added, "that part of the head which was towards the sun was a little brighter and broader than that towards the tail, so that the planetary disk or point was a little eccentric." On October 17, Herschel found the bright point within the coma to have been "a little beyond the centre." He added that "the tail appeared to be more curved than it had been at any time before." On October 19, Herschel examined the comet with his 10-foot reflector. At a magnification of 169×, he noted the bright point within the coma was 1″.39 across; at 600×, he estimated it was between 0″.68 and 1″.06 across. Bode said the tail extended to μ Dra, which amounted to about 14°. The comet reached a maximum solar elongation of 67° on October 31.

V. The Comet Now Outward-Bound

The first elliptical orbit was computed by Flaugergues (1811) during October. He determined an orbital period of 509.6 years and suggested this was a return of the comet seen by the Chinese in September of 1301. Meanwhile, an excerpt of a letter written by Bessel (1811b) on October 20 gave details of Bessel's determination of an elliptical orbit with a period of 3383 years.

On November 3, Herschel observed with his night glass and noted, "The two branches were nearly of an equal length." On November 4, Burchell (1822) — near the Vaal River, about 50 miles west of present day Kimberley, South Africa — wrote, "as I lay waiting for sleep, and amusing myself in observing the constellations above my head, I noticed a faint nebulous star of the third magnitude, which I had not been used to see in that part of the heavens. Looking at it more attentively, it appeared plainly to be a comet." He said it was located in the tail of Aquila and formed a right triangle with α Cyg and α Lyr. Herschel found the nucleus "more eccentric than I had ever seen it before" and showed a slight disk in the 10-foot reflector with a magnification of 289×. On November 5, he estimated that the tail was not longer than 12°.5. He added that the preceding "stream" was 5°16′ long, while the following "stream" was 4°41′ long. Bode estimated the tail as 10° in length. On November 9, Herschel noted, "The two branches might still be seen to extend full 4 degrees, but their light was much scattered." He added, "The tail of the comet being very near the milky-way, the appearance of the one compared to that of the other, in places where no stars can be seen in the milky-way, was perfectly alike." He estimated the tail's length as 10°. With his 10-foot reflector, Herschel saw the nucleus "imperfectly" with a magnification of 169×, but "it was more visible" with a magnification of 240×; however, "the nebulosity of the envelope overpowered its light already so much that no good observations could be made of it." On November 10, he obtained only a glimpse of the nucleus in the 10-foot reflector and noted it was as eccentrically placed as on the 4th; he added that the preceding branch was 5°16′ long, while the following one was 3°31′ long.

On November 13, Herschel could no longer see the nucleus. He did notice that the following "stream" was now longer and 4°06′ in length, while the preceding "stream" was 3°31′ long. Piazzi did report a nucleus with a diameter of 2′15″, but, as on October 3rd, this was apparently a bright inner coma. On November 14, the comet entered Sagitta. Herschel found both "streams" equal in length and 3°31′ long. On November 15, the comet entered Aquila. Herschel noted the following "stream" was 4°06′ long, while the preceding was 3°31′ long. The comet was moving along the Sagitta-Aquila border by mid-November. On the 16th, Herschel noted the tail was about 7°.5 long to the naked eye and found the following "stream" 3°48′ long, while the preceding one was 3°13′ long. On November 19, he found the two "streams" to be of equal length and 4°23′ long. The tail was estimated as 6°10′ long.

On December 2, Herschel noted the tail was "hardly 5 degrees long and of a very feeble light." He said the streams were both 3°12′ long, and he added, "they joined more to the sides than the vertex, and had lost their former vivid appearance; their colour being changed into that of scattered light." The comet passed less than one-half degree from Altair on December 3. On December 4, Bode observed the comet with his 3.5-foot Dollond telescope, and said the comet was "noticeably smaller with the coma seeming more diffuse." He estimated the tail as 5° long. On December 9, Herschel wrote that the tail length had changed little since the 2nd. He noted, "The branches were already so much scattered that observations of them could no longer be made with any accuracy." Piazzi again said he saw the "nucleus," and gave its diameter as 2′. As in October and November, this was probably an inner coma. On December 14, Herschel wrote that the tail "still remained as before, but the end of it was much fainter." The comet entered Delphinus on December 18, re-entered Aquila on the 25th, and then passed into Aquarius on the 26th.

As 1812 began, the comet was moving slowly southeastward through Aquarius, some 37° from the sun. On January 2, Herschel (1812b) commented that the comet "could only be distinguished from a bright globular nebula by the scattered light of its tail, which was still 2 degrees 20 minutes long." Ferrer determined positions of the comet on six evenings during the period January 5-10, and noted, "the sky was very clear, but the light of the comet was so weak that it could scarcely be distinguished with the naked eye." He also pointed out that, on January 8, the comet was first seen when its altitude was 16° or 17°, and was last seen when its altitude was only 5°. Barnabe Oriani (1812), at Milan (Italy), determined positions on January 7 and 10. Zach's (1812) last sighting came on January 11.76, when he was able to make only a semi-precise determination of the comet's position. The comet was then 29° from the sun.

The comet's solar elongation decreased as January continued, dropping to 30° by the 10th, 25° by the 17th, and 20° by the 24th. The elongation had decreased to 15° as February began, and had dropped to 10° by the 12th. On February 17, the comet passed only 9°.5 from the sun, and then its solar elongation began to increase.

During March 1812, Ferrer (1829) took positions he had determined during the period May 21-January 8, and computed an elliptical orbit with an orbital period of 3757 years. He wrote that the comet would arrive at opposition at the beginning of August, when the distance from Earth would decrease to 3.14 AU. Ferrer pointed out that on January 8 the comet had been situated 2.86 AU from Earth, so that "it can be scarcely doubted therefore, that it will be visible in its opposition, and in the meridian." He computed an ephemeris for the period June 1-August 25.

Ferrer began looking for the comet in early July. He used the refractor of focal length 4.5 feet, "but I could not discover it on account of the little light it had at that time." However, while using a 4-inch refractor on July 11.31, Ferrer spotted the comet with a magnification of only 5×. The subsequent field-of-view was given as 5°. Ferrer wrote "some stars of the 10th and 12th magnitude surrounded" the comet. He added, "the extremity of its nucleus was in contact with one of these stars, and its centre 2 minutes towards the south, and in the same right ascension." He continued, "The comet appeared as a very slight vapour, its tail opposed to the sun scarcely looked 10 minutes in length". The comet was again observed by Ferrer on July 13 and July 14, but he was not able to determine an accurate position. He even tried using a 12-inch "repeating-circle," but whenever the threads were illuminated, the comet would disappear. Ferrer last saw the comet on July 15.31, and noted it was "in contact with a star of 10th magnitude". The comet entered Capricornus on July 30.

Vincent Wisniewski (1816), at Novocherkassk (Russia), found the comet with his Dolland telescope of focal length 3.5 feet on July 31. He described it as faint and blurred, with a coma scarcely 1'.5 across, but no tail was seen. He added that it appeared yellowish. On August 11, Wisniewski observed under not-so-clear skies with his Dolland telescope and described the comet as extremely faint. On August 12, he said the sky was clearer than on the previous night and noted the comet was subsequently more distinctly seen; it was about 1′ across. He added, "The comet had scarcely the brightness of an 11th-magnitude star." On August 15, Wisniewski said the sky was not very clear, and the comet was subsequently extremely faint.

The comet was last detected on 1812 August 17.97 by Wisniewski. He said a strong wind was shaking the telescope, and the comet could hardly be seen. The comet was then at an elongation of 167°; it was also situated 3.55 AU from Earth and 4.54 AU from the sun.

VI. Assessment of the Apparition of C/1811 F1

Because of the state of communications in those days, several years passed before all of the observations of comet C/1811 F1 were finally published. During 1825, Argelander did evaluate the observations at hand and computed an elliptical orbit with an orbital period of 3065 years (Galle 1894), but even he did not have the benefit of Ferrer's observations, which were not published in their final form until 1829.

The comet's orbit was finally re-examined in 1892, when Norbert Herz used nearly 1000 positions obtained between 1811 March 31 and 1812 August 17, as well as perturbations by two planets, and computed an elliptical orbit with a perihelion date of 1811 September 12.76 and an orbital period of 3095 years (Galle 1894).

In the years that followed, numerous people looked back on this comet. Ferrer (1829) wrote, "I used all attention to discover the nucleus of this comet" (with the 4.5-foot refractor) while it was visible, "yet never could perceive more than a luminous point from time to time, which can no how be supposed to arise from defect of clearness of sky in the Isle of Cuba." He concluded "it is beyond a doubt that the diameters of these bodies [referring to comets 1807, 1811 I, and 1813 II] are exceedingly small, and we much fear therefore that the greater part of those who have observed them have confounded the nucleus with the nebula." Ferrer specifically noted Herschel's observation of October 16, and wrote "not to mention the difficulty of measuring such small quantities, radiation must augment considerably the luminous disc."

Astronomer John Russell Hind (1857) wrote, "The finest comets which have been observed during the present century are those of 1811 and 1843. The former one was more remarkable for its brilliancy and the length of time it continued visible, than for the apparent extent of the tail; indeed, we have frequently met with eye-witnesses of that comet who have no recollection of any vestige of a tail."

Even the French writer Jules Verne (1878) knew of this comet as he wrote, "The great comet of 1811 . . . has caused the year of its appearance to be familiarly recognised as 'the comet-year' . . ."

The great comet of 1811 has orbital characteristics that are not unlike those of comet C/1995 O1 (Hale-Bopp). It is interesting to look at the comet of 1811 as a possible model for C/1995 O1, but one cannot really say that the latter comet will behave as did the former. C/1811 F1 was discovered when 2.72 AU from the sun, pre-perihelion; C/1995 O1 will be at this distance on 1996 Oct. 15, so it will be interesting to make a comparison between the appearance of C/1995 O1 at that time with the discovery appearance of C/1811 F1. And, as noted by Green and Morris (1995), the type of tail formed by C/1995 O1 may be one of the most important factors regarding its acceptance as a "great" comet; in the case of the great comet of 1811, it is uncertain from the records as to how intense was the surface brightness of its tail, despite its lengths of up to 25°. Herschel (1812a) noted that the outermost reaches of those longer tail length measurements were just above the sky background in brightness. It may be more instructive, indeed, to compare these two comets *after* C/1995 O1 (Hale-Bopp) has come and gone.

Acknowledgements.

Daniel Green and Brian Marsden provided useful suggestions and references for this article. In addition, Paul Messerschmidt uncovered some interesting details about "comet wine".

REFERENCES

Bessel, F. W. (1811a). *Monatliche Correspondenz* **24**, 302-303.
— (1811b). *Monatliche Correspondenz* **24**, 513-514.
— (1814). *Berliner Astronomisches Jahrbuch*, pp. 257-258.
Bode, J. E. (1814). *Berliner Astronomisches Jahrbuch*, pp. 262-263.
— (1815). *Berliner Astronomisches Jahrbuch*, pp. 167-171.
Broadbent, G. (1981). *The Great Vintage Wine Book* (Alfred Knopf).
Brown, P. L. (1974). *Comets, Meteorites & Men* (New York, NY: Taplinger Publishing Co.), p. 145.

Burchell, W. J. (1822). *Travels in the Interior of Southern Africa* (London: Longman, Hurst, Rees, Orme, and Brown), pp. 159-160, 431.
Burckhardt, J. K. (1811a). *Monatliche Correspondenz* **23**, 599.
— (1811b). *Monatliche Correspondenz* **24**, 93-96.
Ferrer, D. J. J. d. (1829). *Mem. Astron. Soc. London* **3**, 9-38.
Flaugergues, H. (1811). *Monatliche Correspondenz* **24**, 508-509.
Galle, J. G. (1894). *Cometenbahnen* (Leipzig: Verlag von Wilhelm Engelmann), pp. 34-35, 186-187.
Green, D. W. E.; and C. S. Morris (1995). *ICQ* **17**, 179.
Herschel, W. (1812a). *Phil. Trans. Roy. Soc. London* **102**, 115-143.
— (1812b). *Phil. Trans. Roy. Soc. London* **102**, 232.
Hind, J. R. (1857). *The Comet of 1556* (London: John W. Parker and Son), p. 55.
Marsden, B. G. (1995). *IAUC* 6202.
Olbers, H. W. M. (1811). *Monatliche Correspondenz* **24**, 301-302.
— (1812a). *Monatliche Correspondenz* **25**, 4-5.
— (1812b). *Monatliche Correspondenz* **25**, 16-17.
— (1814). *Berliner Astronomisches Jahrbuch*, pp. 242-246.
Oriani, B. (1812). *Monatliche Correspondenz* **25**, 93.
Pérez, J. P. (1979). *The Codex Pérez and The Book of Chilam Balam of Maní*, transl. and ed. by E. R. Craine and R. C. Reindorp (Norman: University of Oklahoma Press), p. 58.
Perkins, S. (1978). *The Diary of Simeon Perkins*, ed. by C. Bruce Ferguson (Great Britain: Robert MacLehose and Company Limited), pp. 335-336.
Piazzi, G. (1816). *Berliner Astronomisches Jahrbuch*, pp. 214-215.
Pons, J. L. (1811). *Monatliche Correspondenz* **23**, 422.
Ross, A. (1904). "Adventures of the First Settlers on the Oregon or Columbia River", in *Early Western Travels: 1748-1846*, Vol. **7** (ed. by R. G. Thwaites (Cleveland, OH: The Arthur H. Clark Company), p. 151.
Verne, J. (1878). *Hector Servadac*, transl. by E. E. Frewer (London: Sampson Lowe, Marston, Searle & Rivington), p. 216.
Wisniewski, V. (1816). *Berliner Astronomisches Jahrbuch*, pp. 261-265.
Zach, F. X. von (1811a). *Monatliche Correspondenz* **24**, 191.
— (1811b). *Monatliche Correspondenz* **24**, 554-555.
— (1812). *Monatliche Correspondenz* **25**, 183-184.

Φ Φ Φ

Dennis Milon (1940–1995)

Dennis Milon, well-known amateur astronomer, expert astrophotographer, and comet discoverer, passed away last October. From 1964 until 1984, he was the Recorder for the Comets Section of the Association of Lunar and Planetary Observers (ALPO). In the pre-*ICQ* days, Dennis Milon was the focal point for amateur comet observation both in the US and for many observers world-wide. He not only encouraged the observation of comets, but also the scientific analysis of the observations. In July 1975, Dennis was the co-discoverer of comet C/1975 N1 (Kobayashi-Berger-Milon) = 1975 IX = 1975h, of which he was very proud.

Dennis Milon was born on 1940 January 21 (which was also the 60th birthday of George Van Biesbroeck). In the early 1960s, he was active in the Houston amateur astronomy club and taught himself high-resolution photography with the club's 8-inch reflector. He joined the Lunar and Planetary Laboratory (LPL) in 1963 after meeting Gerard Kuiper at McDonald Observatory, having impressed him with some very good lunar photographs he had taken in Houston. Milon worked in the LPL photolab and was involved in the early lunar, planetary, and cometary photography with the Catalina 61-inch telescope in 1965. Milon also worked with analog rectification of lunar-limb-area photos using projection onto a huge plaster sphere. He also led several meteor observing trips to Kitt Peak, including the spectacular Leonid shower in 1966. Milon also was an observing assistant to George Van Biesbroeck and Elizabeth Roemer. He enjoyed writing popular articles, and — when the opportunity arose — Milon moved to Cambridge, Massachusetts, to work at *Sky and Telescope* (*S&T*) magazine.

Hired as an Assistant Editor at *S&T* in April 1967, Milon remained on the magazine staff until May 1991, when he pursued other positions in photography (as the magazine moved from photography into the electronic publishing era). For many years, he ran the darkroom at *S&T*. So good was Milon at developing astronomical photographs that authors and photographers often remarked that photographs reproduced in the magazine often looked better than the originals! Milon also did the custom printing for the magazine's Spotlight poster astronomical photographs. Dennis diCicco remarks that Milon's expert printing of astronomical photographs undoubtedly increased the fame and popularity of numerous astrophotographers by making their work so well reproduced in print form. Milon was also very visible at *Sky and Telesçope* in other ways. He often responded to astronomical questions via telephone and letters.

Dennis Milon succumbed to a series of mini-strokes and heart attacks; his death on 1995 October 9 in Boston ended several weeks in intensive care at Massachusetts General Hospital.

(continued on next page)

The editors of the *ICQ* had extensive interaction with Dennis Milon over the years. Charles Morris worked with him on ALPO Comets Section analyses for a number of years. Milon's initial encouragement is a significant factor in Charles' continuing interest in the study of comets. Daniel Green's early interest in observing comets (in the early 1970s) was spurred by Milon's typical energy and enthusiasm in writing letters and offering advice and observing aids as Comets Section Recorder. It should be noted that a significant percentage of the pre-1979 data in the *ICQ* archive were collected by Milon while Recorder of the ALPO Comets Section.

[Compiled by Charles S. Morris and Daniel W. E. Green, with input supplied courtesy of Dennis diCicco, Steve Larson, Brian Marsden, and David Meisel.]

Φ Φ Φ

First Latin-American Workshop on Comets

The first Latin-American Workshop on Comets will be held during 1996 June 7-9 at the Asociacion Argentina Amigos de la Astronomia in Buenos Aires, Argentina. The Workshop will principally include some invited talks and round-table discussions. Additional brief oral and poster papers may be contributed by registrants and given at the discretion of the Scientific Organizing Committee.

