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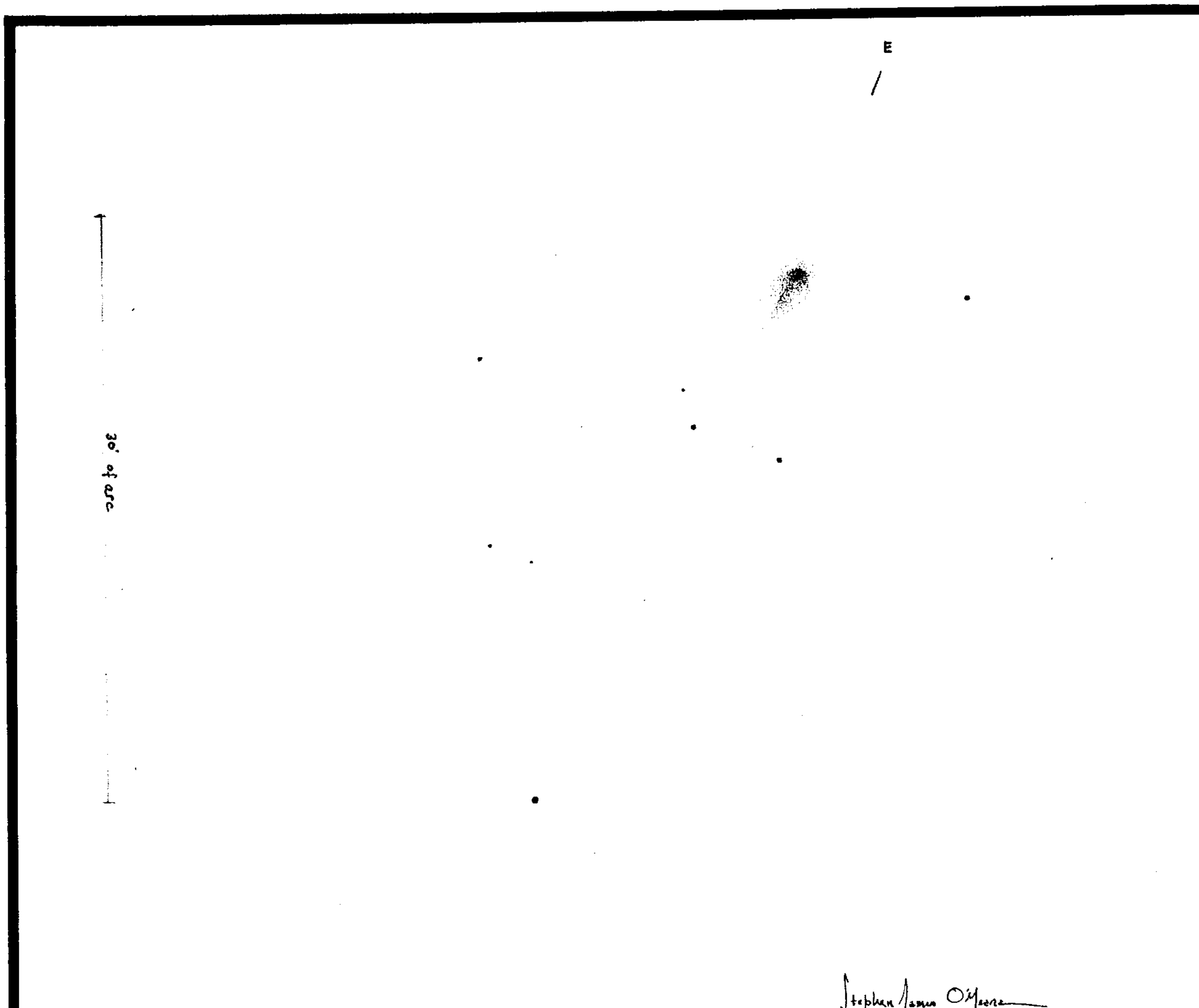

Drawing of periodic comet Giacobini-Zinner 1984*e*, as seen by Stephen J. O'Meara with the 18-inch Clark refractor in Amherst, Massachusetts, at 1:30 UT on August 24, 1985.

INSIDE THIS ISSUE

The International Comet Quarterly (*ICQ*) is a non-profit journal devoted to news and observation of comets. Issues are published 4 times per year (January, April, July, and October). The *ICQ* is published by the Department of Physics and Astronomy at Appalachian State University in Boone, North Carolina.

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Manuscripts will be reviewed for possible publication; send typed, double-spaced copy to the Editor (Cambridge address above). Cometary observations also should be sent to the Editor in Cambridge; all data intended for publication in the *ICQ* should be sent on standard *ICQ* observation report forms.

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This issue is No. 56 of the publication originally called *The Comet*, founded in March 1973, and is Vol. 7, No. 4, of the *ICQ*. *[ISSN 0736-6922]*

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NOTICE: *Effective immediately, annual subscription rates to this journal are* $16.00 *per year (special rates are now* $10.00 *within North America —* $12.00 *outside North America). See page 92. — The Editor.*

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OBSERVATIONS OF COMETS IN THE ULTRAVIOLET

Paul D. Feldman
Department of Physics and Astronomy
Johns Hopkins University

Despite the very long recorded history of observations of comets, it was not until fifteen years ago that observations of comets were first extended to vacuum ultraviolet wavelengths, that is wavelengths below ~ 3000 Å. Such observations must be necessarily made from space, since the O_2 and O_3 of the terrestrial atmosphere strongly absorb radiation at these short wavelengths. In fact, ultraviolet (UV) astronomy, as we now know it, did not exist before the "space age" and has evolved in the past 25 years from technologically advanced, but otherwise simple, experiments carried aloft by sounding rockets (giving about 5 minutes of useful observing time above 150 km) to sophisticated orbiting observatories providing similar operational capabilities as found at large ground-based telescopes. The *International Ultraviolet Explorer* (*IUE*), which has been used to observe nearly two dozen comets, is now in its eighth year of operation, soon to be followed by the *Hubble Space Telescope (HST)*.

The motivation for undertaking ultraviolet observations of comets is fundamentally what makes UV astronomy such an important tool in many areas of astrophysics: the resonance transitions of the most abundant chemical elements in the universe (*e.g.*, H, C, O, N, S), as well as those of many of the simple molecules made of these elements, lie principally between 1200 and 3000 Å. This is particularly important for comets whose radiation we detect is mainly the result of resonance scattering or fluorescence of solar radiation (except, of course, for the sunlight *reflected* by cometary dust grains). Perhaps even more important, the dissociation products of the primary constituent of cometary ice, H_2O, all fluoresce in the UV (water molecules themselves do not fluoresce strongly at all), as do CO, CO_2, and their dissociation and ionization products. The gaseous species which make up the visible coma, such as CN, C_2, C_3, and NH, are all dissociation products of polyatomic molecules which exist as impurities (totaling less than 1%) in the water ice. As I have remarked previously (Feldman 1983), "in the ultraviolet we see the 'ice' products from the 'dirty ice' nucleus, whereas in the visible we see, and have seen quite spectacularly for millennia, only the dirt."

The earliest attempts at rocket observations of comets were hampered by the very short time scale for the apparition of a reasonably bright comet. Two *Aerobee* payloads were prepared and launched (within about a two-week period) to observe the sun-grazing comet Ikeya-Seki in 1965 but were not sufficiently baffled to keep scattered solar UV radiation from contaminating the data. The extended cometary hydrogen Lyman-α (λ = 1216 Å) envelope (the result of the H atoms attaining a high velocity as a result of H_2O or OH photodissociation) was discovered by two orbiting observatories, OAO-2 and OGO-5, in observations of comets Tago-Sato-Kosaka 1969 *IX* and Bennett 1970 *II* in 1970. This Lyman-α envelope was first directly imaged from a rocket experiment launched in January 1974 to observe comet Kohoutek 1973 *XII* (Opal *et al.* 1974), whose discovery nine months earlier had allowed sufficient time to design and build rocket payloads specifically optimized for cometary UV work. Another rocket, a few days earlier, spectroscopically detected a large abundance of neutral carbon atoms in the coma (Feldman *et al.* 1974). In both of these experiments, the earth's limb was used to occult the sun while still permitting observations to be made at relatively small solar elongation (~ 20°). These experiments were repeated two years later, along with two other rocket launches, for comet West 1976 *VI* and provided the first comprehensive cometary spectra in the wavelength region from 1200 to 3200 Å (Feldman and Brune 1976; Smith *et al.* 1980).

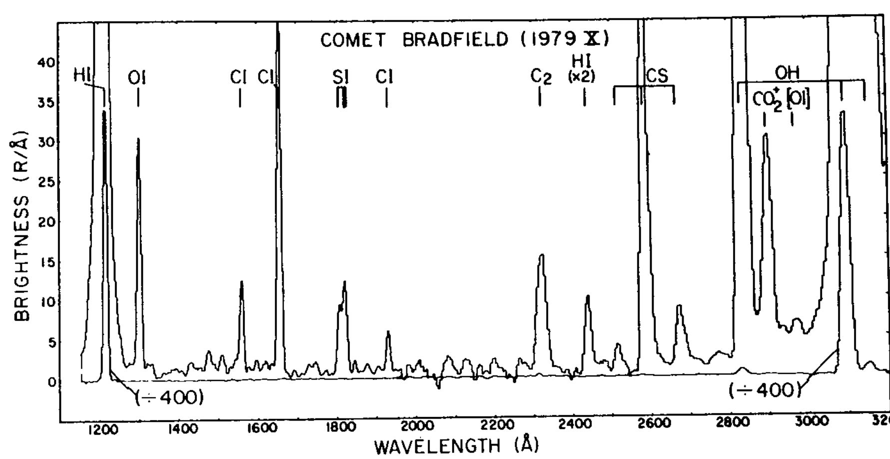

Figure 1. Composite ultraviolet spectrum of Comet Bradfield (1979 *X*) obtained by the *IUE* satellite observatory on 10 January 1980 at which time the comet was 0.71 AU from the sun and 0.62 AU from the earth.

The presence of an orbiting ultraviolet observatory, such as *IUE*, launched in January 1978, alleviates most of the problems associated with sounding-rocket observations of comets and additionally makes possible the study of the evolution of the coma as the comet races past the sun. However, there are some constraints, such as the solar avoidance cone (originally 45° but now 55°), which prevents observations of comets at heliocentric distances < 0.8 AU, and the relatively small field-of-view of the *IUE* spectrograph apertures ($10'' \times 20''$). The UV emitting species in the coma have scale lengths of $10^5 - 10^6$ km (at 1 AU) and hence appear to fill several arc-minutes across the sky (Opal *et al.* 1974). Nevertheless, *IUE* has observed nearly two dozen comets, both by U.S. and European teams, and has provided a wealth of new information and new surprises, even though there has not been a single apparition of a bright, dusty comet since comet West in 1976. These results have been recently reviewed (Feldman 1983, 1984) and only a few highlights are discussed below.