The first Workshop *Circular* was issued on 1995 Dec. 30 and is available by e-mail and postal mail from the Asociacion Argentina Amigos de la Astronomia; Av. Patricias Argentinas 550; 1405 — Capital Federal; Argentina. Or one can request information via e-mail from `cometwor@aaaa.org.ar`, or via telephone from 863-3366 (fax from 2^h to 21^h UT; voice from 21^h to 2^h UT).

The Local Organizing Committee is chaired by Eng. Cristian Rusquellas. This information was contributed to the *ICQ* by Jose Guilherme de S. Aguiar of Brazil, who is a member of the "Cientific Commitee".

Φ Φ Φ Φ Φ

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 October 1995 issue, p. 183.]

Old			*New-Style Designation*	*P*	*T*	*q*	*IAUC*
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)		8/2/95	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
			123P/1995 S2 (West-Hartley)	7.6	5/12/96	2.1	6249
			124P/1995 S3 (Mrkos)	5.6	11/9/96	1.4	6250
		⋆	C/1995 Y1 (Hyakutake)		2/24/96	1.05	6279
		⋆	P/1996 A1 (Jedicke)	17.9	10/19/95	4.1	6287
		⋆	C/1996 B1 (Szczepanski)		2/7/96	1.45	6296
		⋆	C/1996 B2 (Hyakutake)		5/1/96	0.23	6299

— Catalogue of Cometary Orbits —

The 11th edition of the *Catalogue of Cometary Orbits 1996* has recently been issued as a joint publication of the International Astronomical Union's Central Bureau for Astronomical Telegrams and Minor Planet Center. It includes comets observed through the end of 1995 contains a complete list of the new-style designations for comets, vs. the old. The price is US$20.00 (US$30.00 for airmail delivery), with checks payable to "Minor Planet Center". For further information, contact the Minor Planet Center, M.S. 18, Smithsonian Observatory, 60 Garden St., Cambridge, MA 02138, U.S.A. (e-mail IAUSUBS@CFA.HARVARD.EDU).

Φ Φ Φ

Tabulation of Comet Observations

Due to time constraints, observations contributed on paper have not been included in this issue; they will appear in the April issue.

Descriptive Information (to complement the Tabulated Data):

◇ *Comet C/1993 A1 (Mueller)* ⟹ 1993 Aug. 17.90: possible faint narrow tail 7'.5 long in p.a. 315° [OST]. Aug. 18.01: w/ 15-cm *f*/4 L (40×), 7'.5 coma, DC = 2 [OST].

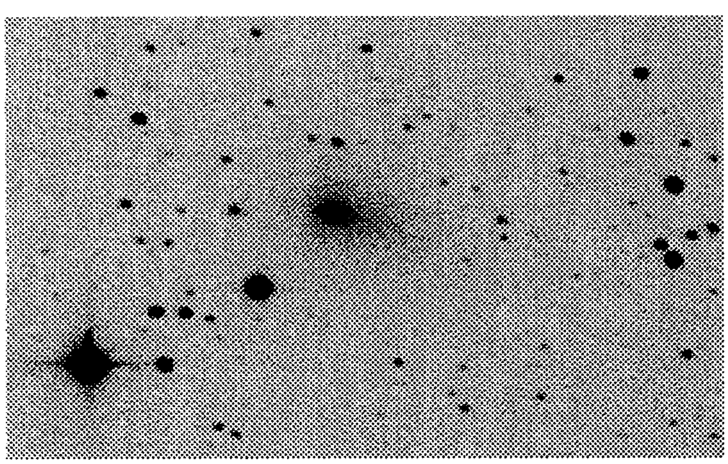
◇ *Comet C/1995 O1 (Hale-Bopp)* ⟹ 1995 Sept. 26.83: image was processed with another of the same field taken one month later, in order to substract the stars; this reveals an assymetric coma, elongated towards p.a. 35°, of size 1'.9 × 2'.6 [GAR02]. Oct. 16.15: w/ 20-cm T (167×), faint stellar cond. [MOR]. Oct. 21.12: w/ 26-cm L (156×), no stellar cond. [MOR]. Oct. 22.12: w/ 50-cm L (275×), no stellar cond. [MOR].

◇ *Comet C/1995 Q1 (Bradfield)* ⟹ 1995 Oct. 7.12: at 40×, 6' × 4' coma, slightly extended in p.a. 280° [BAR06]. Oct. 13.13: 6' × 4' coma, extended in p.a. 305° (possible tail) [BAR06]. Oct. 17.82: 16-cm *f*/3.8 W (+ TP2415 film) shows 10' sunward tail in p.a. 155° and 3'.5 ion tail in p.a. 315° [TSU02]. Oct. 21.11: m_1 = 9.1 w/ ref. HS [MID01]. Oct. 21.50: w/ 25.6-cm *f*/4 L (45×), 0°.5 tail in p.a. 185° [MOR]. Oct. 22.10: coma is slightly extended in p.a. 332° [VEL03]. Oct. 25.09: w/ 20-cm *f*/6 L (78×), m_1 = 9.4 (MM: S), 5' coma, DC = 0-1 [SZA04]. Oct. 26.11: at 40×, well visible faint, star-like nucleus of mag ~ 11.8, does not affect DC by more than 1 unit [BAR06]. Oct. 27.06: faint starlike nucleus of mag ~ 11.7 in very diffuse coma [BAR06]. Nov. 3.07: difficult observation; comet was only slightly brighter than the sky background [MID01]. Nov. 3.07: AC chart for T UMa [GRA04]. Nov. 19.17: photometry w/ 20-cm *f*/2 Baker-Schmidt camera + *V* filter + ST-6 CCD; diffuse circular coma of dia. ~ 7' [MIK]. Nov. 20.07: obs. hampered by 11th-mag star near center of coma [SAR02]. Nov. 26.21: faint circular coma w/ cond. [MIK].

◇ *Comet C/1995 Y1 (Hyakutake)* ⟹ 1996 Jan. 4.76: w/ 1.0-m reflector + CCD, coma diameter 2'.0, w/ slight extension to the SW; central core of the comet is ~ 5", possibly extended by seeing [R. H. McNaught and G. J. Garradd, Siding Spring Observatory, Australia]. Jan. 17.15: coma was elongated along p.a. 118°-298° [BAR06]. Jan. 26.528: dust tail in p.a. 246°; narrow gas tail in p.a. 272° [SCO01]. Jan. 31.20: small, condensed object w/ no central cond. [KAM01].

◇ ◇ ◇

Below: ***Image of C/1995 Y1 by Gordon Garradd (25-cm f/4.1 Newtonian reflector + HI-SIS22 CCD; 300-sec CCD exposure taken from Loomberah, New South Wales, on 1995 Dec. 28.675 UT. North is up; field is 11'.4 × 7'. Astrometric exposures of 5 and 10 sec show no strong central condensation, but rather a region of diameter ~ 10" of fairly uniform brightness; taken in seeing of ~ 3".***



◇ *Comet C/1996 B1 (Szczepanski)* ⟹ 1996 Jan. 31.18: large diffuse object; weak central cond. toward the W [KAM01]. Jan. 31.99: coma slightly elongated [BAR06].

◇ *Comet 6P/d'Arrest* ⟹ 1995 July 3.99: circular coma; well-defined tail in p.a. 182° [BAR06]. Aug. 10.89: coma involved with a bright star [ZNO].

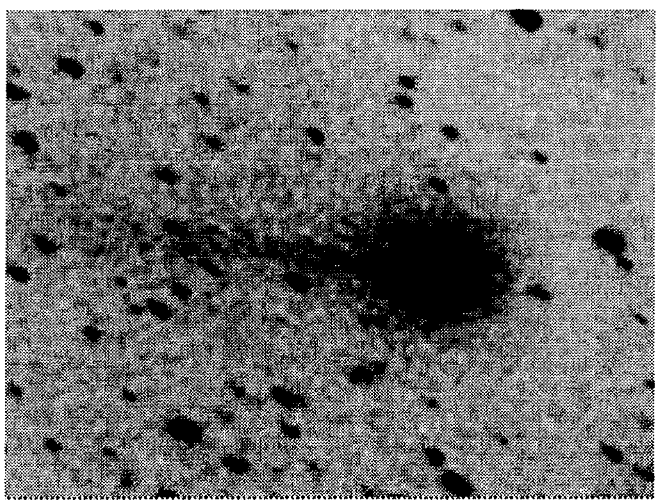
◇ *Comet 29P/Schwassmann-Wachmann 1* ⟹ 1995 Nov. 21.18: faint circular coma of dia. ~ 1'.5 w/ a 10″ 'stellar' central cond.; a jet-like, slightly-curved feature extends from the central cond. to the outer coma (edge in p.a. ~ 5°; the jet length is exactly half the coma dia. — 0'.7; it appears the same on further 3-min *R* and 7-min *B* images taken around Nov. 21.19 UT as on the 5-min *V* exp. mentioned above) [MIK]. 1996 Jan. 18.14: 13″ star-like central cond. surrounded by a delicate coma [MIK].

◇ *Comet 32P/Comas Solá* ⟹ 1995 Oct. 26.00: fan-shaped tail spans p.a. 57°-91° [GAR02]. Oct. 27.29: for this and all Oct. data, the individual magnitude estimates were taken off of 300-sec exp.; the tail and coma measurements are from three co-added 300-sec exposures yielding a total of 900 sec; most of the co-added exposures have been placed on a World Wide Web site at `http://www.lpl.arizona.edu/bss/comets.html` [HER02].

◇ *Comet 45P/Honda-Mrkos-Pajdušáková* ⟹ 1995 Dec. 24.10: comet very close to Venus, much brighter w/ Lumicon Premium Deep-Sky filter [SPR]. Dec. 26.08: comet very close to horizon; much brighter w/ Lumicon Swan-Band filter [SPR]. 1996 Jan. 31.22: very diffuse object w/ a slight enhancement toward the center; best visible in binoculars [KAM01].

◇ ◇ ◇

Below: *Image of 45P by Tim Puckett, Villa Rica, GA, U.S.A. (30.5-cm f/7 Schmidt-Cassegrain reflector + ST6 CCD camera); 300-sec exposure taken on 1995 Dec. 14.001 UT.*



◇ ◇ ◇

◇ *Comet 58P/Jackson-Neujmin* ⟹ 1995 Nov. 16.44: central cond. elongated in p.a. 45° [NAK01]. Nov. 21.45: central cond. elongated in p.a. 50° [NAK01].

◇ *Comet 67P/Churyumov-Gerasimenko* ⟹ 1995 Oct. 24.91: the p.a. of the tail is now 60° (rotation of 11° in 90 min); no perceived variation of m_2 in 90 min (<0.1 mag) [GAR02]. Oct. 25.94: second tail 1'.1 long in p.a. 88° [GAR02]. Nov. 16.43: 2'.0 anti-tail in p.a. 255° [NAK01]. Nov. 18.09: sunward trail extends 19'.27 in p.a. 246° [SCO01]. Nov. 18.13: w/ 26-cm L (156×), comet extremely diffuse w/ a knot of material in the center and a very faint (m_2 ~ 15) stellar cond. [MOR]. Nov. 20.78: photometry w/ 36-cm *f*/6.8 T + *V* filter + CCD; fan-like tail ~ 6′ long in p.a. ~ 55° [MIK]. Nov. 21.44: 1'.8 anti-tail in p.a. 240° [NAK01]. Dec. 10.44: faint anti-tail in p.a. 230° [NAK01]. 1996 Jan. 16.74: photometry w/ 20-cm *f*/2 Baker-Schmidt camera + *V* filter + ST-6 CCD shows trace of a fan-like tail ~ 3′ long in p.a. ~ 45° [MIK]. Jan. 20.18: a narrow, well defined dust trail extends at least 28'.73 in p.a. 235°.5 and at least 19'.59 in p.a. 55°.5 [SCO01].

◇ *Comet 71P/Clark* ⟹ 1995 June 22.96: pretty large coma appeared as roughly elliptical, w/ long axis aligned from p.a. 95° to 275° and dimensions 3'.5 × 2'.5; altitude quite low, but sky conditions good; all obs. of this comet made at Zelenchk astronomy station in the Caucasus mountains [BAR06]. June 23.97: parabolic or fan-shaped coma, opening to p.a. 280°-10°; 1'.4 weak central cond. appeared elongated toward long axis [BAR06]. June 23.97: parabolic coma has dimensions 2′ × 2'.5 [OST]. June 24.98: parabolic coma, p.a. 260° [BAR06]. June 25.97: coma 2′ × 3′, parabolic in shape [OST]. June 25.98: parabolic coma, p.a. 270° [BAR06]. June 26.96: coma 2'.5 × 3′, parabolic in shape [OST]. June 26.98: parabolic coma; weak, narrow tail in p.a. 291° [BAR06]. Nov. 17.07: faint sunward tail extends 2'.44 in p.a. 252° [SCO01].

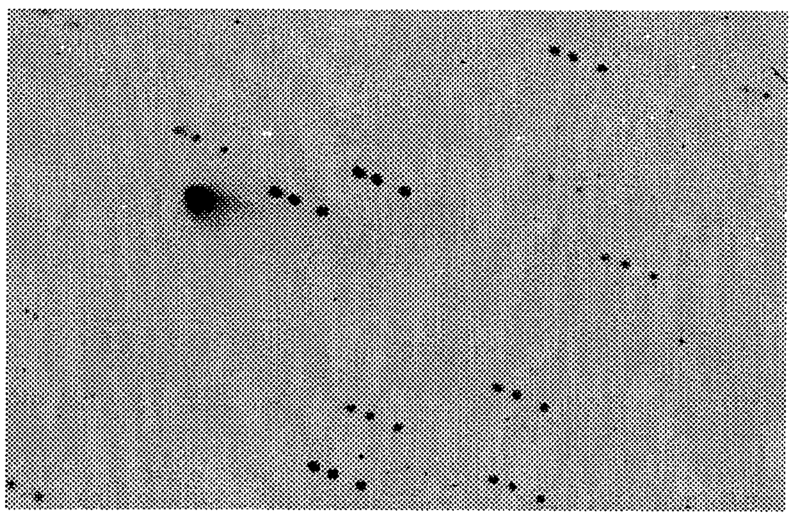
◇ *Comet 73P/Schwassmann-Wachmann 3* ⟹ 1995 Oct. 25.10: w/ 26-cm L (67×), dense, broad, teardrop-shaped brightness plateau in the coma; even at 156×, no stellar nucleus; leading edge of the tail looks like a bow shock front [MOR]. Nov. 11.09: w/ 26-cm L (111×, 156×), faint stellar cond. w/ an extension back into the tail [MOR]. Nov. 16.40: faint anti-tail in p.a. 290° [NAK01]. Nov. 18.10: w/ 26-cm L (67×), a diffuse, faint anti-tail was visible w/ a possible flattened fan connecting the main tail thru N; a very faint stellar cond. visible; tail 0°.1 long in p.a. 295° [MOR]. Nov. 19.11: star in coma; m_1 is probably an underestimate [MOR]. Dec. 9.38: anti-tail > 11′ long in p.a. 245° [YUS]. Dec. 10.39: 0°.70 anti-tail in p.a. 253° [NAK01]. Dec. 10.39: 16-cm *f*/3.8 W (+ TP2415) shows 6′ coma; 14′ tail in p.a. 80° and 22′ anti-tail in p.a. 255° [TSU02]. Dec. 12.16: coma extension in solar direction (p.a. 224°); anti-tail ~ 0°.2 long [BAR06]. Dec. 16.12 and 21.12: comet looked like an edge-on galaxy; the main tail (~ 5′) and anti-tail (~ 10′) were ~ 180° apart; the anti-tail was brighter than the main tail [MOR]. Dec. 21.68: star of mag 10.5 and starlike nucleus mag of ~ 11.5 involved in diffuse coma; at 56×, coma elongated in p.a. 50°-230°, more extended in solar direction; faint main tail ~ 0°.4 long; 3′ jet in p.a. 230° [BAR06]. Dec. 22.67: coma extended in solar direction; at 56×, 3′ jet in p.a. 230°; main tail is not seen [BAR06]. Dec. 23.40: 16-cm *f*/3.8 W (+ TP2415) shows 3′ coma; 5′ tail in p.a. 85° and 15′ anti-tail in p.a. 240° [TSU02]. 1996 Jan. 8.11: w/ 26-cm L, the anti-tail is faintly visible [MOR].

◇ *Comet 95P/Chiron [(2060) Chiron]* ⟹ 1995 Dec. 20.86: used ST-7 CCD (768×512), 10.0-min integrations for images w/ dark subtract and flat fielding; Chiron moved < 1 pixel width (2″.2) on each of 7 images; magnitudes were determined with CCDOPS software and a 31-pixel sample window; Megastar's star database (GSC) was used as the star-magnitude reference [KEN02].

◇ *Comet 116P/Wild 4* ⟹ 1995 Nov. 21.17: stellar coma ~ 0′.5; fan-like tail ~ 3′ long in p.a. ~ 285° [MIK]. 1996 Jan. 17.82: photometry w/ 36-cm *f*/6.8 T + *V* filter + CCD shows fan-like tail ~ 5′ long in p.a. ~ 275° [MIK].