The most studied comet by *IUE* was comet Bradfield 1979 *X*, and a "typical" UV spectrum of this comet is shown in Figure 1. All of the principal UV species are identified in the figure (Weaver *et al.* 1981), and, in contrast with the spectrum of comet West, only CO^+ (~ 2200 Å) and C^+ (1335 Å) are absent from the spectrum. Of course, CO^+ is easily seen from the ground in the blue comet-tail bands and comet Bradfield showed only a very weak ion tail and no dust tail, in contrast to the spectacular ion and dust tails associated with comet West (Koutchmy and Lamy 1978). The small field-of-view makes possible the determination of scale lengths by measuring the spatial distribution of the emission within the $10'' \times 20''$ aperture (the spatial resolution is $\sim 5''$), as in the case of CS (Jackson *et al.* 1982), or by taking offset exposures at angular distances large compared to the slit size (Weaver *et al.* 1981). One unexpected result was the variation of the water production rate, derived from the OH surface brightness, with heliocentric distance. Over the range 0.71 to 1.5 AU, this production rate was found to vary as $r^{-3.7}$, whereas the traditional water-ice vaporization model would predict nearly an r^{-2} dependence (Weaver *et al.* 1981). Similar behaviour was also seen for comet Austin 1982 *VI*. In the case of periodic comet Encke, comparison of pre-perihelion observations in 1980 with post-perihelion data obtained in 1984 showed the OH production rate to be nearly symmetric about perihelion in sharp contrast with the well-known asymmetry of the visual light curve (A'Hearn *et al.* 1985). Moreover, the impurity product CS was found to mimic the asymmetry of C_2 and CN, so that the impurity species appear to be non-uniformly distributed in the cometary ice. Previously it had been thought that the asymmetry in the light curve was the result of different amounts of exposed ice on the different "hemispheres" of the comet, the rotation axis being aligned so that one hemisphere faced the sun before perihelion and the other after perihelion (Whipple and Sekanina 1979).

The most surprising result was obtained during the 1983 apparition of comet IRAS-Araki-Alcock 1983 *VII*, when our *IUE* observing shift was scheduled to begin at the time of closest approach of the comet to Earth (0.032 AU). This was coincidentally the time of an outburst (as monitored by the *IUE* Fine Error Sensor) during which a new cometary species, S_2, was first discovered (A'Hearn *et al.* 1983). The high spatial resolution achieved at the comet (~ 100 km) made the detection of S_2 possible, and it was inferred that S_2 had a scale length of ~ 450 km and was produced directly from the cometary ice. This was the first detection of the sulfur dimer in any celestial object, including interstellar molecular clouds (in which a number of other sulfur-containing molecules have already been detected). The presence of S_2 (or possibly elemental sulfur) in cometary ice has raised some interesting questions regarding the region of formation of comets in the primordial solar nebula and also about the irradiation history (by cosmic-rays or galactic x-rays) of comets since their formation.

The current apparition of Halley's comet will produce a new wealth of ultraviolet observations, some to be made by instruments with order of magnitude improvements in sensitivity and resolution over those used in some of the investigations described above. UV observations will be made from sounding rockets, the *Space Shuttle*, the Soviet *VEGA* spacecraft, and from the orbit of Venus (*Pioneer Venus Orbiter*). *IUE* will monitor the activity of P/Halley from mid-September 1985 through July 1986, and should provide a measure of the evolution of the gaseous coma to complement the other, more time-limited, measurements. Perhaps most exciting will be the results from *ASTRO-1*, scheduled for launch on the *Space Shuttle* on March 6, 1986. *ASTRO-1* carries three state-of-the-art UV telescopes for spectroscopy, imaging, and polarimetry, and will devote a fair fraction of its resources to P/Halley. As part of *ASTRO*, the Hopkins Ultraviolet Telescope will extend the spectral coverage to wavelengths shorter than 500 Å and will make possible the detection of the noble gases He, Ne, and Ar, if they are present in any reasonable abundance, in the cometary ice. Moreover, the *ASTRO* mission will be observing P/Halley at the times of encounter by the *VEGA-2* and the European *Giotto* spacecraft, and thus for the first time it will be possible to correlate the remote observations, principally of the daughter species, with *in situ* measurements of the parent molecules. While the *HST* will not be in orbit in time for this apparition of P/Halley, in the future we can look forward to vacuum ultraviolet observations of comets by *HST* with higher spatial and spectral resolution than heretofore.

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THE LIGHT CURVE OF PERIODIC COMET WILD 2

Charles S. Morris
International Comet Quarterly

Periodic comet Wild 2 is of particular interest to astronomers because it is the prime candidate for NASA's Comet-Rendezvous/Asteroid-Flyby (CRAF) mission, which has been proposed as a new start for fiscal year 1987. The comet was discovered in 1978 January by Paul Wild on a photograph taken with the 40-cm Schmidt telescope at the Zimmerwald Station of the Astronomical Institute of the University of Berne. It was quickly recognized as a new short-period comet with a revolution period of 6.2 years and a perihelion date of 1978 June 15.9 UT.

The comet (1978 *XI*) was observed visually from early February until late June of 1978. However, visual magnitude estimates are only available through early June. Thus, the available data only represent the pre-perihelion light curve. During the period of observation, the comet brightened slowly from magnitude 11.5 to 10.5 as it headed toward the sun. P/Wild 2 was typically described as a slightly-to-moderately-condensed object of 1′–2′ diameter. A short tail was also noted by some observers.

P/Wild 2 (1983s) was also observed visually during its recent return in 1984. This was a much poorer return, and, as a result, only 4 magnitude estimates were reported. All of these observations were made in 1984 April, with the comet a full four months from perihelion. The comet was described as a minute of arc or less in size and slightly condensed. The 13th-magnitude object was somewhat fainter than expected. Further observations were not possible because P/Wild 2 moved into conjunction with the sun.

Bortle (1978) analyzed 22 of his own observations to obtain the following photometric formula for P/Wild 2 in 1978:

$$H = 6.51 + 13.96 \; log \; r,$$

where H is the comet's heliocentric magnitude (which is corrected for the comet's geocentric distance) and r is the comet's heliocentric distance. In this power-law formula, H_o, the absolute magnitude, is 6.51, and n, the power-law exponent, is 5.58.

In the present study, a total of 49 visual magnitude estimates from 1978 and 4 from the 1984 return have been analyzed. The observers, their *ICQ* Key designations, and the number of observations made are listed below.

OBSERVERS OF P/WILD 2 IN 1978

Observer (Code)	Number of Observations Used
J. Bortle (BOR)	22
S. O'Meara (OME)	13
G. Hurst (HUR)	5
J. Morgan (MOR02)	5
A. Jones (JON)	2
C. Morris (MOR)	2

OBSERVERS OF P/WILD 2 IN 1984

Observer (Code)	Number of Observations Used
C. Morris (MOR)	3
A. Hale (HAL)	1

The magnitude estimates were reduced to a standard aperture of 6.78 cm, using the aperture corrections for reflectors and refractors derived by Morris (1973).

Figure 1 depicts the heliocentric brightness of P/Wild 2 as a function of *log r*. The straight-line power-law solution indicated on the figure was derived from the 1978 data. This solution gives

$$H = 6.34 + 14.62 \; log \; r,$$

where $H_o = 6.34 \pm 0.10$ (p.e.) and $n = 5.85 \pm 0.18$ (p.e.). As might be expected, these results are similar to those found by Bortle. However, the resulting light curve is much more complete with the additional data points.

The 1984 data are also shown in Figure 1. Assuming the same value of n in 1984, $H_o = 6.7$. Whether or not this apparent fading is real can not be determined, as the 1984 data points fall within the range of fluctuations/scatter of the 1978 data.

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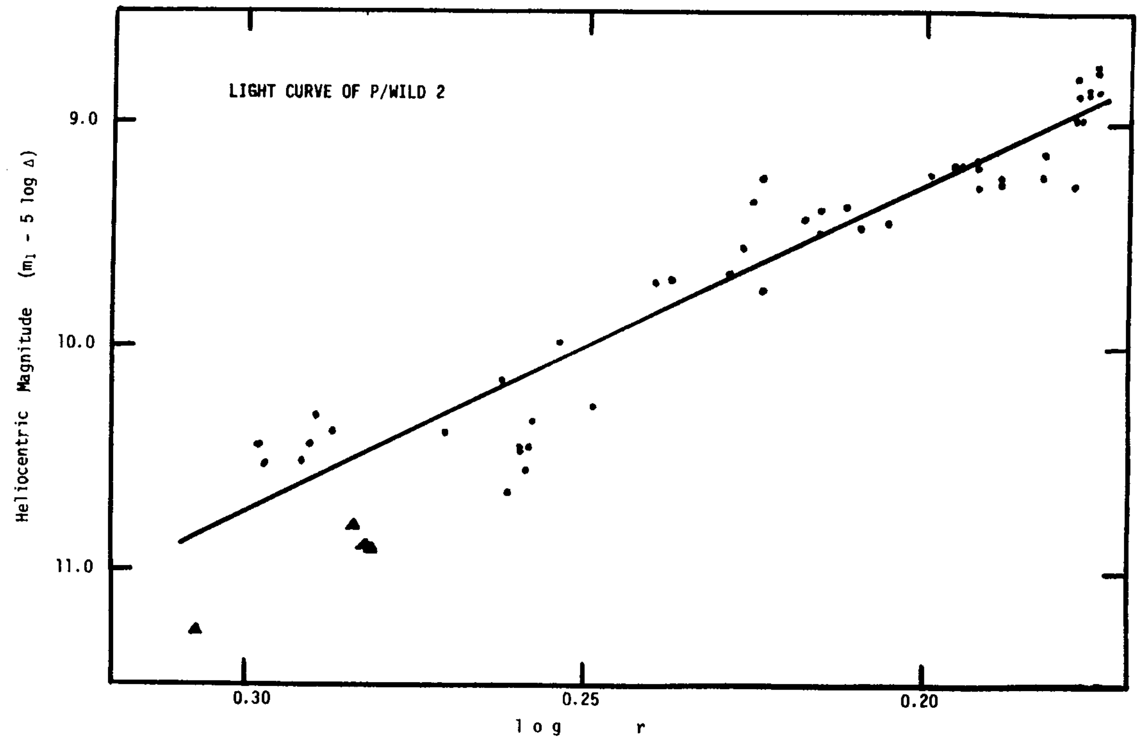

Figure 1. Light curve of P/Wild 2 in 1978 (dots: •s) and 1984 (triangles: ▲s). Straight line is the 1978 power-law solution discussed in the text.

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COMETS FOR THE VISUAL OBSERVER IN 1986

Alan Hale
Los Angeles, California

The deluge of bright short-period comets which have kept comet observers busy since the beginning of the 1980s will reach a dramatic peak in early 1986, as periodic comet Halley makes its long-anticipated return. A couple of very faint periodic comets should also be visible during the first months of the year, but once P/Halley is out of sight, the era of the observable short-period comets will be over for at least a year. Ephemerides for the objects described here will be published in the *ICQ* as the season for their observability approaches.