◇ ◇ ◇

Below: ***CCD image of 116P taken by S. Larson with the Steward Observatory 1.5-m reflector on 1995 Dec. 22. Image supplied by Carl Hergenrother, Lunar and Planetary Laboratory, University of Arizona.***

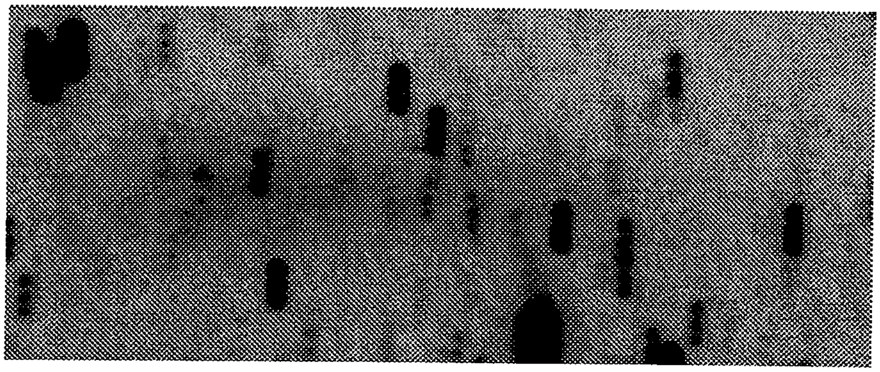


◇ ◇ ◇

◇ *Comet 119P/Parker-Hartley* ⟹ 1995 Oct. 21.07: fan-shaped tail spans p.a. 232°-244° [GAR02].

◇ *Comet 121P/Shoemaker-Holt 2* ⟹ 1995 Oct. 26.07: "there is 'something' at the expected position; it could be the comet, but this suspect is too faint to validate the detection (the comet 'should' be nearly stellar, of mag $m_2 = 18.7$)" [GAR02].

◇ *Comet 122P/1995 S1 (de Vico)* ⟹ 1995 Sept. 26.09: a hard stellar nucleus at the center of cond. now totally dominates the comet's appearance [BAR06]. Sept. 28.16: w/ 20.3-cm *f*/10 T (50×), 2′.5 coma, DC = 8 [KAM01]. Sept. 29.10: strong stellar nucleus; comet much brighter then previously (possible outburst) [BAR06]. Oct. 1.14: w/ 7.5-cm *f*/7 R (21×), coma dia. 5′; weak, curved 0°.3 tail in p.a. 290° [FIE]. Oct. 1.23: photo w/ Tech Pan film and 7-cm D shows primary tail 3° long in p.a. 280° and secondary tail 1° long in p.a. 290° [ROD01]. Oct. 4.07: at 40×, star-like central cond. of mag 6.6; dia. 2′ [BAR06]. Oct. 6.10 and 7.09: at 40×, bright central disk; long and quite broad tail brighter near the coma [BAR06]. Oct. 12.10: at 40×, bright central disk 2′; tail is well visible in strong moonlight; possibly two other tails [BAR06]. Oct. 13.15: main tail in p.a. 320° is long and broad; two other tails 24′ and 12′ in p.a. 345° and 290° [BAR06]. Oct. 15.14: 3° dust tail in p.a. 325° [CSU]. Oct. 16.12: at 40×, bright central disk of mag 6.2 and dia. 1′.7 [BAR06]. *(cont. on next page...)*



Above: ***CCD image of 122P taken by S. Larson with the Steward Observatory 2.3-m reflector at Kitt Peak on 1996 Jan. 21. Image consists of three 120-sec co-added exposures and was supplied by Carl Hergenrother, Lunar and Planetary Laboratory, University of Arizona.***

◇ ◇ ◇

Comet 122P/1995 S1 (de Vico) [cont.] ⟹ Oct. 21.21: second tail 9′ long in p.a. 332°; outer coma elongated towards W [GAR02]. Oct. 21.52: secondary 0°.17 dust tail in p.a. 320°, seen in 26-cm *f*/4 L (45×) [MOR]. Oct. 21.76: uncertainty in brightness due to a very close bright star [BIV]. Oct. 22.10: quite broad main tail 1°.2 in p.a. 355°; narrow and possibly brighter second 0°.5 tail in p.a. 317° [BAR06]. Oct. 22.52: w/ 26-cm L, comet was blue; at 156×, no stellar cond. [MOR]. Oct. 23.09: broad main 2°.1 tail in p.a. 340°; two other narrow tails 0°.2 and 0°.5 long in p.a. 310° and 5° [BAR06]. Oct. 23.74: quite broad main tail 1°.4 long in p.a. 345°; narrow and possibly brighter second tail 0°.4 long in p.a. 300° [BAR06]. Oct. 24.11: broad main 1°.7 tail in p.a. 345°; two other narrow 0°.3 tails in p.a. 320° and 90° [BAR06]. Oct. 24.16: "the inner coma seems to be have a square-like shape with the angles pointing approximately toward N, E, S, and W; the impression is confirmed by an inspection at low powers with a 19-cm *f*/4 L; perhaps a fountain structure is present; a objective-prism spectrum taken w/ a 135-mm-focal-length camera lens by Eraldo Guidolin and MIL02 shows strong emissions due to C_2 w/ faint extension in the tail; violet emission of CN is also strong; there is no trace of continuum; a faint red emission in the tail is probably due to H_2O^+" [MIL02]. Oct. 25.13: w/ 10×50 B, m_1 = 6.7 (MM: S); 4′ coma, DC = 7-8 [SZA04]. Oct. 25.72: bright disk-like inner coma and fainter outer coma; main tail is well visible; no secondary tails seen [BAR06]. Oct. 29.20: observed during the 1995 DSE Star Meeting, near Hvittingfoss, Norway [HIL02]. Oct. 30.8, 31.2, and 31.8: w/ 20.3cm L *f*/6 (40×), start of 0°.2 tail around p.a. 350°; 5′ coma, DC = 7 [BIV].

Nov. 1.10: First Quarter moon; comet much brighter in Lumicon Premium Deep-Sky filter [SPR]. Nov. 2.09: strong moonlight; comet brighter w/ No. 8 yellow filter (also w/ Lumicon Premium Deep-Sky filter) [SPR]. Nov. 3.17-3.18: apparently stellar cond. of m_2 ~ 10 was seen [GRA04]. Nov. 5.68: w/ 11-cm *f*/7 L (32×), 5′ coma, DC = 4 [VEL03]. Nov. 20.72: trace of a ~ 10′ tail in p.a. ~ 355° [MIK]. Nov. 24.72: photometry w/ 20-cm *f*/2 Baker-Schmidt camera + *V* filter + ST-6 CCD; another 3-min exp. with *R* filter shows ~ 2′ coma and ~ 6′ tail in p.a. ~ 350° [MIK]. 1996 Jan. 18.19: diffuse object w/ slight cond.; thin cirrus cloud [MIK].

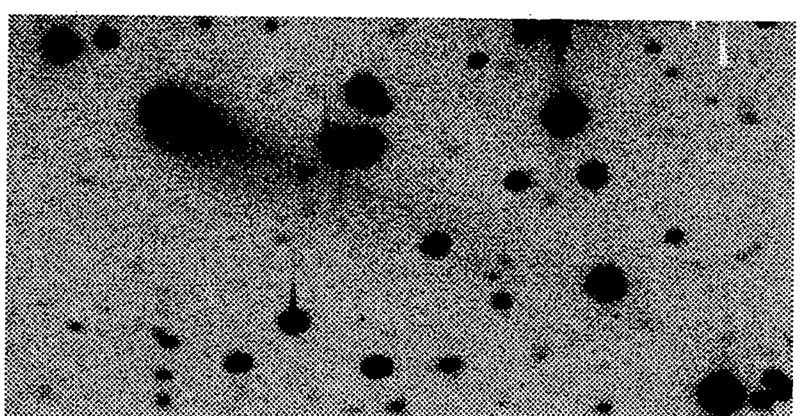
◇ *Comet 123P/1995 S2 (West-Hartley)* ⟹ 1995 Oct. 26.10: comet very faint, nearly-stellar; on one image, the coma appears elongated in p.a. 93°/273° [GAR02].

◇ *Comet 124P/Mrkos* ⟹ 1995 Sept. 20.42: for this and all other Sept. data, the individual magnitude estimates were taken off of 120-sec exposures; the tail and coma measurements are from three co-added 120-sec exposures yielding a total of 360 sec [HER02].

◇ *Comet P/1996 A1 (Jedicke)* ⟹ 1996 Jan. 17.89: photometry w/ 36-cm *f*/6.8 Schmidt-Cassegrain + *V* filter + CCD; "stellar" coma of dia. 10″; faint tail ~ 1′ long in p.a. ~ 285° [MIK].

◇ ◇ ◇

Below: ***CCD image of P/1996 A1 taken by Larson and Hergenrother with the Steward Observatory 2.3-m reflector on 1996 Jan. 21. Image consists of three 120-sec co-added exposures.***



THIS PAGE WAS INCORRECTLY PRINTED IN THE ENCLOSED JANUARY ISSUE. BELOW IS THE CORRECT PAGE 23:

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:*

APF	23	Ladislav Apfelthaler, Czech Republic
BAN	18	Jaroslaw Bandurowski, Poland
BAR06		Alexandr R. Baransky, Ukraine
BEA	07	Sally Beaumont, England
BEN04	18	Leszek Benedyktowicz, Poland
BIV		Nicolas Biver, France
BRO04		Eric Broens, Belgium
BUS01	11	E. P. Bus, The Netherlands
CNO	18	Ryszard Cnota, Poland
COM	11	Georg Comello, The Netherlands
CSU	32	Matyas Csukas, Salonta, Romania
DEM	23	Eduard Demencik, Slovak Republic
DIE02		Alfons Diepvens, Belgium
DIM	36	Alessandro Dimai, Italy
DZI	18	Wilhelm Dziura, Poland
FEI	11	Henk Feijth, The Netherlands
FIE		Marsilio Fierimonte, Italy
GAR02		Stephane Garro, France
GRA04	24	Bjoern Haakon Granslo, Norway
HAL		Alan Hale, U.S.A.
HAL04	23	Karel Halir, Czech Republic
HAS02		Werner Hasubick, Germany
*HAS08	16	Yuji Hashimoto, Hiroshima, Japan
HER02		Carl Hergenrother, AZ, U.S.A.
*HIL02	24	Trond Erik Hillestad, Norway
HOR02	23	Kamil Hornoch, Czech Republic
KAM01		Andreas Kammerer, Germany
*KEN02		David Kenyon, CA, U.S.A.
KER	32	Akos Kereszturi, Hungary
*KID01	18	Krzysztof Kida, Elblag, Poland
KIE	18	Grzegorz Kieltyka, Poland
KIS02	32	Laszlo Kiss, Szeged, Hungary
KLA01	23	P. Klasek, Czech Republic
KOS	07	Attila Kosa-Kiss, Romania
KRY01		Timur V. Kryachko, Russia
KYS	23	J. Kysely, Czech Republic
LAN01	11	M. Langbroek, The Netherlands
MAI	37	Alexander S. Maidic, Ukraine
MAR02	13	Jose Carvajal Martinez, Spain
MAT06	18	Leslaw Materniak, Poland
MID01	24	Oernulf Midtskogen, Norway
MIK		Herman Mikuz, Slovenia
MIL02	36	Giannantonio Milani, Italy
MIZ01		Attila Mizser, Budapest, Hungary
MOE		Michael Moeller, Germany
MOO05	07	Stewart Moore, England
MOR		Charles S. Morris, CA, U.S.A.
NAG02	12	Takashi Nagata, Hyogo, Japan
NAK01	16	Akimasa Nakamura, Japan
NES	17	Yurij V. Nesterov, Russia
OSS	18	Piotr Ossowski, Poland
OST		Andrew Y. Ostapenko, Russia
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
RES	18	Maciej Reszelski, Poland
ROD01		Diego Rodriguez, Spain
SAN04	38	J. M. San Juan, Madrid, Spain
SAR02	32	Krisztian Sarneczky, Hungary
SCH04	11	Alex H. Scholten, The Netherlands
SCI	18	Tomasz Sciezor, Poland
SCO01		James V. Scotti, AZ, U.S.A.
*SCO04	37	Borys Skorichenko, Ukraine
SHA02	07	Jonathan D. Shanklin, England
SIE	33	Henryk Sielewicz, Lithuania
SIW	18	Ryszard Siwiec, Poland
*SIW01	18	Michal Siwak, Tuchow, Poland
SKI	24	Oddleiv Skilbrei, Norway
*SLO01	18	Wieslaw Slotwinski, Poland
SOC	18	Krzysztof Socha, Poland
SPE01	18	Jerzy Speil, Poland
SPR		Christopher E. Spratt, BC, Canada
SWI	18	Mariusz Swietnicki, Poland
SZA	32	Sandor Szabo, Sopron, Hungary
TRI	38	Josep Ma Trigo i Rodriguez, Spain
TSU02	16	Mitsunori Tsumura, Japan
VAN04		Tony VanMunster, Belgium
VAN06	36	Gabriele Vanin, Italy
VEL03		Peter Velestschuk, Ukraine
YOS	16	Shigeru Yoshida, Japan
YUS	16	Toru Yusa, Kogota, Miyagi, Japan
ZAN		Mauro Vittorio Zanotta, Italy
ZAN01	11	W. T. Zanstra, The Netherlands
ZNO	23	Vladimir Znojil, Czech Republic

◇ ◇ ◇

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].

Key to observers with observations published in this issue, *with 2-digit numbers between Observer Code and Observer's Name indicating source. Those with asterisks (*) preceding the 5-character code are new additions:*

*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

◇ ◇ ◇

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^o, east = 90^o). "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.

◇ ◇ ◇

Comet C/1993 A1 (Mueller)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1993 08 17.90		S	11.2	GA	35	L	5	88	6	3			OST
1993 08 17.91		S	11.2	GA	35	L	5	88	5	3			BAR06
1993 08 18.01		S	11.1	GA	35	L	5	88	4	2			OST
1993 08 18.02		S	11.1	GA	35	L	5	88	4	2/			BAR06
1993 08 21.02		S	10.9	GA	35	L	5	50	5	3			OST
1993 08 23.02		S	10.9	GA	20	L	5	50	5	3			OST
1993 08 25.01		S	11.1	GA	35	L	5	88	2.5	2			OST
1993 09 22.18		S	10.8	GA	35	L	5	50	4	5			OST
1993 09 26.10		S	10.7	GA	35	L	5	88	3.7	4			OST
1993 10 15.95		S	9.9	GA	35	L	5	88	4.1	4/			OST
1993 10 16.90		S	10.0	GA	35	L	5	88	4.5	4			OST
1993 10 17.15		S	10.0	GA	35	L	5	88	4.7	4			OST
1993 10 18.10		S	10.4	GA	35	L	5	88					OST

Comet C/1995 O1 (Hale-Bopp)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 07 26.92		M	11.8:	HS	30	L	5	200	1.2				POP
1995 07 30.92		M	10.3	TI	35	L	5	104	1.7	3/			PLS
1995 08 02.90		M	11.3	TI	35	L	5	104	0.6	4			PLS
1995 08 02.90		S	11.7	TI	35	L	5	104	0.7	2			HOR02
1995 08 03.87		M	10.7	TI	35	L	5	104	0.7	4/			PLS
1995 08 03.88		S	10.8	TI	35	L	5	104	0.9	2			HOR02
1995 08 09.87		M	10.4	TI	10	B		25	1.5	3/			ZNO
1995 08 10.89		M	10.2	TI	10	B		25	1.5	3			ZNO
1995 08 19.85		S	10.7	GA	25.4	J	6	59	1.5	2			FEI
1995 08 20.83		S	10.4	GA	25.4	J	6	59	2	3			FEI
1995 08 22.83		S	10.3:	GA	25.4	J	6	59	& 2	5			COM
1995 08 22.84		S	10.2	GA	25.4	J	6	59	& 1	2			BUS01
1995 08 23.84		S	10.2	GA	25.4	J	6	59	& 1	2			BUS01
1995 08 23.86		S	10.2	GA	25.4	J	6	59	1.0	3			FEI
1995 08 23.86		S	10.5	GA	25.4	J	6	59	& 3	6			COM