P/Halley 1982i

The year 1986 will begin with this famous comet in the evening sky, fairly high up at sunset, and presumably just visible to the naked eye as an object of magnitude 5 or 6. It will rapidly sink lower in the western sky as it approaches its February 9.45 ET perihelion, and will be lost in the twilight sky about the fourth week of January. The comet will probably be unobservable for approximately a month.

P/Halley will reappear in the morning sky at the end of February, and will move rapidly to its April 11 opposition. Unfortunately for northern hemisphere observers, the comet's declination at that time will be about -45^{o}, placing the comet very low near the southern horizon. Southern hemisphere observers, however, will have the comet superbly placed, nearly overhead at midnight in mid-April.

Brightness predictions for this period are abundant in the current literature. Some recent studies (e.g., Bortle and Morris 1984) predict a maximum brightness as bright as magnitude 2 for early April. Expected tail lengths are in the range 20^{o} to 40^{o}. While the comet might well be fainter than this prediction, it should nevertheless be a spectacular sight for well-placed, experienced observers.

Following opposition, P/Halley will be moving northward and fading, and should be conveniently placed in the evening sky during May. It should be visible telescopically until August, when it will become lost in twilight, the magnitude then being approximately 10 or 11. Observers with large telescopes may possibly be able to glimpse the comet in the morning sky at the end of the year, when it might be about magnitude 13.

P/Halley will be met by an international fleet of spacecraft at this return. The Soviet probes *Vega 1* and *Vega 2*, the Japanese probe *Planet A*, and the European Space Agency's *Giotto* will be encountering the comet during early March. Another Japanese probe, *Sakegake*, will be studying the comet from a distance. The American *Pioneer Venus* spacecraft will also be observing the comet, as will the *Pioneer 7* probe, launched in 1966, which will fortuitously pass 0.2 AU from the comet in late March. The *International Cometary Explorer (ICE)* will be taking upstream solar-wind-particle measurements, following its encounter with P/Giacobini-Zinner in 1985 September. Neither of these last two spacecraft contains any imaging equipment.

Visual observations at the time of this writing (late August 1985) show the comet to be about magnitude 13, reasonably consistent with most pre-perihelion predictions. Updates of the comet's status during this apparition will be appearing in the *ICQ*.

P/Ashbrook-Jackson 1985a

This intrinsically-bright, 7.5-year-period comet was recovered on 1985 March 20 by A. C. Gilmore and P. M. Kilmartin at Mount John University Observatory. It will pass perihelion on 1986 January 24.4, but at that time will be on the far side of the sun. Observers with large telescopes might be able to locate it during the first half of January, when it will be low in the western sky during the early evening. On January 5, P/Ashbrook-Jackson will be 11.5° south of P/Halley.

The brightness formula determined by Bortle (1979) from observations made during the comet's well-observed 1978 return predicts a magnitude of about 13 during this period. Initial observations by the author (in early August 1985) indicate this light curve to be approximately correct.

P/Boethin

This 11-year-period comet, making its first return since its discovery in 1975, is predicted to pass perihelion on 1986 January 19.9. Brightness predictions for this return are uncertain; while the observing circumstances will be quite similar to the discovery apparition, it is not impossible that its brightness then might have been due to a pre-discovery flare. If the comet should behave in brightness at this return as it did in 1975, a maximum magnitude of 11-12 may be expected to occur during the latter part of January.

P/Boethin will be in the evening sky during January, along with the above two comets. It will have passed 2.5° north of P/Ashbrook-Jackson in mid-December 1985, and will be 9.5° south of P/Halley on January 1.

P/Wirtanen

To the author's knowledge, this intrinsically faint, 5.5-year-period comet has never been observed visually. The recent returns have been very poor, with the comet barely recovered in 1974 and missed entirely during 1980. In 1986, P/Wirtanen will pass perihelion around March 19.8, at a distance of 1.084 AU. In early March it should be accessible in the evening sky some 40° from the sun, with a brightness perhaps as bright as magnitude 13.

P/Schwassmann-Wachmann 1

During 1986, this comet will travel through the rich Milky Way region in the Sagittarius "Teapot", and will pass opposition at the end of June. As was the case in 1985, the southerly declination (−30°) may hamper northern hemisphere observers, while all observers will be hindered somewhat by the rich star fields. The comet has continued the pattern of inactivity which it has exhibited during the past several years. No 1985 activity has been reported as of this writing (late August), and in fact no activity at all has been reported since early 1983.

Shoemaker 1984f

Discovered as long ago as May 1984, this intrinsically bright long-period comet will pass opposition in January 1986, having passed perihelion on 1985 September 4.7. At the time of opposition, the comet will be in the southern circumpolar skies and unobservable from the northern hemisphere. Observations by C. S. Morris and the author at the 1985 opposition indicate a magnitude between 11 and 12 should hold around the January opposition. The comet will then move northward and begin fading. It will pass superior conjunction during mid-June, and observers with large telescopes may possibly pick it up in the morning sky as a 14th-magnitude object during the last few months of the year.

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LETTER TO THE EDITOR: Some Notes on Comet Hunting

In my previous letter (*ICQ* **7**, 47), I did not include the topic of my visual discoveries. I will add a few notes here, at the request of the Editor of the *ICQ*.

My comet patrol began on 1950 August 13, using a 10-cm reflector (at 25×, actual field of view < 2°) at my home in Kochi City, whose population then was ~ 180,000. I looked over the western sky at dusk and the eastern sky at dawn. Overlapping about one-third of the visual field, I searched 60° horizontally and 50° vertically. The observable limit was ~ 11th magnitude.

There were, I think, enough capabilities within my telescope to discover comets, for I could see nebulae of 10th magnitude very well. However, I did not have good luck. I then used a 15-cm $f/6$ reflector from 1952 to 1960. Although I discovered P/Crommelin independently on 1956 October 5, I did not have any other new discovery. Upon my "discovery" on Oct. 5.75 UT, P/Crommelin was at $m_1 = 10.5$ and 5′ in diameter, and was located northward from the predicted position by 10°. (An impressive event to me besides that comet was that I could see P/Schaumasse by naked eye in 1951 February.)

In 1961 September, I moved to using a very efficient 9-cm comet-seeker (at 17×), which had a wide field-of-view of $3\frac{1}{2}^{\circ}$. Only after 1000 hours of observation in 11 years (since 1950) did I find comet Seki 1961*f*, using this new telescope, on 1961 October 10. I estimated the magnitude (to $\pm\frac{1}{2}$) by defocusing comparison star images slightly.

Even now I sometimes search for comets with a 12-cm binocular. Geisei's sky is so dark that I am certain that I can find another comet if I work hard. Since I hear that Mr. Ikeya, my old rival, also looks for comets by binoculars sometimes, perhaps we will find the third comet Ikeya-Seki soon!

◇ *Tsutomu Seki*, Geisei, Japan, 1985 March 9

[*translated by Ikko Fushiki, Center for Astrophysics*]

BOOK REVIEW: HALLEY'S COMET — A BIBLIOGRAPHY

Halley's Comet: A Bibliography *(1984). R. S. Freitag, compiler. Library of Congress, Washington, 585 pp., hardbound, $26.00 (order stock number 030-000-00158-3 from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402).*

Ruth Freitag has done an admirable job in compiling this bibliography of published sources for P/Halley material. A Library of Congress press release said the volume "lists 3,289 references to the popular as well as the voluminous scientific literature on the comet. Works in most European and some Oriental languages are represented . . . [and] the book contains 20 illustrations, a [brief] historical introduction, a list of bibliographic sources, many annotations, and name and topical indexes." The 20 illustrations are most interesting, including (for example) a page from *The Canterbury Psalter* (a manuscript from the mid-12th century), showing what may be P/Halley as it appeared in 1145, and also two pages from Edmund Halley's notebook detailing his personal observations of P/Halley in 1682.

With an index of this nature, it is very difficult to determine the best format to use in listing sources. At the Central Bureau for Astronomical Telegrams, we have had, for many months now, a list of all titles published on the *IAU Circulars* from *No.* 1 through the present, and have been planning to publish an index for the first 4000 *IAUCs*; however, the process of deciding how everything should be listed has prevented a published index from appearing thus far. In the *Preface* to her book, Freitag notes, "Citations are arranged alphabetically by main entry, whether author or title, according to the *Filing Rules for the Dictionary Catalogs of the Library of Congress*". It seems that when no author could be located, items are listed by title, and this would present problems – were it not for the two lengthy indices at the end of the book. Freitag obviously put a lot of work into the *Bibliography*; she does state in her *Introduction* that she "could not in good conscience call the end result 'comprehensive', being too well aware of the quantity of published material for which my information was unacceptably incomplete." While an attractive book, the price seems unusually high for a U.S. Government Printing Office book; with this in mind, I can recommend this to librarians and serious students and admirers of P/Halley.

There are some errors in the book, and a 2-page Addenda sheet is supplied with the book. I would point out one problem with the bibliographic listing: both Brian G. Marsden and myself are listed several times as authors for *IAU Circulars* in which P/Halley observations or orbital calculations were actually made by other astronomers; we should not have been listed at all, since we were only the editors of the *IAUCs*, and the observers and computers should have been listed as authors (unfortunately, they were not, although Freitag does include them in the "Name Index" at the end of the book).

— Daniel W. E. Green

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FROM THE EDITOR

Subscribers will note that we have increased our subscription rates, effective immediately, to offset rising computer, printing, and postage costs. We are finally forced to raise overseas rates above that of domestic rates for special subscribers. Also, a new billing procedure is being instated now to reflect the new subscription/accounting setup, and regular subscribers will note the unambiguous nature of the new invoices. The new rates are published on the second page of this issue. Subscriptions paid prior to the publication of this issue will be permitted to run their course at the old rates for up to one year. One year from now, *all* subscriptions will be at the new rates (including those entered by subscribers recently for two or more years), so that extended subscriptions (which we discourage) will not last for the period which was anticipated when payment was made.

Despite our attempts to stick to a rigid publication schedule, our printer at Appalachian State University (who is not in the Department of Physics and Astronomy) really held up the July issue; he had lost a page, but nonetheless proceded to completely print up the July issue without its second page, and we forced him to re-print the entire July issue from scratch. Such delays will be prevented, hopefully, in the future. (For the information of many concerned subscribers, the July issue was mailed on September 20.)