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

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 08 24.84		S	9.9	GA	25.4	J	6	59	1.0	3			FEI
1995 08 24.84		S	10.2	GA	25.4	J	6	59	& 1	2			BUS01
1995 08 24.85		S	10.1	GA	25.4	J	6	59	3	5/			COM
1995 08 25.78	&	S	10.3	GA	35	L	5	70	3.0	s3			BAR06
1995 08 25.84		S	10.0	GA	25.4	J	6	59	1.0	4			FEI
1995 08 25.85		S	10.5	GA	25.4	J	6	59	5	5			COM
1995 08 26.83		S	10.0	GA	25.4	J	6	59	1.3	3			FEI
1995 08 26.85		S	10.3	GA	20.0	T	10	78	& 3	4/			COM
1995 08 27.78		S	10.1	AC	6.3	R	13	52	3	1			KOS
1995 08 27.88		S	10.4	GA	25.4	J	6	59	1.0	5			FEI
1995 08 28.83		S	10.0	GA	25.4	J	6	59	1.0	5			FEI
1995 08 28.83		S	11.0:	AC	25.4	T	10	63	1	3			VAN06
1995 08 28.85		S	10.0	GA	12.0	B		25	& 1	2			BUS01
1995 08 28.86		S	10.1	GA	25.4	J	6	59	& 1	2			BUS01
1995 08 29.83		S	10.0	GA	25.4	J	6	59	1.3	5			FEI
1995 08 29.84		M	10.6	HS	20	L	5	125	1.4	2			HOR02
1995 08 29.85		M	10.6	TI	20	L	5	125	1	3/			PLS
1995 08 29.85		S	10.0	GA	25.4	J	6	59	& 1	2			BUS01
1995 08 29.86		S	10.2	GA	20.0	T	10	78	& 3	3/			COM
1995 08 31.85		S	10.2	GA	20.0	T	10	78	& 2	5			COM
1995 09 11.76		S	9.6	AC	6.3	R	13	52	5	3			KOS
1995 09 12.75		S	9.6	AC	6.3	R	13	52	4	3			KOS
1995 09 21.74		S	9.4	AC	6.3	R	13	52	5	3			KOS
1995 09 23.74		S	9.4	AC	6.3	R	13	52	5	3			KOS
1995 09 26.69		B	10.2	HS	35	L	5	56	2.0	s5			KRY01
1995 09 26.83	c	C	9.8	LB	20.3	T	10		2.6		? 3	m 342	GAR02
1995 10 10.71		S	9.4	AC	6.3	R	13	52	4	2			KOS
1995 10 11.72	&	S	10.2:	GA	11	L	7	130	1.6	3			BAR06
1995 10 12.72	&	S	10.3:	GA	11	L	7	130	2	4			BAR06
1995 10 13.42		M	10.2:	HS	12.5	L	6	23					TSU02
1995 10 14.66		S	10.2	HS	35	L	5	100	1.7	4/			KRY01
1995 10 15.74	&	S	10.0:	GA	11	L	7	130	2	3			BAR06
1995 10 16.15		M	9.8	AC	20.0	S	10	80		s4/			MOR
1995 10 21.12		M	10.2	AC	25.6	L	4	67	2.2	s5			MOR
1995 10 21.73		M	9.8	TI	35	L	5	92	2.3	3/			HOR02
1995 10 22.12		M	10.0	AC	25.6	L	4	67	2.5	4			MOR
1995 10 23.71	&	S	10.3:	GA	11	L	7	130	2.5	3			BAR06
1995 10 25.11		S	10.0	AC	25.6	L	4	67	2.2	3			MOR
1995 10 28.11		M	10.0	AC	25.6	L	4	67	1.8	3			MOR
1995 11 12.42		M	10.2:	HS	12.5	L	6	23					TSU02
1995 11 13.09		S	9.8:	HS	25.6	L	4	67	1.7	3			MOR
1995 11 15.08		S	9.8	HS	25.6	L	4	67	1.7	3			MOR
1995 11 17.08		M	9.6	HS	25.6	L	4	67	2.3	3			MOR
1995 11 18.08		M	9.6	HS	25.6	L	4	67	2.3	4			MOR
1995 11 19.08		S	9.7	HS	25.6	L	4	67	2.1	3			MOR

Comet C/1995 Q1 (Bradfield)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 09 25.13		S	7.0:	S	5.0	B		10	& 4				OSS
1995 09 25.99		B	8.1	S	12	R	5	27	& 3	4			SIE
1995 09 26.99		B	7.7	S	12	R	5	27	& 3	4			SIE
1995 09 28.17		S	8.0:	S	20.3	T	10	50	2.3	6/			KAM01
1995 09 29.12		S	7.6:	S	6.7	B		20	& 4	6			SCI
1995 09 29.14		B	7.9	S	25	L	6	50	&12	3			RES
1995 09 29.14		B	8.1	TI	11	L	8	32	2.6	5			KYS
1995 09 30.00		B	7.7	S	12	R	5	27	& 3	4			SIE
1995 09 30.13		S	8.3:	S	6.7	B		20	& 4	5			SCI
1995 10 01.99		B	8.3	S	12	R	5	27	& 3	4			SIE
1995 10 02.13		S	7.7	AA	6.3	R	13	52	7	5			KOS
1995 10 03.18		B	8.1	S	10.0	B		25	&10	5			PLE01
1995 10 03.99		B	8.5	S	12	R	5	27	4.2	4			SIE
1995 10 04.11		S	8.0	AA	11	L	7	32	6	4	0.1	290	BAR06
1995 10 05.12		S	8.1	AA	11	L	7	32	6	3/	0.1	290	BAR06

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

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 05.13		S	8.5	S	6.7	B		20	& 5	5			SCI
1995 10 05.14		S	7.9	AA	6.3	R	13	52	7	5			KOS
1995 10 05.14		S	8.5:	S	8.0	B		20					SPE01
1995 10 05.19		B	8.3	S	10.0	B		25	&10	5/			PLE01
1995 10 06.12		S	8.0	AA	11	L	7	32	4	2			VEL03
1995 10 06.12		S	8.1	AA	6.0	B		20	9	2			CSU
1995 10 06.13		B	8.0:	S	25	L	6	100	& 5	1			SWI
1995 10 06.16		S	8.3	AA	8.0	B		15	& 4	4			COM
1995 10 06.17		B	8.3	S	10.0	B		25	&10	5/			PLE01
1995 10 06.22		S	8.2	AA	11	L	7	32	5.5	4			BAR06
1995 10 07.12		S	8.3	AA	11	L	7	32	6	4/		280	BAR06
1995 10 10.16		S	8.9	S	6.6	B		20	& 8	5			PLE01
1995 10 12.11		S	8.6:	AA	11	L	7	32	5.5	3			BAR06
1995 10 13.13		S	8.8	AA	11	L	7	40	6	3	0.08	305	BAR06
1995 10 15.12		S	9.0	AA	6.0	B		20	4	2			CSU
1995 10 15.13		S	9.0	AA	6.3	R	13	52	5	3			KOS
1995 10 15.51		M	8.8	AA	8.0	B		20		5			MOR
1995 10 16.12		S	8.6	AA	11	L	7	40	6.1	3/			BAR06
1995 10 17.82		M	8.6	S	12.5	L	6	23	5	3			TSU02
1995 10 18.99		M	8.8	S	35	L	5	56	5	3/			KRY01
1995 10 19.18		S	9.5:	S	6.6	B		20	& 7	5			PLE01
1995 10 21.11		S	8.9	HD	31.6	L	5	62	2.8	3			MID01
1995 10 21.16		S	8.7	S	6.7	B		20	& 4	4			SCI
1995 10 21.19		C	9.7	LB	20.3	T	10		8		>0.25	156	GAR02
1995 10 21.50		M	8.3	AA	8.0	B		20	6.6	4			MOR
1995 10 22.02		S	9.5:	AA	11	L	7	32	5	3			BAR06
1995 10 22.02		S	9.6:	AA	11	L	7	40	5	3			BAR06
1995 10 22.10		S	8.5	AA	11	L	7	32	6	4		332	VEL03
1995 10 22.11		S	9.2	AA	6.3	R	13	52	4	2			KOS
1995 10 22.12		M	8.7	TI	35	L	5	92	5	4/			HOR02
1995 10 22.17		S	8.4	S	20.3	T	10	50	4.5	4			KAM01
1995 10 22.17		S	9.1	TI	11	L	8	32	6.0	2			KYS
1995 10 22.20		S	9.4:	S	6.6	B		20	& 6	5			PLE01
1995 10 23.07		S	8.7	AA	11	L	7	40	6	3			BAR06
1995 10 23.12		S	9.0	AA	6.3	R	13	52	6	2			KOS
1995 10 23.13		M	8.3	TI	8.0	B		10	4	4			HOR02
1995 10 23.15		S	9.0:	S	9	R	6	16	& 8	1			PAR03
1995 10 23.16		S	8.7:	S	6.7	B		20	& 4	3/			SCI
1995 10 23.17		S	9.2	TI	11	L	8	32	4.2	1			KYS
1995 10 23.19		S	9.5:	S	6.6	B		20	& 5	5			PLE01
1995 10 24.08		S	8.5	AA	11	L	7	32	6.5	s3			BAR06
1995 10 24.11	a	S	9.2	NP	8.0	B		20	7	2			MIL02
1995 10 24.13		S	9.1	AA	6.3	R	13	52	6	2			KOS
1995 10 24.15		M	8.8	TI	8.0	B		10	9	3/			HOR02
1995 10 24.15		S	9.0:	S	6.7	B		20	& 5	3/			SCI
1995 10 24.18		S	9.5:	S	6.6	B		20	& 5	5			PLE01
1995 10 25.09		S	8.5	AA	11	L	7	32	7.1	2/			BAR06
1995 10 25.09		S	10.1	AA	27	L		75	4.5	1			SZA
1995 10 25.10		S	9.2	AA	11	L	7	32	9	3			VEL03
1995 10 25.15		M	8.8	TI	8.0	B		10	10	3/			HOR02
1995 10 25.15		S	9.0:	S	6.7	B		20	& 7	3			SCI
1995 10 25.15		S	9.5:	AC	28.0	T	10	108	& 4	2			COM
1995 10 25.16		S	9.4:	S	6.6	B		20	& 4	5			PLE01
1995 10 25.80		S	8.9	S	15.0	R	5	25	7	3			NAG02
1995 10 26.11		S	8.7	AA	11	L	7	32	7.2	s3			BAR06
1995 10 26.15		S	9.3:	S	6.6	B		20	& 5	5			PLE01
1995 10 27.06		S	8.9	GA	11	L	7	32	5.7	s2			BAR06
1995 10 27.10		S	9.3	AA	11	L	7	32	8	3			VEL03
1995 10 27.14		M	9.0	TI	8.0	B		10	9	3			HOR02
1995 10 27.14		S	9.5:	S	8.0	B		20	3.6	1			SPE01
1995 10 27.20		S	9.2:	S	6.6	B		20	& 5	5			PLE01
1995 10 27.80		S	8.9	S	15.0	R	5	25	8	3			NAG02
1995 10 28.12		S	9.5	AA	11	L	7	32	6	4			VEL03
1995 10 28.15		S	9.0	AC	28.0	T	10	108	& 6	2			COM

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

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 28.19		S	9.1	AA	10	B		14	7.6	3			SHA02
1995 10 29.15		S	8.8	AC	28.0	T	10	108	& 7	2/			COM
1995 10 29.22		S	9.1	AA	10	B		14	7.6	3			SHA02
1995 10 31.05		S	9.4	AA	10	B		14	5.0	2			SHA02
1995 10 31.08		B	10.2	HS	20.3	L	6	40	6	3			BIV
1995 10 31.19		S	9.1	AA	10	B		14	8.9	2			SHA02
1995 11 02.11		S	9.2	AC	28.0	T	10	108	> 8	2			COM
1995 11 03.07		S	9.3	AC	20.3	T	10	80	6	1			GRA04
1995 11 03.15		S	9.2	AA	10	B		14	8.9	2			SHA02
1995 11 04.17		S	9.3	AA	10	B		14	8.9	2			SHA02
1995 11 04.18		S	7.5	AA	15.0	R	8	75	3	2			DIE02
1995 11 04.70		B	8.9	S	6.6	B		20	& 6	5/			PLE01
1995 11 05.19		S	9.2	AC	28.0	T	10	108	& 8	1/			COM
1995 11 05.21		B	9.0	S	21.0	L		100	10	4			SAN04
1995 11 05.21		M	8.9	S	21.0	L		100	10	2			MAR02
1995 11 05.22		S	9.5	AA	10	B		14	13	2	0.1	160	SHA02
1995 11 07.73		M	9.3	TI	10	B		25	4	4			ZNO
1995 11 09.68		S	8.9	S	6.6	B		20	& 5	5			PLE01
1995 11 16.12		S	9.6	AA	20.0	T	10	64	4	2/			SPR
1995 11 17.97		S	10.3	AC	25.4	L	6	61	6	1			GRA04
1995 11 18.36		S	10.7	NP	25.6	L	4	45	5	1			MOR
1995 11 18.81		S	11.6	HS	44.5	L	5	72	3.5	0			KIS02
1995 11 18.81		S	11.7	HS	44.5	L	5	72	4	0/			SAR02
1995 11 18.90		O	[12.2	TI	20	L	5	125	! 3				HOR02
1995 11 19.17	!	V	10.7	YF	20.0	T	2		& 7	5			MIK
1995 11 20.07		S	11.9:	HS	44.5	L	5	72	3.7	0			SAR02
1995 11 20.12		S	9.9	AA	20.0	T	10	64	4	2/			SPR
1995 11 20.88		S	12.6	HS	35	L	5	66	2	2			HOR02
1995 11 21.75		M	11.5:	TI	10	B		25	2	2			ZNO
1995 11 21.76		C	11.1	GA	8.0	R	6		7.5		15 m	160	NAK01
1995 11 22.70		M	11.8:	TI	10	B		25	2.5	3			ZNO
1995 11 22.73		S	10.0	HS	35	L	5	56	5.5	1/			KRY01
1995 11 22.76		O	[12.2	HS	35	L	5	158	! 2				HOR02
1995 11 22.96		B	10.5:	S	10.0	B		25	& 4	4			PLE01
1995 11 23.90		B	[11.0:		10.0	B		25					PLE01
1995 11 26.21	!	V	11.7	YF	20.0	T	2		& 6	3			MIK
1995 11 26.66		S	11.8	HS	35	L	5	56	3.5	2			KRY01
1995 12 17.63		C	14.9	GA	60.0	Y	6		1.5				NAK01
1995 12 23.12		S	10.1	AA	20.0	T	10	113	2	2/			SPR
1995 12 24.12		S	10.5	AA	20.0	T	10	113	2	1/			SPR

Comet C/1995 Q2 (Hartley-Drinkwater)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 09 20.18					228.6	L	2		0.35	7	1.1m	84	HER02
1995 10 13.44		C	17.8:	GA	60.0	Y	6		0.2				NAK01

Comet C/1995 Y1 (Hyakutake)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 12 27.82		C	11.4:	HS	20.3	T	6		2.5		1.6m	235	YUS
1995 12 27.86		C	11.2	GA	8.0	R	6		5.4				NAK01
1995 12 27.87		M	9.4	S	16.0	W	4	49					TSU02
1995 12 27.87		M	9.4	S	16.0	W	4	49					TSU02
1995 12 30.85		S	10.4	NP	15.0	R	5	25	4	4/			NAG02
1996 01 01.83		S	10.3	NP	15.0	R	5	25	5	4			NAG02
1996 01 01.84		S	9.9:	AA	10.5	R	7	23		2/			HAS08
1996 01 02.85		M	9.2	S	16.0	W	4	49	5	2			TSU02
1996 01 02.85		M	9.2	S	16.0	W	4	49	5	2			TSU02
1996 01 04.85	a	C	11.1	GA	8.0	R	6		4.8		6.5m	250	NAK01
1996 01 13.84		C	11.2	HS	20.3	T	6		4.9		4.5m	240	YUS
1996 01 16.85		S	9.5	NP	15.0	R	5	25	6	4			NAG02
1996 01 17.15		S	8.8	AA	11	L	7	56	4.5	3		298	BAR06
1996 01 17.16		S	8.7	AA	11	L	7	32	5.1	2			BAR06

Comet C/1995 Y1 (Hyakutake) [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1996 01 18.19		S	9.3:	AA	15.0	B		25	4	3			ZAN
1996 01 18.19	!	V	9.3	YF	20.0	T	2		& 8	6			MIK
1996 01 19.21		S	8.9	S	10.0	B		25	2.2	4			HAS02
1996 01 20.84		S	9.2	S	15.0	R	5	25	7	4			NAG02
1996 01 26.53		C	13.1	FA	91.4	L	5				>16.1m	272	SC001
1996 01 26.53		c	19.8	FA	91.4	L	5		5.45		>12.1m	246	SC001
1996 01 26.85		S	9.0	AA	10.5	R	7	23	5	4			HAS08
1996 01 27.84		M	8.6	S	16.0	W	4	19					TSU02
1996 01 31.20		S	8.8	S	20.3	T	10	50	2.1	3/			KAM01
1996 02 01.20		S	8.4	AA	15.0	R		75	7	1			DIE02

Comet C/1996 B1 (Szczepanski)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1996 01 29.86		S	9.5:	AA	15.2	L		42	4.0	1			MOE
1996 01 30.15		S	9.9	AC	35	L	5	97	10.5	8			VAN04
1996 01 31.18		S	8.1	S	20.3	T	10	50	4.5	2/			KAM01
1996 01 31.87		S	8.5	AC	10.0	B		25	1.3	3			HAS02
1996 01 31.99		S	8.4	AA	11	L	7	32	9	2/			BAR06
1996 02 01.16		S	8.2	AA	11	L	7	32	9	2			BAR06
1996 02 01.19		S	8.4	AA	15.0	R		75	9	1			DIE02

Comet 2P/Encke

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 09 18.59		C	19.9	GA	60.0	Y	6		0.2				NAK01

Comet 6P/d'Arrest

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 05 28.04		O	[12.1	TI	11	L	8	54	! 1				KYS
1995 06 27.99		S	12.8:	AC	28.0	T	10	108		0			COM
1995 06 28.02		O	[13.8	HS	35	L	5	207	! 0.8				HOR02
1995 07 01.01		O	[13.6	HS	35	L	5	207	! 0.8				HOR02
1995 07 03.99		S	11.9	HS	35	L	5	98	3.4	3	0.08	182	BAR06
1995 07 04.91		S	12.5	HS	35	L	5	88	2.7	3			BAR06
1995 07 04.99		S	12.3	HS	25	L	4	52	3.6	2/			BAR06
1995 07 06.97		O	[12.5	HS	35	L	5	207	! 1				HOR02
1995 07 08.00		S	11.8:	AC	28.0	T	10	108	2	0/			COM
1995 07 09.02		M	12.1	TI	11	L	8	54	1	3			KYS
1995 07 25.01		S	10.2	AC	28.0	T	10	88	& 4	0/			COM
1995 07 26.01		S	9.2:	AC	20.0	L	5	42	6	0			SCH04
1995 07 26.02		S	9.9	AC	28.0	T	10	88	& 4	0/			COM
1995 07 27.94	&	S	7.5:	AA	11	L	7	32	20	2			VEL03
1995 07 27.94	&	S	8 :	AA	11	L	7	32	15	2			VEL03
1995 07 27.94	&	S	8 :	AA	11	L	7	32	20	2			VEL03
1995 07 27.94	&	S	8.0:	AA	11	L	7	32	15	3			VEL03
1995 07 30.95		M	8.7	TI	20	L	5	48	7.8	2/			PLS
1995 07 31.02		S	9.2	AC	28.0	T	10	88	& 5	1			COM
1995 07 31.95		M	9.5	TI	20	L	5	48	5.7	2/			PLS
1995 08 01.01	a	S	9.6:	AC	20.0	L	5	42	& 5	0/			SCH04
1995 08 01.02		S	9.2	AC	20.0	T	10	63	& 5	1			COM
1995 08 01.04		M	9.3	TI	20	L	5	48	6	3			HOR02
1995 08 01.05		M	9.4	TI	20	L	5	48	5	3			KYS
1995 08 02.04		S	8.7	AC	20.0	T	10	68	& 8	1			COM
1995 08 03.04		S	8.7	AC	20.0	T	10	68		1			COM
1995 08 03.97		M	9.3	TI	20	L	5	48	6.3	2			HOR02
1995 08 03.98		M	9.4	TI	20	L	5	48	9.5	2/			PLS
1995 08 05.00		S	9.1	AA	30.0	T	5	60	8	1			SCH04
1995 08 06.00		S	9.2	AA	25.4	J	6	59	5	3			FEI
1995 08 07.04		S	9.2	AA	25.4	J	6	59	5	3			FEI
1995 08 08.02	&	M	10.9:	AA	24	L	6	32	4	3			MAI
1995 08 09.03	&	M	10.8:	AA	24	L	6	32	4	3			MAI
1995 08 09.99		M	8.8	TI	10	B		25	11	2/			ZNO

Comet 6P/d'Arrest [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 08 10.99		S	9.0:	TI	10	B		25	9				ZNO
1995 08 11.98		M	9.1	TI	10	B		25	9	2			ZNO
1995 08 23.00		S	7.9	AC	8.0	B		15	&15	2			COM
1995 08 23.00		S	8.7	AA	8.0	B		15	8	1			FEI
1995 08 24.01		S	7.5	S	5.0	B		7	18	2			BUS01
1995 08 24.01		S	7.6	S	8.0	B		15	18	2/			BUS01
1995 08 25.98		S	7.4	AC	8.0	B		15	&15	2			COM
1995 08 25.99		S	7.7	SC	8.0	B		15	11	1			FEI
1995 08 26.99		S	7.2	AC	8.0	B		15	&15	3			COM
1995 08 26.99		S	7.7	SC	8.0	B		15	11	1			FEI
1995 08 27.00		S	7.6	S	5.0	B		7	18	2/			BUS01
1995 08 27.00		S	7.7	S	8.0	B		15	18	2/			BUS01
1995 08 27.99		S	7.3	AC	8.0	B		15	&15	2			COM
1995 08 28.99		S	7.3	AC	8.0	B		15	&12	2			COM
1995 08 29.99		B	7.8	S	25	L	4	33	13	s5			KRY01
1995 08 30.00		S	7.5	S	5.0	B		7	20	2			BUS01
1995 08 30.00		S	7.6	SC	5.0	B		7	9	1			FEI
1995 08 31.99		S	7.5	S	8.0	B		15	20	2			BUS01
1995 09 02.00		S	7.6	S	5.0	B		7	20	2			BUS01
1995 09 03.02		S	7.7	S	5.0	B		7	18	1/			BUS01
1995 09 20.37		k	11.8	EB	228.6	L	2		3.12	6	>6.1m	326	HER02
1995 09 26.94		B	9.2	S	6	R	5	20	15	3			KRY01
1995 10 21.01	a	C	11.7	LB	20.3	T	10		2.4				GAR02
1995 10 21.28		S	9.3	AA	8.0	B		20	13	1			MOR
1995 10 22.26		S	9.3	AA	8.0	B		20	13	1			MOR
1995 10 24.93	a	C	11.6	LB	20.3	T	10		3.5				GAR02
1995 11 12.56		C	12.4	HS	25.4	T	6		+ 2.1				YOS
1995 11 16.51	a	C	12.7	GA	60.0	Y	6		3.1				NAK01
1995 11 18.16		S	10.7	NP	25.6	L	4	45	7	0/			MOR

Comet 9P/Tempel 1

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 28.33		k	19.8	EB	154.9	L	3		0.10	9	4.5m	244	HER02

Comet 15P/Finlay

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 11 18.52		C	20.5	FA	91.4	L	5		0'.22		25.2s	296	SCO01

Comet 18P/Perrine-Mrkos

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 09 17.90		S	[14.5	HS	44.0	L	5	156					HAS02
1995 11 18.80		S	[13 :	HS	44.5	L	5	230					SAR02

Comet 19P/Borrelly

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 05 02.90		S	[13.5	HS	44.5	L	5	222					HAS02

Comet 22P/Kopff

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 12 21.86	a	C	15.6	GA	60.0	Y	6		0.6		0.9m	303	NAK01
1995 12 27.85		C	15.7	GA	60.0	Y	6		0.65				NAK01
1996 01 13.81		C	15.6	HS	20.3	T	6		0.4				YUS

Comet 29P/Schwassmann-Wachmann 1

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 21.17	a	C	13.2	LB	20.3	T	10		1.8				GAR02
1995 10 21.17	a	c	15.3	LB	20.3	T	10						GAR02
1995 10 26.18		C	13.1	LB	20.3	T	10		2.3				GAR02

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

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 26.18		c	15.8	LB	20.3	T	10						GAR02
1995 11 18.45		S	13.3:	NP	25.6	L	4	156		2			MOR
1995 11 18.82		C	13.3	HS	25.4	T	6		2.0				YOS
1995 11 21.18	!	V	14.0	GA	36.0	T	7		& 1.5	5	& 1 m	5	MIK
1995 11 21.78		C	13.1	GA	60.0	Y	6		2.7				NAK01
1995 11 21.78		c	16.5	GA	60.0	Y	6						NAK01
1995 12 21.81		C	13.7	GA	60.0	Y	6		2.6				NAK01
1995 12 21.81		c	16.9	GA	60.0	Y	6						NAK01
1995 12 27.80		C	13.9	GA	60.0	Y	6		2.3				NAK01
1995 12 27.80		c	16.8	GA	60.0	Y	6						NAK01
1996 01 04.83		C	13.8	GA	60.0	Y	6		1.5	8/			NAK01
1996 01 13.79		C	13.7	HS	20.3	T	6		1.1				YUS
1996 01 13.98		S	13.8	NP	44.5	L	5	100	2	2			SAN04
1996 01 13.98		S	13.9	NP	44.5	L	5	100	2	1			MAR02
1996 01 18.14	!	V	14.6	GA	36.0	T	7		0.8	7			MIK

Comet 30P/Reinmuth 1

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1996 01 24.54		c	20.9	FA	91.4	L	5		0.20		88.2s	292	SC001
1996 01 24.55		C	17.4	FA	91.4	L	5						SC001

Comet 32P/Comas Solá

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 26.00		C	15.2	LB	20.3	T	10		0.5		0.6m	57	GAR02
1995 10 26.00		c	16.2	LB	20.3	T	10						GAR02
1995 10 27.28		k	15.6	EB	154.9	L	3						HER02
1995 10 27.28		k	15.7	EB	154.9	L	3		0.57	4			HER02
1995 10 27.29		k	15.9	EB	154.9	L	3						HER02
1995 11 12.61		C	15.4	HS	25.4	T	6		0.5		0.8m	38	YOS
1995 11 16.46		C	15.3	GA	60.0	Y	6		0.7			50	NAK01
1995 11 21.56		C	15.5	GA	60.0	Y	6		0.7			55	NAK01
1996 01 21.16		C	15.5	FA	91.4	L	5		0.63		172.2s	78	SC001
1996 01 21.16		c	19.7	FA	91.4	L	5		0.63		172.2s	78	SC001

Comet 45P/Honda-Mrkos-Pajdušáková

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1990 08 26.06		S	8.0	AA	11	L	7	32	4	3			BAR06
1990 08 27.06		S	7.9:	AA	11	L	7	32	4	3			BAR06
1990 08 28.06		S	8.0:	AA	11	L	7	32	3.5	3			BAR06
1995 10 28.07		k	[20.0	EB	228.6	L	2						HER02
1995 11 16.39	a	C	15.9:	GA	60.0	Y	6		0.3				NAK01
1995 11 18.39	a	C	15.7:	GA	60.0	Y	6		0.3				NAK01
1995 11 19.09		S	[12.0:		25.6	L	4	156					MOR
1995 12 10.36		C	11.1:	HS	20.3	T	6		1.5				YUS
1995 12 10.38	a	C	10.1	GA	8.0	R	6		3.7				NAK01
1995 12 10.38	a	C	10.2	GA	60.0	Y	6		3.1				NAK01
1995 12 16.10		M	8.4	S	25.6	L	4	45		7/			MOR
1995 12 17.37		S	7.9	S	15.0	R	5	25	3	6/			NAG02
1995 12 21.09		M	7.5	AA	8.0	B		20		7	0.5	78	MOR
1995 12 24.10		S	6.6	AA	20.0	T	10	64	4	6/			SPR
1995 12 26.08		S	6.4	AA	10.0	R	5	49	3.5	4/			SPR
1995 12 27.69		O	[7.0	TI	8	R	4	17	! 2				KYS
1995 12 28.09		M	6.8	AA	8.0	B		20		7/	0.33		MOR
1995 12 28.69		S	6.7:	TI	11	L	7	54	2.5	3			KYS
1995 12 29.38		S	7.1	S	15.0	R	5	25	3	5/			NAG02
1996 01 02.38		S	6.8	S	15.0	R	5	25	4	5			NAG02
1996 01 27.85		M	7.2	S	3.5	B		7	15	3			TSU02
1996 01 31.22		S	7.2	S	6.3	B		9	12	1			KAM01
1996 02 01.16		S	6.4	AA	11	L	7	32	37	3			BAR06
1996 02 01.21		S	8.5	AA	15.0	R		75	6	1			DIE02

Comet 47P/Ashbrook-Jackson

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1993 08 18.02		S	12.6	GA	35	L	5	111	2.0	4			OST
1993 08 18.04		S	12.7	GA	35	L	5	111	2	3			BAR06
1993 08 20.01		S	12.3	GA	35	L	5	111	2.8	3			OST
1993 08 21.02		S	12.7	GA	35	L	5	111	1.5	3			OST
1993 08 21.03		S	12.8	GA	35	L	5	111	3	3			BAR06
1993 08 22.01		S	12.2	GA	35	L	5	88	1.7	2			OST

Comet 58P/Jackson-Neujmin

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 07 23.98		O	[14.1	HS	35	L	5	207	! 1.1				HOR02
1995 07 30.98		O	[14.1	HS	35	L	5	207	! 1.2				HOR02
1995 08 03.94		O	[14.3	HS	35	L	5	207	! 0.8				HOR02
1995 08 23.87		S	13.9	HS	35	L	5	207	0.8	2			HOR02
1995 09 01.99		S	13.0:	AA	25.4	J	6	59	& 1	2			BUS01
1995 09 03.01		S	13.0	AA	40.0	L	4	115	& 1	2			BUS01
1995 09 17.88		O	[12.8	HS	35	L	5	207	! 0.7				HOR02
1995 09 20.26		k	14.6	EB	228.6	L	2		1.50	5			HER02
1995 09 26.86		O	[11.9	HS	20	L	5	125	! 2				HOR02
1995 10 21.19		S	12.0	NP	25.6	L	4	67	3.2	1			MOR
1995 10 21.88		O	[11.2	TI	20	L	5	57	! 1				KYS
1995 10 22.19		S	12.0	NP	25.6	L	4	67	3.2	1			MOR
1995 10 25.92		C	12.8	LB	20.3	T	10		2.2		2 m	60	GAR02
1995 10 25.92		c	15.6	LB	20.3	T	10						GAR02
1995 11 12.51		C	11.4	HS	25.4	T	6		2.1				YOS
1995 11 16.44		C	11.8	GA	60.0	Y	6		3.5				NAK01
1995 11 18.15		S	10.2	NP	25.6	L	4	45	7	2/			MOR
1995 11 21.45	a	C	11.9	GA	60.0	Y	6		3.6				NAK01
1995 11 24.82		S	10.6	GA	21.0	L	6	60	4	1			MAR02
1995 12 10.41		C	12.3	HS	20.3	T	6		2.0				YUS
1995 12 10.46		C	12.8	GA	60.0	Y	6		2.7				NAK01
1995 12 22.12		S	11.0	NP	25.6	L	4	67	5.1	0/			MOR
1996 01 10.45		C	13.1	HS	20.3	T	6		1.2				YUS
1996 01 12.45		C	13.7	GA	60.0	Y	6		2.2			65	NAK01
1996 01 13.92		S	13.0	NP	44.5	L	5	100	5	1			SAN04
1996 01 13.92		S	13.1	NP	44.5	L	5	100	3	0			MAR02

Comet 65P/Gunn

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1996 01 13.82		C	14.8	HS	20.3	T	6		0.7		2.2m	290	YUS

Comet 67P/Churyumov-Gerasimenko

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 08 25.94		S	15.1:	HS	35	L	5	190	0.8	2			BAR06
1995 08 26.95		S	14.6	HS	35	L	5	190	0.8	2			BAR06
1995 08 27.95		S	14.5	HS	35	L	5	190	1.0	3			BAR06
1995 08 28.94		S	14.7	HS	35	L	5	190	1.2	2			BAR06
1995 09 15.82		S	14.3	HS	35	L	5	190	0.9	2			BAR06
1995 09 20.22		k	12.2	EB	228.6	L	2		1.15	6	1.3m	269	HER02
1995 10 13.49		C	14.0	GA	60.0	Y	6		1.0			45	NAK01
1995 10 20.47		C	14.0	GA	60.0	Y	6		0.95		2.0m	48	NAK01
1995 10 21.79		O	[11.4	TI	20	L	5	57	! 1				KYS
1995 10 22.15		M	13.5	NP	50.8	L	4	120	1.5	3			MOR
1995 10 22.83		O	[11.5	TI	20	L	5	57	! 1				KYS
1995 10 24.84		C	13.3	LB	20.3	T	10		0.8		2.7m	49	GAR02
1995 10 24.84		c	15.0	LB	20.3	T	10						GAR02
1995 10 25.94		C	13.3	LB	20.3	T	10		0.7		2.4m	45	GAR02
1995 10 25.94		c	14.8	LB	20.3	T	10						GAR02
1995 10 27.14		k	14.5	EB	154.9	L	3		0.42	5	1.7m	50	HER02
1995 10 27.15		k	15.1	EB	154.9	L	3				0.3m	26	HER02
1995 11 12.46		C	13.5	HS	25.4	T	6		0.6		1.2m	50	YOS
1995 11 16.43		C	13.5	GA	60.0	Y	6		1.1		3.6m	57	NAK01

Comet 67P/Churyumov-Gerasimenko [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 11 17.74		B	14.6	HS	35	L	5	100	1.0	2/			KRY01
1995 11 18.09		C	13.6	FA	91.4	L	5		0.67		433.8s	65	SCO01
1995 11 18.13		M	13.0	NP	25.6	L	4	156	1.8	s2			MOR
1995 11 18.65		B	14.7	HS	35	L	5	100	1.0	3			KRY01
1995 11 18.77		S	13.1	AC	44.5	L	5	146	0.8	5/			SAR02
1995 11 20.77		O	[12.5	HS	35	L	5	158	! 1.5				HOR02
1995 11 20.78	!	V	13.7	GA	36.0	T	7		& 1	8	& 6 m	55	MIK
1995 11 21.44		C	13.3	GA	60.0	Y	6		1.2		3.8m	62	NAK01
1995 11 22.65		B	14.1	HS	35	L	5	100	0.8	3			KRY01
1995 11 22.73		O	[12.5	HS	35	L	5	207	! 1.5				HOR02
1995 11 26.65		B	13.9	HS	35	L	5	100	1.1	3			KRY01
1995 12 10.44		C	13.2	GA	60.0	Y	6		1.3		3.2m	69	NAK01
1995 12 21.15		M	12.2	NP	25.6	L	4	111	1.9	4			MOR
1996 01 06.44		C	12.7	HS	20.3	T	6		1.0		1.5m	50	YUS
1996 01 08.12		S	11.0	NP	25.6	L	4	45	4.1	2/			MOR
1996 01 12.41		C	12.2	GA	60.0	Y	6		3.0			73	NAK01
1996 01 13.90		S	11.8	NP	44.5	L	5	100	2	3			MAR02
1996 01 13.90		S	11.9	NP	44.5	L	5	100	2	3			SAN04
1996 01 14.75		S	12.0	GA	20.0	L	4	47	& 1	2			MIK
1996 01 16.74	!	V	12.0	YF	20.0	T	2		2.5	8	& 3 m	45	MIK
1996 01 20.18		C	12.4	FA	91.4	L	5		2.16		3.6m	76	SCO01