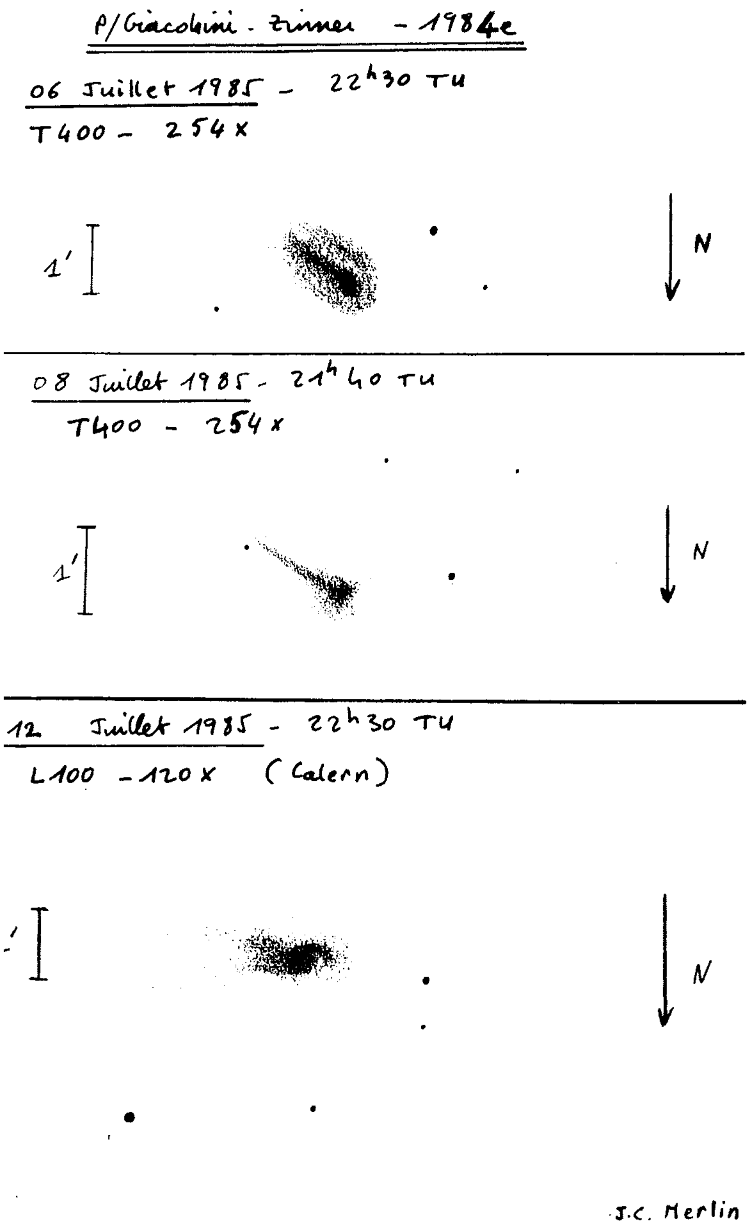
We were planning to publish an article concerning the observability of P/Halley at its current return, but so much has been published elsewhere that we feel it appropriate to simply provide ephemerides. Alan Hale's article in this issue discusses P/Halley for 1986, and other articles (including the regular column, "Recent News and Research Concerning Comets") and the Tabulation of Comet Observations in each issue will give the reader much information. While P/Halley will doubtless provide a tremendous number of observations for the *ICQ* to publish, we do not wish to ignore the other observable comets, either.

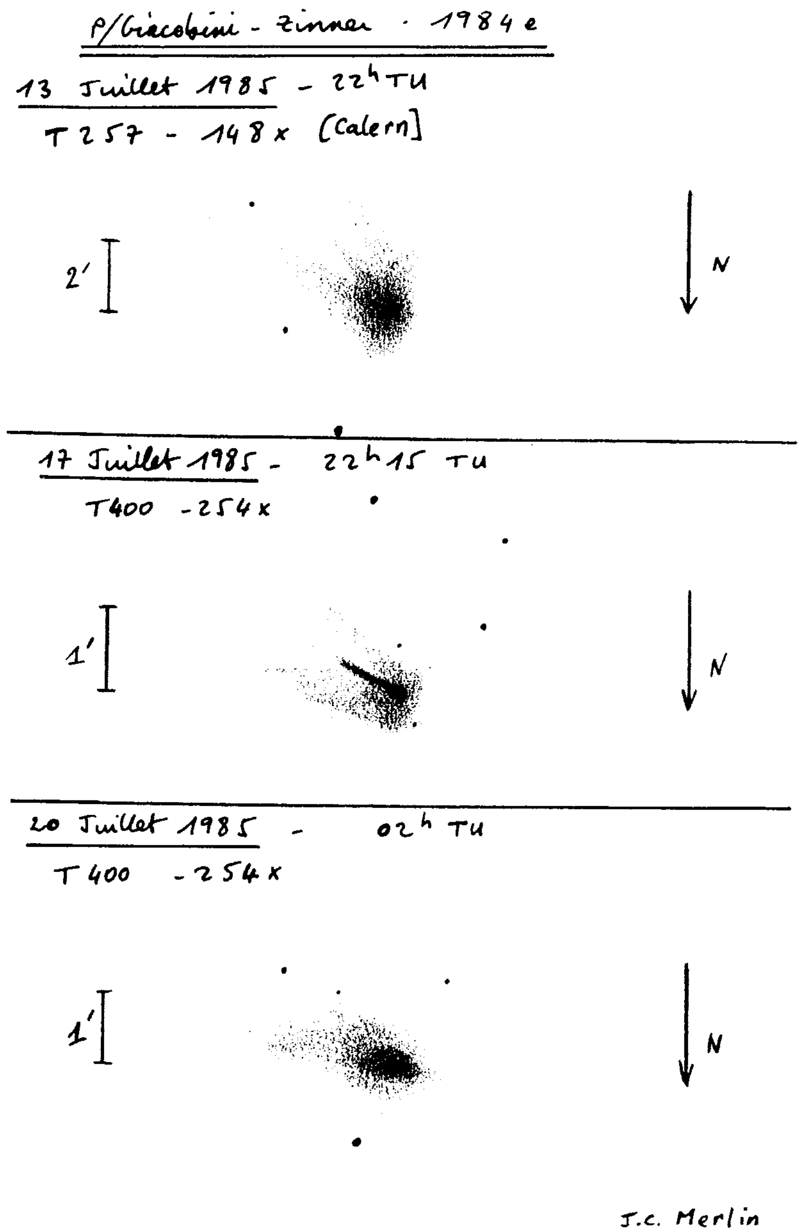
Readers will also note the type-set appearance of the text in this issue, a result of our new Imagen laser printer connected to the Digital VAX of the Center for Astrophysics. I thank Barbara L. Welther of the CfA for her help in providing some helpful information on the road to producing the double-column output which you are now reading. We plan to continue using the laser printer for all articles, but there are still severe problems with conveniently printing out tables of our cometary observational data using the same typeface; we must therefore continue printing data out with our NEC Spinwriter until a solution is reached – thus the reason for two different sets of type in this issue.