Comet 71P/Clark

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 06 21.98	&	S	11.5:	HS	25	L	4	52	3	2		295	BAR06
1995 06 21.98	&	S	11.5:	HS	25	L	4	52	& 3	2			BAR06
1995 06 21.98	&	S	11.7	HS	35	L	5	98	2.5	3			OST
1995 06 22.96	&	S	11.3	HS	35	L	5	98	3.5	3		275	BAR06
1995 06 23.97	&	S	11.3	GA	35	L	5	98	2.6	3		280	BAR06
1995 06 23.97	&	S	11.7	GA	35	L	5	98	2	2/			OST
1995 06 24.96	&	S	12.1	GA	35	L	5	98	2.5	3			OST
1995 06 24.98	&	S	11.7	GA	35	L	5	98	3.0	2		260	BAR06
1995 06 25.96	&	S	11.5	HS	25	L	4	52	2.8	2/		270	BAR06
1995 06 25.97	&	S	11.7	GA	35	L	5	98	2	3			OST
1995 06 25.98	&	S	11.6	GA	35	L	5	98	2.5	3		270	BAR06
1995 06 26.96	&	S	11.5	GA	25	L	4	52	3.2	3		291	BAR06
1995 06 26.98	&	S	11.5	GA	35	L	5	98	3.2	3	0.1	291	BAR06
1995 09 20.18					228.6	L	2		1.60	7	1.3m	30	HER02
1995 10 24.86		C	15.1	LB	20.3	T	10		0.9		2.5m	49	GAR02
1995 10 25.91	a	C	15.7	LB	20.3	T	10		0.7				GAR02
1995 10 27.12		k	16.9	EB	154.9	L	3		0.35	6	0.6m	52	HER02
1995 10 27.13		k	17.1	EB	154.9	L	3						HER02
1995 11 16.43	a	C	16.0	GA	60.0	Y	6		0.8				NAK01
1995 11 17.08		C	17.3	FA	91.4	L	5		0.43		96.6s	71	SCO01
1995 12 10.43		C	16.2	GA	60.0	Y	6		0.8				NAK01

Comet 73P/Schwassmann-Wachmann 3

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 09 17.09	!	M	8.3:	NP	20	L	6	49					HAL
1995 10 15.11		M	5.3	AA	5.0	B		10		6	4.0	93	MOR
1995 10 16.11		M	5.5	AA	5.0	B		10		6	3.67	95	MOR
1995 10 18.11		M	5.9	AA	5.0	B		10		4	1.75	94	MOR
1995 10 19.10		M	5.7	AA	5.0	B		10		6	1.33	97	MOR
1995 10 21.10		M	6.3	AA	8.0	B		20		S8	1.75	96	MOR
1995 10 22.10		M	6.5	AA	8.0	B		20		S7/	1.0	96	MOR
1995 10 25.10		M	6.7	AA	8.0	B		20		5	2.0	93	MOR
1995 10 28.09		M	6.5	AA	8.0	B		20		6	1.75	95	MOR
1995 11 08.70		S	7.4:	TI	20	L	5	48	2	2/			HOR02
1995 11 08.70		S	7.4:	TI	20	L	5	48	6.2	3/			PLS
1995 11 10.11		M	7.0	AA	8.0	B		20		3	0.75	97	MOR
1995 11 11.40		S	6.7	AA	12.0	B		20	& 8	4			NAK01
1995 11 11.41		M	6.6	S	12.5	L	6	23		2			TSU02

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

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 11 12.09		M	6.8	AA	8.0	B		20		3	0.5	95	MOR
1995 11 12.43		M	8.0	S	12.5	L	6	23		2			TSU02
1995 11 13.10		M	6.9	AA	8.0	B		20		4	0.5	85	MOR
1995 11 13.41		M	7.5	AA	16.0	W	4	19					TSU02
1995 11 15.10		M	6.9	AA	8.0	B		20		3	1.1	80	MOR
1995 11 16.40	a	C	6.9	GA	8.0	R	6		16.5		>1.06	86	NAK01
1995 11 17.11		M	7.3	AA	8.0	B		20		3	1.2	90	MOR
1995 11 18.10		M	7.3	AA	8.0	B		20		4	1.1	90	MOR
1995 11 19.11		S	7.7:	AA	8.0	B		20		3	1.1	83	MOR
1995 11 24.79		M	7.9	S	21.0	L	6	60	9	7	0.5	80	MAR02
1995 11 26.63		B	8.5	S	35	L	5	56	6	s5	0.5	80	KRY01
1995 11 26.69	&	S	7.7	S	11	L	7	32	5	3			BAR06
1995 11 26.78		M	8.0	S	44.5	L	5	100	7	5	0.25	80	SAN04
1995 11 26.78		M	8.1	S	44.5	L	5	100	4	7	0.40	85	MAR02
1995 12 09.38		C	8.9	HS	20.3	T	6		5.9		0.17	78	YUS
1995 12 10.38		C	9.1	HS	20.3	T	6		6.6				YUS
1995 12 10.39		C	7.4	GA	8.0	R	6		17.2		0.45	81	NAK01
1995 12 10.39		M	7.9	S	16.0	W	4	19	7.0	3			TSU02
1995 12 10.39		M	7.9	S	16.0	W	4	19	7.0	3			TSU02
1995 12 15.69	&	S	8.8:	HD	6.0	B		20	7	2			KER
1995 12 15.69	&	S	9.0:	HD	6.0	B		20	5	2/			SAR02
1995 12 16.12		S	8.2	AA	8.0	B		20		1/			MOR
1995 12 16.12		S	8.2	AA	25.6	L	4	45	4.9	1/			MOR
1995 12 16.67		S	7.9	AA	11	L	7	32	12	2/	&0.2	224	BAR06
1995 12 16.68		S	8.0	AA	11	L	7	56	10	3	&0.3	224	BAR06
1995 12 17.67		S	7.9:	AA	11	L	7	56	10	3			BAR06
1995 12 21.12		S	8.2	AA	8.0	B		20	11.5	1/			MOR
1995 12 21.12		S	8.6	AA	25.6	L	4	45	5	1/			MOR
1995 12 21.68		S	8.2	AA	11	L	7	56	9	s3	3 m	230	BAR06
1995 12 21.69		S	8.3	AA	11	L	7	32	10	2	&0.4	45	BAR06
1995 12 22.10		S	8.1	AA	8.0	B		20	16	1			MOR
1995 12 22.66		S	8.6	HD	11	L	7	56	8	s3	3 m	230	BAR06
1995 12 22.67		S	8.7	HD	11	L	7	32	9	2			BAR06
1995 12 23.40		M	8.0	S	16.0	W	4	19					TSU02
1995 12 23.40		M	8.0	S	16.0	W	4	19					TSU02
1995 12 24.11		S	8.5	AA	20.0	T	10	64	4	3/			SPR
1995 12 27.71		O	[8.5	TI	8	R	4	17	! 2				KYS
1995 12 28.11		S	8.2	AA	8.0	B		20	11.3	0			MOR
1995 12 28.11		S	8.6	AA	25.6	L	4	45	5.5	0			MOR
1995 12 28.71		S	9.1:	TI	11	L	7	54	3	4			KYS
1995 12 29.71		S	9.5:	TI	20	L	4	57	2	3			KYS
1995 12 29.77		S	8.1	AA	11	L	7	32	4	3			BAR06
1996 01 06.39		C	10.5	HS	20.3	T	6		3.5		>0.3	233	YUS
1996 01 08.10		S	8.5:	AA	8.0	B		20	11	0			MOR
1996 01 08.11		S	9.3	AA	25.6	L	4	45	4.7	1			MOR
1996 01 12.40	a	C	10.1	GA	8.0	R	6		6.5		0.79	238	NAK01
1996 01 13.76		S	9.1	S	10.0	B		25	1.5	2			HAS02

Comet 74P/Smirnova-Chernykh

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 13.46		C	17.9	GA	60.0	Y	6		0.25				NAK01

Comet 81P/Wild 2

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 28.35		k	20.1	EB	154.9	L	3						HER02
1995 10 28.35		k	20.5	EB	154.9	L	3		0.08	8			HER02
1995 10 28.36		k	20.7	EB	154.9	L	3						HER02

Comet 86P/Wild 3

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 09 20.27		k	[22.0	EB	228.6	L	2						HER02

Comet 94P/Russell 4

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 27.39		k	19.3	EB	154.9	L	3						HER02
1995 10 27.39		k	20.0	EB	154.9	L	3		0.07	8			HER02
1995 10 27.40		k	19.5	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 02 25.71		C	15.4	HS	20.3	L	4		0.1	9			KEN02
1995 03 30.63		C	15.1	HS	20.3	L	4			9			KEN02
1995 05 19.28		C	16.0	HS	20.3	L	4		0.1	9			KEN02
1995 12 20.86		C	15.8	HS	20.3	L	4		0.2	8			KEN02
1996 01 13.80		C	15.9	HS	20.3	T	6			9			YUS

Comet 111P/Helin-Roman-Crockett

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 28.39		k	20.3	EB	154.9	L	3		0.10	3	0.2m	273	HER02
1995 10 28.40		k	20.2	EB	154.9	L	3						HER02
1995 10 28.40		k	20.5	EB	154.9	L	3						HER02
1995 11 16.57		C	20.0	GA	60.0	Y	6		0.2				NAK01

Comet 116P/Wild 4

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 21.12		C	16.6	LB	20.3	T	10		0.3				GAR02
1995 11 21.17	!	V	16.3	GA	36.0	T	7		0.5	9	& 3 m	285	MIK
1995 11 21.73		C	15.8	GA	60.0	Y	6		0.75		2.9m	286	NAK01
1995 12 17.69		C	14.6	GA	60.0	Y	6		0.9		3.4m	280	NAK01
1995 12 21.80		C	14.4	GA	60.0	Y	6		1.0			285	NAK01
1996 01 13.76		C	13.1	HS	20.3	T	6		1.1		3.6m	270	YUS
1996 01 13.96		S	13.6	NP	44.5	L	5	100	1	4			MAR02
1996 01 13.96		S	13.6	NP	44.5	L	5	100	1	5			SAN04
1996 01 17.82	!	V	13.7	GA	36.0	T	7		0.8	8	& 5 m	275	MIK
1996 01 20.74		C	13.1	GA	60.0	Y	6		1.6		3.6m	275	NAK01

Comet 119P/Parker-Hartley

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 21.07		C	15.6	LB	20.3	T	10		0.5		1.1m	238	GAR02
1995 10 21.07		c	16.9	LB	20.3	T	10						GAR02
1995 11 16.46		C	16.8	GA	60.0	Y	6		0.4		1.0m	245	NAK01
1995 11 17.10		C	17.2	FA	91.4	L	5		0.27		117.6s	250	SC001
1995 11 21.49		C	16.9	GA	60.0	Y	6		0.35		0.8m	248	NAK01
1995 12 10.45		C	17.1	GA	60.0	Y	6		0.35				NAK01
1996 01 12.42		C	17.2	GA	60.0	Y	6		0.5			250	NAK01
1996 01 20.17		c	21.2	FA	91.4	L	5		0.25				SC001
1996 01 20.19		C	17.9	FA	91.4	L	5				376.2s	252	SC001

Comet 120P/Mueller 1

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 28.17		k	21.3	EB	154.9	L	3		0.08	8			HER02
1995 10 28.18		k	21.3	EB	154.9	L	3						HER02

Comet 121P/Shoemaker-Holt 2

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 26.07	1	C	[18.7	LB	20.3	T	10						GAR02

Comet 122P/de Vico

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 09 21.15		B	6.2	S	6.6	B		20	& 5	5	&0.9	270	PLE01
1995 09 21.17		S	6.3:	AA	8.0	B		15	& 5	7			SCH04

Comet 122P/de Vico [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 09 21.18		S	6.2:	AA	20.0	L	4	42	& 5	6/			SCH04
1995 09 23.18		B	6.3	AA	5.0	B		10	5		0.5		DIM
1995 09 24.18		B	5.9	S	6.6	B		20	& 6	5/	&0.8	270	PLE01
1995 09 25.16		S	6.0	S	8.0	B		20	15				MO005
1995 09 25.99		B	6.2:	AA	12	R	5	27	5.8	6			SIE
1995 09 26.07		B	5.8	S	8.0	B		10	7	s6	>2.0	275	KRY01
1995 09 26.09		B	5.8	AA	8.0	B		12	2	S8			BAR06
1995 09 26.09		B	6.0	VF	8.0	B		12	2	S8			BAR06
1995 09 26.14		S	6.0:	S	6.7	B		20	&10	6	&0.27	310	SCI
1995 09 26.99		B	6.2	AA	12	R	5	27	6.0	6			SIE
1995 09 27.07		B	5.9	S	8.0	B		10	6	s6/	>2.5	275	KRY01
1995 09 27.10		B	6.2	S	6.7	B		20	&10	6	&0.43	310	SCI
1995 09 28.08		B	6.5:	AA	13.3	R	5	33	5	4			SC004
1995 09 28.15		B	5.5:	S	5	R	6	10	&15	6/			RES
1995 09 28.16		B	5.5	AA	6.3	B		9		8	0.5	285	KAM01
1995 09 28.16		B	5.7	S	6.6	B		20	& 8	5/	&1.0	275	PLE01
1995 09 29.00		B	5.6	AA	12	R	5	27	6.0	6			SIE
1995 09 29.07		B	5.9	SP	8.0	B		10	7	s6/	>3.0	275	KRY01
1995 09 29.07		B	6.1:	AA	13.3	R	5	33	2.3	4/			SC004
1995 09 29.10		B	4.7	AA	4	R		7	4	S7			BAR06
1995 09 29.10		B	4.9	VF	11	L	7	32	4	S7			BAR06
1995 09 29.12		B	5.8	S	6.7	B		20	&10	7	&0.60	305	SCI
1995 09 29.13		B	5.8	S	25	L	6	50	&10	6	&1.00	290	RES
1995 09 29.18		B	5.5	AA	5.0	B		10	7		>1		DIM
1995 09 29.98		B	5.4	AA	12	R	5	27	& 6	6			SIE
1995 09 30.12		B	5.8	S	6.0	B		20		4			BEN04
1995 09 30.12		B	5.9	S	6.7	B		20	&10	7	&0.33	295	SCI
1995 09 30.17		B	5.5	S	10.0	B		25	& 8	6	&1.8	280	PLE01
1995 09 30.18		B	5.5	AA	5.0	B		10	8		>1		DIM
1995 10 01.09		B	5.6	AA	13.3	R	5	33	3.3	5	0.08	280	SC004
1995 10 01.13		B	5.7	S	6.0	B		20	& 6	6			PAR03
1995 10 01.14	w	S	5.8	AA	4.2	B		7		S7			FIE
1995 10 01.21		B	5.3	AA	8.0	B		20	8		1.5		DIM
1995 10 01.23		B	5.2	S	7.0	B		10	12	8	3	280	ROD01
1995 10 01.97		B	6.2	AA	12	R	5	27	& 6	6			SIE
1995 10 02.11		S	6.0	AA	5.0	B		7	6	9	2.1	279	KOS
1995 10 02.12		B	5.7	VF	11	L	7	32	5	S6	0.4	300	BAR06
1995 10 02.12		B	5.8	AA	11	L	7	32	5	S6			BAR06
1995 10 02.13		B	5.6	S	5.0	B		10	& 5	6			SWI
1995 10 02.13		B	6.4	S	5.0	B		10		5			MAT06
1995 10 02.13		S	5.8	AA	5.0	B		7	5	4	0.5	280	VEL03
1995 10 02.14		M	5.5	AA	8.0	B		15	& 5	8/	&2	280	COM
1995 10 02.14		S	5.5	AA	8.0	B		20					LAN01
1995 10 02.14		S	5.8	AA	6.0	B		20	5	7	0.25	298	CSU
1995 10 02.16		S	5.6	AA	5.0	B		10	4.5	7			ZAN01
1995 10 03.12		B	6.0	S	6.7	B		20	& 8	7	&0.38	280	SCI
1995 10 03.13		B	6.1	S	5.0	B		10		5			MAT06
1995 10 03.13		S	5.5	AA	6.0	B		20	6	8	4.75	288	CSU
1995 10 03.13		S	5.7	AA	5.0	B		7	6	9	3.5	290	KOS
1995 10 03.18		B	5.3	S	10.0	B		25	& 8	6	&2.5	300	PLE01
1995 10 03.99		B	5.5	AA	12	R	5	27	5.1	6			SIE
1995 10 04.07		B	5.3	AA	11	L	7	32	5.5	S6	1.7	290	BAR06
1995 10 04.13		B	5.8	S	5.0	B		10		5			MAT06
1995 10 04.19		B	5.3	AA	5.0	B		10	7		0.5		DIM
1995 10 04.23		B	5.2	S	7.0	B		10	12	8	3	290	ROD01
1995 10 04.97		S	5.6	AC	4.0	B		8		8			SCH04
1995 10 05.10		B	5.3	AA	11	L	7	32	6	D6	1		BAR06
1995 10 05.10		B	5.8	S	5.0	B		10		5			MAT06
1995 10 05.12		B	5.5	S	5.0	B		10	& 7	4	&0.25		SIW01
1995 10 05.12		S	5.5	AA	5.0	B		7	6	9	5.1	288	KOS
1995 10 05.13		B	5.5	S	5.0	B		7	5.4	7	&0.45	290	SPE01
1995 10 05.13		B	5.5	S	25	L	6	50	&15	6			RES
1995 10 05.13		B	5.7	S	6.7	B		20	& 8	7	&0.53	282	SCI
1995 10 05.13		S	5.5	AA	6.0	B		20	6	8	5	291	CSU

Comet 122P/de Vico [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 05.19		B	5.2	S	10.0	B		25	& 9	6/	&2.0	300	PLE01
1995 10 05.94		S	5.4	AC	4.0	B		8	& 8	7/	2.5	295	SCH04
1995 10 06.10		B	5.3	AA	11	L	7	32	5	D6	2.0	290	BAR06
1995 10 06.10		B	5.9	S	5.0	B		10		5			KIE
1995 10 06.10		B	5.9	S	5.0	B		10		5			MAT06
1995 10 06.11		S	5.3	AA	5.0	B		7	6	9	6.7	293	KOS
1995 10 06.12		B	5.8	S	25	L	6	100	& 4	6			SWI
1995 10 06.12		S	5.5	AA	5.0	B		7	7	5	2	303	VEL03
1995 10 06.12		S	5.5	AA	11	L	7	32	10	6	0.5	301	VEL03
1995 10 06.14		S	5.6	AA	6.0	B		20	5	8	3.7	293	CSU
1995 10 06.15		B	5.5	S	5.0	B		10	& 7	4	&0.33		SIW01
1995 10 06.15		M	5.4	AA	8.0	B		15	& 3	8	&3	293	COM
1995 10 06.16		B	5.6	S	25	L	6	50	&15	6			RES
1995 10 06.18		B	5.2	S	10.0	B		25	& 9	7	&1.8	305	PLE01
1995 10 07.09		B	5.5	AA	11	L	7	32	6	D6/	2.0	305	BAR06
1995 10 07.10		M	5.6	AA	4	R	4	12	6	8			MAI
1995 10 07.11		S	5.5	AA	5.0	B		7	7	4			VEL03
1995 10 07.11		S	5.5	AA	11	L	7	32	5	6	1.0	294	VEL03
1995 10 07.12		B	5.7	AA	4	R		7		S8			BAR06
1995 10 07.13		S	5.3	AA	6.3	R	13	52	6	9		285	KOS
1995 10 07.95		S	5.4	AC	4.0	B		8	& 6	8	?		SCH04
1995 10 07.96		B	5.9	S	12	R	5	27		6			SIE
1995 10 08.06		B	5.8:	AA	13.3	R	5	33	2	5	0.08	300	SC004
1995 10 08.10		M	5.7	AA	4	R	4	12	6	8			MAI
1995 10 08.14		S	5.3	AA	6.3	R	13	52	6	9			KOS
1995 10 08.16		B	4.9	AA	8.0	B		20	8		2		DIM
1995 10 09.17		S	5.2	S	10	B		25			0.5		HAL04
1995 10 09.19		S	5.8	AA	12.5	R	5	20	5	3			BEA
1995 10 09.96		B	5.7	S	12	R	5	27		6			SIE
1995 10 10.12		B	6.1:	S	6.0	B		20		3			KID01
1995 10 10.12		S	5.6	AA	5.0	B		7	6	6	1.0	302	VEL03
1995 10 10.15		S	5.7	S	6.0	B		20	& 5	5			SIW
1995 10 10.17		B	5.3	S	6.6	B		20	&10	6/	&1.2	315	PLE01
1995 10 10.17		B	5.8	S	5	R	6	10	&10	5			RES
1995 10 10.19		S	5.6	AA	12.5	R	5	20	5	3			BEA
1995 10 10.53		M	5.4	AA	5.0	B		10		8			MOR
1995 10 11.10		M	5.7	AA	4	R	4	12	6	8			MAI
1995 10 11.12		S	5.6	AA	5.0	B		7	7	5	1.0	313	VEL03
1995 10 11.13		B	5.6	S	5	R	6	10	&17	5/			RES
1995 10 11.13		B	5.7	AA	6.0	B		20		4			BAN
1995 10 11.15		S	5.3	AA	5.0	B		7	6	9	4.9	304	KOS
1995 10 11.19		B	5.0	AA	5.0	B		10	8				DIM
1995 10 11.19		S	5.8	AA	12.5	R	5	20	5	3			BEA
1995 10 11.54		M	5.4	AA	5.0	B		10		8			MOR
1995 10 12.06		B	5.5	AA	13.3	R	5	33	1.8	6			SC004
1995 10 12.09		S	5.7	AA	5.0	B		7	6	5			VEL03
1995 10 12.10		B	5.5	AA	11	L	7	32	6.5	5/	1.5	305	BAR06
1995 10 12.10		B	6.0	S	5.0	B		10		5			KIE
1995 10 12.10		M	5.8	AA	4	R	4	12	6	8			MAI
1995 10 12.10		S	5.7	AA	11	L	7	32	8	6	1.5	310	VEL03
1995 10 12.12		B	6.0	S	5.0	B		10	& 6	3/			SIW01
1995 10 12.13		B	5.9	S	5.0	B		10		5			MAT06
1995 10 12.13		B	6.0	S	5.0	B		10	& 4	6			SWI
1995 10 12.14		S	5.4	AA	5.0	B		7	6	9	4.0	304	KOS
1995 10 12.15		B	5.7	S	6.7	B		20	& 5	7	&0.53	300	SCI
1995 10 13.10		B	5.1	AA	11	L	7	32	5	6	1.5	320	BAR06
1995 10 13.10		S	5.8	AA	5.0	B		7	6	6	1.5	310	VEL03
1995 10 13.12		S	5.8	AA	11	L	7	32	6	6	1.0	320	VEL03
1995 10 13.13		B	5.8	S	11	L	7	32		4			SL001
1995 10 13.13		B	6.0	S	6.0	B		20		4			BEN04
1995 10 13.14		B	5.9	S	5.0	B		10		5			MAT06
1995 10 13.14		S	5.4	AA	6.3	R	13	52	5	9	4.5	317	KOS
1995 10 13.17		B	5.8	S	6.7	B		20	& 6	7	&0.33	300	SCI
1995 10 14.02		B	6.0	SP	8.0	B		10	7	s6			KRY01

Comet 122P/de Vico [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 14.10		M	5.8	AA	4	R	4	12	6	8			MAI
1995 10 14.14		S	5.4	AA	6.3	R	13	52	5	8	5.5	318	KOS
1995 10 14.14		S	5.6	AC	5.0	B		10					MIZ01
1995 10 14.19		B	5.4	AA	5.0	B		10	8		1		DIM
1995 10 15.10		M	5.8	AA	4	R	4	12	7	8			MAI
1995 10 15.14		S	5.5	AA	6.0	B		20	4	7	5	306	CSU
1995 10 15.15		S	5.5	AA	5.0	B		7	5	8	3.2	313	KOS
1995 10 15.52		M	5.5	AA	5.0	B		10		8	6.0	325	MOR
1995 10 16.10		M	5.8	AA	4	R	4	12	7	8			MAI
1995 10 16.12		B	5.4	AA	11	L	7	32	7.2	D6	1	312	BAR06
1995 10 16.12		S	5.7	AA	5.0	B		7	8	7	1.2	322	VEL03
1995 10 17.01		B	5.9	SP	5.0	B		7	7	4/			KRY01
1995 10 17.10		M	5.8	AA	4	R	4	12	7	8			MAI
1995 10 17.19		B	6.3	AA	6.3	B		9		8/			KAM01
1995 10 17.19		B	6.3:	SC	5.0	B		7					BIV
1995 10 18.10		M	6.2	AA	4	R	4	12	7	8			MAI
1995 10 18.16		B	6.2	S	5.0	B		7		7			SPE01
1995 10 18.17		B	5.8	AA	5.0	B		10	8				DIM
1995 10 18.53		M	5.8	AA	5.0	B		10		8			MOR
1995 10 18.76		S	5.6	HI	5.0	B		7	3				SKI
1995 10 19.07		B	5.7	SP	5.0	B		7	8	6	4.0	325	KRY01
1995 10 19.10		M	6.2	AA	4	R	4	12	7	8			MAI
1995 10 19.14		B	6.3	S	4.5	B		12	& 5	4/			SIW
1995 10 19.14		S	6.2	AA	6.3	R	13	52	6	7	3.2	315	KOS
1995 10 19.14		S	6.2	S	6.0	B		20	& 5	4/			SIW
1995 10 19.18		B	5.8	S	6.6	B		20	& 8	6	&0.5	330	PLE01
1995 10 19.22		B	5.9:	SC	5.0	B		7					BIV
1995 10 19.53		M	5.9	AA	5.0	B		10		8			MOR
1995 10 19.75		S	5.9	HI	5.0	B		7	5				SKI
1995 10 20.03		B	6.1	SP	5.0	B		7	7	4/			KRY01
1995 10 20.17		S	5.8	AA	8.0	B		20	4	4	1.2	338	VAN06
1995 10 20.19		S	5.8	AA	12.5	R	5	20	8	5			BEA
1995 10 20.53		M	5.9	AA	8.0	B		20		7/			MOR
1995 10 21.11		B	6.3	S	6.0	B		20		3			KID01
1995 10 21.12		S	6.1	Y	5.0	R		8	7	7			MID01
1995 10 21.14		B	6.2	S	6.7	B		20	& 5	7	&0.62	312	SCI
1995 10 21.18		B	6.1	AA	5.0	B		10	6				DIM
1995 10 21.21	a	C	6.7	LB	20.3	T	10		8		>0.4	342	GAR02
1995 10 21.22		K	6.3	S	5.0	B		7		2	0.5		TRI
1995 10 21.22		S	5.8	AA	12.5	R	5	20	8	5			BEA
1995 10 21.52		M	6.0	AA	5.0	B		10		8	1.33	344	MOR
1995 10 21.72		M	5.5:	TI	8.0	B		10	4	4			HOR02
1995 10 21.72		M	5.9:	TI	8.0	B		10	3	5			PLS
1995 10 21.73		S	6.0	S	11	L	7	50					DZI
1995 10 21.76		S	6.5:	SC	5.0	B		7					BIV
1995 10 22.08		B	6.3	AA	11	L	7	32	7.5	D6	1.2	355	BAR06
1995 10 22.10		M	6.1	AA	4	R	4	12	6	8			MAI
1995 10 22.12		B	6.3	AA	6.0	B		20		4			BAN
1995 10 22.12		B	6.4	S	5.0	B		10	& 5	3			SIW01
1995 10 22.12		S	6.4	AA	5.0	B		7	4	6			VEL03
1995 10 22.12		S	6.4	AA	11	L	7	32	8	7	1.0	343	VEL03
1995 10 22.13		B	6.3	S	6.7	B		20	& 4	7			SCI
1995 10 22.13		S	6.4	AA	6.3	R	13	52	6	7	1.0	336	KOS
1995 10 22.13		S	6.6	AA	8	R		10					SZA
1995 10 22.14		B	5.9	S	6.0	B		20	&10	6			PAR03
1995 10 22.14		B	6.3	S	6.0	B		20		4			KID01
1995 10 22.14		S	6.7	AA	8	R		21	5	D6			SZA
1995 10 22.15		S	6.4	S	6.0	B		20	& 5	4/			SIW
1995 10 22.16		B	5.9	TI	3.0	B		6	4	7			KYS
1995 10 22.16		M	6.1	TI	11	L	8	32	3.7	7/			KYS
1995 10 22.18					20.3	T	10	50	4.7	8	>0.5	350	KAM01
1995 10 22.18		B	6.4	AA	6.3	B		9		8/			KAM01
1995 10 22.18		B	6.5	S	6.0	B		20		5			BEN04
1995 10 22.18		M	6.3	TI	8.0	B		10	5				POD

Comet 122P/de Vico [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 22.19		B	6.6	SC	5.0	B		7					BIV
1995 10 22.20		B	5.8	S	6.6	B		20	& 7	6	&0.7	332	PLE01
1995 10 22.53		M	6.3	AA	5.0	B		10		7/	1.33		MOR
1995 10 22.70		S	6.4	S	11	L	7	50	& 5	5			DZI
1995 10 22.71		M	6.2	TI	11	L	8	32	3.5	6			KYS
1995 10 22.72		S	6.0	TI	11	L	8	54	4	5			KYS
1995 10 22.75		B	6.7	SC	5.0	B		7					BIV
1995 10 23.09		B	6.1	AA	11	L	7	32	6.8	5	2.1	340	BAR06
1995 10 23.10		B	6.2	S	11	L	7	32		4			SLO01
1995 10 23.11		B	6.2	S	6.0	B		20	&15	5			CNO
1995 10 23.11		B	6.6	S	6.0	B		20		3			KID01
1995 10 23.11		M	6.4	AA	4	R	4	12	8	8			MAI
1995 10 23.13		B	6.6	S	5.0	B		10	& 3	5			SWI
1995 10 23.13		M	7.0	TI	8.0	B		10	6	5/			HOR02
1995 10 23.14		B	5.9	S	9	R	6	16	&10	6	&0.81	335	PAR03
1995 10 23.14		M	6.4	TI	5.0	B		7	8				APF
1995 10 23.14		S	6.4	S	6.0	B		20	& 5	4/			SIW
1995 10 23.14		S	6.6	AA	6.3	R	13	52	6	7	1.2	340	KOS
1995 10 23.16		B	6.4	S	6.7	B		20	& 6	6/	&0.53	320	SCI
1995 10 23.16		M	6.2	TI	3.0	B		6	4	6			KYS
1995 10 23.16		M	6.2	TI	11	L	8	32	4	6			KYS
1995 10 23.18		B	6.4	S	6.0	B		20		5			BEN04
1995 10 23.19		B	5.9	S	6.6	B		20	& 7	6	&0.3	335	PLE01
1995 10 23.22		K	6.2	S	5.0	B		7		2	0.5		TRI
1995 10 23.53		M	6.3	AA	8.0	B		20		7/			MOR
1995 10 23.70		S	6.4	S	11	L	7	50	& 4	4			DZI
1995 10 23.71		S	6.3	AA	5.0	B		7	6	6	2	10	VEL03
1995 10 23.71		S	6.3	AA	11	L	7	32	7	7	2	10	VEL03
1995 10 23.74		B	6.3	AA	11	L	7	32	6	5	1.4	345	BAR06
1995 10 24.00		M	6.0	S	3.5	B		7					TSU02
1995 10 24.10		B	5.4	HD	11	B		20	4.5	7	0.2		NES
1995 10 24.10		B	6.3	S	11	L	7	32		4			SLO01
1995 10 24.11		B	6.3	AA	11	L	7	32	7.1	D6	1.7	345	BAR06
1995 10 24.11		M	6.5	AA	4	R	4	12	8	8			MAI
1995 10 24.11		S	6.1	AA	4	R		7		6			BAR06
1995 10 24.13		B	6.6	TI	5.0	B		7					KLA01
1995 10 24.13		B	6.7	TI	10	B		25					KLA01
1995 10 24.14		B	6.0	S	9	R	6	16	& 9	6	&0.80	335	PAR03
1995 10 24.14		B	6.3	S	5.0	B		10	& 8	4			SIW01
1995 10 24.14		B	6.3	S	6.0	B		20	&15	5			CNO
1995 10 24.14		B	6.9	S	5.0	B		10		5			MAT06
1995 10 24.14		M	6.6	TI	5.0	B		7	8				APF
1995 10 24.14		M	6.6	TI	8.0	B		10	7	6	0.17	340	HOR02
1995 10 24.15		S	6.8	AA	6.3	R	13	52	6	7	0.7	22	KOS
1995 10 24.16		B	6.0	S	6.0	B		20		4			SOC
1995 10 24.16		B	6.7	S	6.7	B		20	& 6	6/	&0.43	310	SCI
1995 10 24.16		S	6.4	AA	8.0	B		15	& 5	7			COM
1995 10 24.16	a	M	6.0	AA	8.0	B		20	6	6/	1	340	MIL02
1995 10 24.18		B	6.5	S	6.0	B		20		5			BEN04
1995 10 24.19					9.0	M	11	39	3.5	7	?	350	KAM01
1995 10 24.19		B	6.2	S	6.6	B		20	& 6	6			PLE01
1995 10 24.19		B	6.4	AA	6.3	B		9					KAM01
1995 10 24.20		B	6.7	SC	5.0	B		7					BIV
1995 10 24.53	a	M	6.5	AA	8.0	B		20		7			MOR
1995 10 24.71		S	6.4	S	11	L	7	50	& 4	4			DZI
1995 10 24.72		B	6.3	AA	11	L	7	32	7.0	4/			BAR06
1995 10 24.72		M	6.3	TI	10	B		25	5.5	6	0.25		ZNO
1995 10 24.73		B	6.6	TI	5.0	B		7					KLA01
1995 10 24.74		S	6.3	AA	15.0	R		75	5	7			DIE02
1995 10 25.10		B	6.3	S	11	L	7	32		4			SLO01
1995 10 25.10		M	6.6	AA	4	R	4	12	8	8			MAI
1995 10 25.12		B	6.3	S	6.0	B		20	&15	5			CNO
1995 10 25.12		B	6.6	AA	6.0	B		20		5			BAN
1995 10 25.12		S	6.4	AA	5.0	B		7	7	5			VEL03

Comet 122P/de Vico [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 25.12		S	7.0	AA	27	L		70	5	4			SZA
1995 10 25.13		B	6.5	AA	11	L	7	32	7	7			VEL03
1995 10 25.14		B	6.4	AA	11	L	7	32	6.8	5/	0.5		BAR06
1995 10 25.14		M	6.5	TI	8.0	B		10	7	6	0.17	340	HOR02
1995 10 25.14		S	6.2	AA	4	R		7		7			BAR06
1995 10 25.15		B	5.5:	S	6.0	B		20		3			SOC
1995 10 25.16		B	6.5	S	5.0	B		10	& 5	3/			SIW01
1995 10 25.16		B	6.8	S	6.0	B		20		2			KID01
1995 10 25.16		B	6.9	S	6.7	B		20	& 6	6	&0.53	310	SCI
1995 10 25.16		B	6.9:	S	8.0	B		20	6.0	6			SPE01
1995 10 25.17		B	6.3	S	6.6	B		20	& 6	6			PLE01
1995 10 25.18		S	6.5	TI	5.0	B		7	4	5			KYS
1995 10 25.19		B	6.6	S	6.0	B		20		5			BEN04
1995 10 25.54	a	M	6.2	AA	8.0	B		20		7			MOR
1995 10 25.70		B	6.6	AA	5.0	B		7		5	1	45	VEL03
1995 10 25.71		B	6.7	AA	5.0	B		7		6	2	22	VEL03
1995 10 25.72		B	6.5	AA	11	L	7	32	5.7	D6	2.0	348	BAR06
1995 10 25.76		B	6.7	SC	5.0	B		7					BIV
1995 10 25.81		S	6.8	HI	5.0	B		7	7				SKI
1995 10 25.83		S	6.2	S	15.0	R	5	25	6	5	0.16		NAG02
1995 10 26.10		M	6.7	AA	4	R	4	12	6	8			MAI
1995 10 26.11		B	5.7	HD	11	B		20	5	7			NES
1995 10 26.11		B	6.3	S	6.0	B		20	&15	5			CNO
1995 10 26.12		B	6.0	S	6.0	B		20		3			SOC
1995 10 26.13		B	6.5	AA	5.0	B		7	6	5			VEL03
1995 10 26.13		B	6.5	S	11	L	7	32		3			SLO01
1995 10 26.13		B	6.6	AA	11	L	7	32	6.0	5/	1.4	344	BAR06
1995 10 26.14		B	6.7	AA	11	L	7	40	5.8	6	1.4	344	BAR06
1995 10 26.15		B	6.4	S	6.6	B		20	& 5	6			PLE01
1995 10 26.16		B	7.1	S	6.7	B		20	& 5	6			SCI
1995 10 26.19		B	6.3	AA	5.0	B		10	5				DIM
1995 10 26.19		B	6.8	S	6.0	B		20		5			BEN04
1995 10 26.53		M	6.6	AA	8.0	B		20		6/			MOR
1995 10 26.74		B	6.6	AA	5.0	B		7	6	5			VEL03
1995 10 27.09		B	6.7	AA	11	L	7	32	5.5	5			BAR06
1995 10 27.13		B	6.2	S	6.0	B		20		3			SOC
1995 10 27.13		B	6.5	AA	5.0	B		7	7	5			VEL03
1995 10 27.13		B	6.5	AA	11	L	7	32	6	6			VEL03
1995 10 27.15		M	6.2	TI	8.0	B		10	8	5			HOR02
1995 10 27.15		M	6.6	TI	5.0	B		7	10				APF
1995 10 27.16		B	6.8	S	8.0	B		20	5.9	6			SPE01
1995 10 27.16		B	7.3	S	6.7	B		20	& 5	6			SCI
1995 10 27.19		B	6.3	S	6.6	B		20	& 7	6			PLE01
1995 10 27.21		S	6.3	AA	12.5	R	5	20	6	5			BEA
1995 10 27.53		M	6.8	AA	8.0	B		20		6			MOR
1995 10 27.69		B	6.6	AA	5.0	B		7	6	5			VEL03
1995 10 27.69		B	6.6	AA	11	L	7	32	8	5			VEL03
1995 10 27.70		S	6.3	S	15	L	9	33	& 6	6			PAR03
1995 10 27.71		M	7.6	TI	5.6	R	14	40	5	7			DEM
1995 10 27.71		S	6.5	S	11	L	7	50	& 4	4			DZI
1995 10 27.72		B	6.8	AA	11	L	7	32	5.1	5			BAR06
1995 10 27.78		S	7.0	HI	5.0	B		7	10				SKI
1995 10 27.81		S	6.3	S	15.0	R	5	25	6	5	0.16		NAG02
1995 10 28.10		B	5.4	HD	11	B		20	4.5	7			NES
1995 10 28.12		B	6.4	S	6.0	B		20	&12	3			CNO
1995 10 28.13		B	6.7	AA	11	L	7	32	5.7	5/			BAR06
1995 10 28.14		B	6.7	AA	11	L	7	32	8	6			VEL03
1995 10 28.15		B	6.4	S	6.0	B		20		3			SOC
1995 10 28.16		S	6.3	AA	5.0	B		10	6.3	4			ZAN01
1995 10 28.18		S	6.5	AA	8.0	B		15	& 3	6			COM
1995 10 28.20		S	6.6	AA	8.0	B		15	7	7			SCH04
1995 10 28.20		S	6.7	AA	10	B		14	5.0	7	0.2	355	SHA02
1995 10 28.22		S	6.4	AA	5.0	B		7	& 3	7			SHA02
1995 10 28.75		B	6.6	S	5	R	6	10	& 6	3/			RES

Comet 122P/de Vico [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 28.81		B	7.0	S	15.0	L	4	80	5	6	1.0	5	RODO1
1995 10 29.13		B	5.9	HD	11	B		20	4.5	7			NES
1995 10 29.18		S	6.6	AA	8.0	B		15	& 3	5/			COM
1995 10 29.20		S	7.0	HI	5.0	B		10	3				HIL02
1995 10 29.22		S	6.3	AA	7.5	R	16	50	6	4			BEA
1995 10 29.22		S	6.7	AA	10	B		14	5.0	6	0.18	342	SHA02
1995 10 29.74		S	6.4	AA	5.0	B		10	6.3	4			ZAN01
1995 10 29.74		S	6.8	AA	15.0	R		75	3	5			DIE02
1995 10 30.77		B	7.1	SC	5.0	B		7					BIV
1995 10 31.12		B	6 :	HD	11	B		20	4	7			NES
1995 10 31.19	!	S	7.5	AA	10	B		14	5.3	6	0.45	15	SHA02
1995 10 31.23		B	7.1	SC	5.0	B		7					BIV
1995 10 31.77		B	7.2	SC	5.0	B		7					BIV
1995 11 01.10		S	6.9	AA	10.0	R	5	27	4.5	5/			SPR
1995 11 01.77		S	7.7	HI	5.0	B		10	3.5				GRA04
1995 11 01.78		S	7.6	HI	7.6	R	13	25	3.7	4			GRA04
1995 11 01.84		S	7.0	S	15.0	R	5	25	6	4/			NAG02
1995 11 02.09		S	6.9	AA	10.0	R	5	27	4	5			SPR
1995 11 02.22		S	7.0	AA	12.5	R	5	20	5	4			BEA
1995 11 03.17		S	7.5	HI	5.0	B		10	6	4			GRA04
1995 11 03.18		M	7.7	HI	20.3	T	10	50	5.1	5			GRA04
1995 11 03.23		S	7.2	AA	10	B		14	4.7	5			SHA02
1995 11 03.23		S	7.2	AA	12.5	R	5	20	4	3			BEA
1995 11 04.18		S	7.7	AA	10	B		14	4.7	5			SHA02
1995 11 04.19		S	6.9	AA	15.0	R		75	4	5			DIE02
1995 11 04.21		M	7.5	HI	20.3	T	10	50	4.4	5			GRA04
1995 11 04.22		S	7.4	HI	5.0	B		10	4				GRA04
1995 11 04.23		S	7.7	AA	10	B		14	4.7	5	0.17	7	SHA02
1995 11 04.70		B	7.2	S	6.6	B		20	& 5	5			PLE01
1995 11 04.74		S	7.1	AA	15.0	R		75	4	5			DIE02
1995 11 04.75		M	7.6	HI	20.3	T	10	80	4.9	4/			GRA04
1995 11 05.10		S	6.8	AA	8.0	R	4	19	4	4/			SPR
1995 11 05.20		S	7.3	AA	8.0	B		15	& 3	4			COM
1995 11 05.22		S	7.7	S	6.0	R	13	40	4	6			BIV
1995 11 05.23		B	7.0	S	21.0	L		100	4	5			SAN04
1995 11 05.23		M	7.5	S	21.0	L		100	8	4			MAR02
1995 11 05.23		S	7.7	AA	10	B		14	3.7	5	0.17	32	SHA02
1995 11 07.71		M	7.5	TI	20	L	5	48	4	6			PLS
1995 11 07.71		M	7.6	TI	10	B		25	6	6/			ZNO
1995 11 07.72		S	7.8	HI	7.6	R	13	25	4	4			GRA04
1995 11 08.71		M	7.9	TI	8.0	B		10	6	4			HOR02
1995 11 08.74		M	8.3	TI	20	L	5	48	5.5	5			PLS
1995 11 09.68		S	7.9	S	6.6	B		20	& 4	4			PLE01
1995 11 09.69		B	8.2	S	25	L	6	100	& 3	1			SWI
1995 11 09.71		S	7.8	AC	6.0	B		20					MIZ01
1995 11 09.71		S	7.9	AC	6.0	B		20	4	6			SAR02
1995 11 09.72		S	8.0	S	11	L	7	50		2			DZI
1995 11 10.10		M	8.1	AA	25.6	L	4	45		3			MOR
1995 11 11.72		S	8.1	HI	20.3	T	10	50	3.8	4			GRA04
1995 11 11.72		S	8.5	S	11	L	7	50		2			DZI
1995 11 12.11		M	7.7	AA	8.0	B		20		5			MOR
1995 11 12.11		M	7.7	AA	25.6	L	4	45		5			MOR
1995 11 12.38		S	8.1	S	15.0	R	5	25	6	2/			NAG02
1995 11 12.40		M	8.0	S	12.5	L	6	23		4			TSU02
1995 11 12.68		S	8.4	S	11	L	7	50		3			DZI
1995 11 12.71		S	7.7	S	9	R	6	16	6.5	2			PAR03
1995 11 12.71		S	7.9	VF	11	L	7	32	4.8	4/			BAR06
1995 11 12.71		S	8.1	AA	11	L	7	32	4.8	4/			BAR06
1995 11 12.73		S	8.2	AA	15.0	R		75	2	4			DIE02
1995 11 12.74		S	7.9	AA	35	L	5	103	5	3			BRO04
1995 11 12.78	a	M	7.7:	AA	15.0	L	4	26					PER01
1995 11 12.78	a	S	7.8	AA	15.0	L	4	26	& 6	4			PER01
1995 11 13.11		M	8.0	AA	8.0	B		20		4			MOR
1995 11 13.68		S	8.0	VF	11	L	7	32	4.3	4			BAR06

Comet 122P/de Vico [cont.]

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 11 13.68		S	8.3	S	11	L	7	50		3			DZI
1995 11 13.68		S	8.4	AA	11	L	7	32	5	5			VEL03
1995 11 13.69		S	8.2	AA	11	L	7	32	4.3	4			BAR06
1995 11 13.72		B	9.0	TI	10	B		25					KLA01
1995 11 13.72		S	9.0	S	15	L		30	& 5	2			SIW01
1995 11 13.75		M	8.0	HI	6.0	R	15	22	5.4	3			GRA04
1995 11 13.76		S	8.0	HI	5.0	B		10	5				GRA04
1995 11 14.73		B	9.2	TI	10	B		25					KLA01
1995 11 15.11		M	7.9	AA	8.0	B		20	9.8	3/			MOR
1995 11 16.10		S	6.8	AA	20.0	T	10	64	4	4			SPR
1995 11 16.22		S	8.3	HI	20.3	T	10	80	4.4	3			GRA04
1995 11 17.11		M	8.4	AA	8.0	B		20		3/			MOR
1995 11 17.81		S	8.3	HI	6.0	R	15	22	4.2	3			GRA04
1995 11 18.09		M	8.5	AA	8.0	B		20		4			MOR
1995 11 18.71		M	8.8	TI	20	L	5	48	4	6			PLS
1995 11 18.72		S	8.8	AC	6.0	B		20	4	0			KIS02
1995 11 18.72		S	9.0	AC	6.0	B		20	4	2			SAR02
1995 11 18.73		M	8.7	TI	20	L	5	48	6.8	4			HOR02
1995 11 19.11		M	8.6	AA	8.0	B		20		3/			MOR
1995 11 19.74		S	8.6	HI	20.3	T	10	50	3.8	2/			GRA04
1995 11 20.10		S	8.0	AA	20.0	T	10	64	4.5	3/			SPR
1995 11 20.72	!	V	8.7	AA	20.0	T	2		& 9	7	&10 m	355	MIK
1995 11 20.73		S	8.9	AA	15.0	R		75	2	3			DIE02
1995 11 20.74		M	8.8	TI	20	L	5	48	4.6	4			HOR02
1995 11 20.74		S	8.7	AA	10.0	B		25	3.8	4			HAS02
1995 11 21.22		S	8.7	HI	20.3	T	10	50	3.9	2/			GRA04
1995 11 21.69		S	8.9	S	6.6	B		20	& 6	6			PLE01
1995 11 21.69		S	9.0	S	11	L	7	50					DZI
1995 11 21.70		S	8.3	AA	15.2	L	5	42	3.5	3			MOE
1995 11 21.71		M	9.0	TI	10	B		25	3.5	3/			ZNO
1995 11 22.63		B	8.8	S	35	L	5	56	3.5	4			KRY01
1995 11 22.69		M	9.6	TI	10	B		25	3	3/			ZNO
1995 11 22.71		M	9.3	TI	20	L	5	48	4.2	4			HOR02
1995 11 24.72	!	V	8.9	AA	20.0	T	2		& 7	7			MIK
1995 11 25.69		S	8.7	AC	15.2	L	5	42	3.0	3			MOE
1995 11 25.69		S	9.5	S	11	L	7	50	& 5				DZI
1995 11 25.70		S	9.5:	S	6.6	B		20	& 5	5			PLE01
1995 11 26.64		B	9.0	S	35	L	5	56	5	3			KRY01
1995 11 26.70		S	9.4	S	11	L	7	32	3.4	3			BAR06
1995 11 26.71		S	9.6:	S	11	L	7	32	3.2	2			BAR06
1995 11 27.68		S	9.9:	S	35	M	10	90	& 5	5			PLE01
1995 12 10.36		C	11.5	HS	20.3	T	6		1		1.5m	0	YUS
1995 12 29.20		O	[11.0	TI	11	L	7	54	! 1				KYS
1996 01 18.19		V	14.6:	GA	36.0	T	7		& 2	2	& 4 m	7	MIK

Comet 123P/West-Hartley

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 26.10		C	17.5	LB	20.3	T	10		0.2				GAR02
1995 10 26.10		c	18.4	LB	20.3	T	10						GAR02
1995 11 17.51		C	17.8	FA	91.4	L	5		0.19		18.0s	261	SCO01

Comet 124P/Mrkos

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 09 20.42		k	21.7	EB	228.6	L	2		0.07	9			HER02
1995 09 20.43		k	22.3	EB	228.6	L	2						HER02
1995 10 27.35		k	19.4	EB	154.9	L	3		0.10	9			HER02

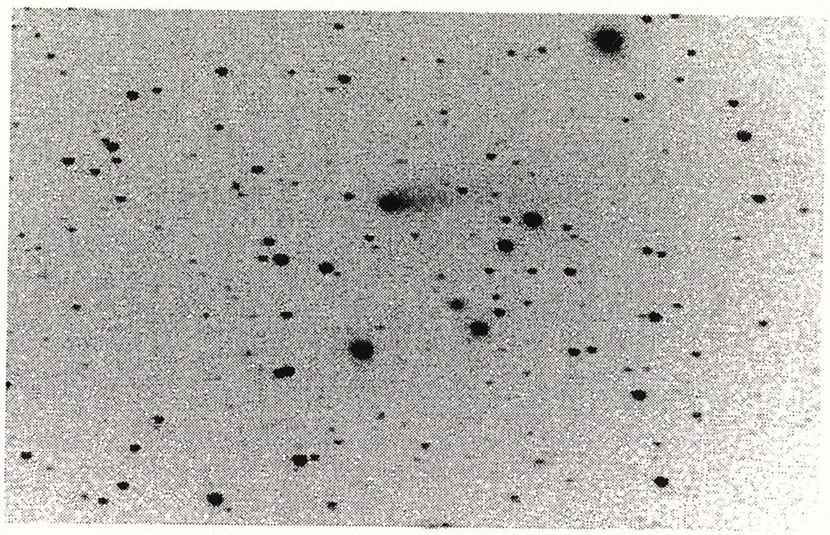
Comet P/1993 K2 (Helin-Lawrence)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1995 10 17.57		C	19.1	GA	60.0	Y	6		0.25				NAK01
1995 11 21.54		C	19.3	GA	60.0	Y	6		0.25				NAK01

Comet P/1996 A1 (Jedicke)

DATE (UT)	N	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL		PA	OBS.
1996 01 17.89	!	V	16.8	GA	36.0	T	7		0.17	9	& 1	m	285	MIK

Φ Φ Φ



Above: *CCD image of 116P/Wild 4 by Tim Puckett with a 30.5-cm f/7 Schmidt-Cassegrain reflector + ST6 camera; 300-sec exposure taken on 1995 Dec. 29.285 UT.*

◇ ◇ ◇

Below: *CCD image of comet 6P/d'Arrest by Puckett; 300-sec exposure taken on 1995 Nov. 13.115 UT.*