— Daniel W. E. Green (Cambridge, MA, 9/21/85)

DRAWINGS OF P/GIACOBINI-ZINNER 1984e

Below are six drawings of periodic comet Giacobini-Zinner on 1985 July 6.94, 8.90, 12.94, 13.92, 17.93, and 20.08 UT, by J.-C. Merlin with a 40-cm reflector. More of his drawings will be published in the next issue.





RECENT NEWS AND RESEARCH CONCERNING COMETS

Daniel W. E. Green
Harvard-Smithsonian Center for Astrophysics

P/Halley 1982*i* has emerged from the glare of solar conjunction and is brightening as it moves through the morning sky towards opposition in mid-November. Photographs obtained by Richard West (40-cm astrograph, European Southern Observatory) and by James Gibson (60-inch reflector and CCD, Palomar Mountain) on July 19 and July 27-29, respectively, showed the first recorded images (at $m_1 \sim 16$) of P/Halley since April (when the magnitude was close to 19). Gibson reported a 22″ coma.

Visual observers quickly located the comet, with Charles S. Morris and Steve Edberg being the first post-conjunction visual observers on July 27.48, when they estimated $m_1 \sim 15.0$ with the 24-inch $f/16$ Cassegrain telescope of Table Mountain Observatory near Los Angeles. The comet gradually brightened to $m_1 = 14$ by mid-August and to $m_1 = 13$ by the first or second week in September. From there it began to accelerate in brightness, as it moved closer both towards the earth and sun, reaching $m_1 \sim 11.5$–12.0 by late September. During August and September, P/Halley showed a noticeable central condensation of magnitude ~ 14 to visual observers, with a growing fainter coma surrounding. The coma was very tenuous and difficult in 8-inch to 20-inch telescopes in August, but the surface brightness increased remarkably in September. Between September 14 and 17, the author noted a definite brightening of the coma in an 8-inch $f/6$ reflector, with the comet being near the limit of detection on the former night but easily seen steadily on the latter occasion. Some visual observers were also noting a pronounced elongation in September, as a tail was evidently forming.

In addition to the increasing size of P/Halley's coma from $\sim 20''$ in July to $\geq 2'$ by late September, astronomers at McDonald Observatory and elsewhere were finding rather strong emission from CN, C_2, and C_3. On Aug. 23.49, P. J. McCarthy and colleagues at Lick Observatory found "a well-developed coma extending some 1.5′ from the nucleus" and that "C_2 emission extends over at least 2′" on CCD images taken with the Shane 3-m reflector (*IAUC* 4104). The *OH* radical was detected in P/Halley at with the Nançay Radio Telescope in late August by D. Bockelée-Morvan and others of the Paris Observatory (of Meudon, France). Spectral observations made by Mercedes Prieto, Mark Kidger, and John Beckman with the 100-inch Isaac Newton Telescope at La Palma in the Canary Islands on September 26 showed strong CN emission out to a radius of 3.9′ (the maximum length possible for the slit size), and from the fading of the lines, they estimated the coma diameter to be as much as $9' - 10'$, considerably larger than the $\sim 2'$ coma sizes reported by visual observers.

Susan Wychoff (Arizona State University) and four other authors reported (*Nature* **316**, 241) that they think that continuous sublimation of P/Halley's nuclear ices did not begin until the comet reached a heliocentric distance of $r \sim 6$ AU (or "sometime between mid-1984 and early 1985"), based mostly on V magnitudes (generally obtained with CCD cameras attached to large reflecting telescopes). Others have noted that some sort of coma activity was probably evident upon P/Halley's recovery in October 1982, and the wide apparent variations in brightness seem to support some (perhaps non-continuous) such coma activity. It will take the post-perihelion monitoring of the comet to provide more evidence one way or the other before more certainty can be had; a large question pertains to the validity of the magnitude of the reported variations in P/Halley's light curve: it is unclear whether instrumental differences play a large role in the apparent variations visible while the comet was at $r > 6$ AU.

Rudolph Schild, Center for Astrophysics, observed comet 1982*i* on 1985 February 16 (when $r = 4.9$ AU) with a CCD and the 61-cm reflector of the Whipple Observatory in southern Arizona. He noted a definite coma which appeared to be more prominent on the sunward side of the nucleus, and he determined V = 19.91 and R = 19.55 at Feb. 16.127 UT.

P/Halley's brightness is not far from the predicted light curve published by Morris and Green (1982, *A. J.* **87**, 918), but the brightness behavior of P/Giacobini-Zinner 1984*e* has been a little more puzzling. The total magnitude (m_1) data of this latter comet has much scatter during its favorable 1985 apparition, due largely to its large size. Comet 1984*e* has displayed a rather bright ($m_1 \sim 7.5$ in August) coma, but its outer boundaries have been quite tenuous and difficult to discern — size estimates correspondingly vary from $\sim 2'$ to $\sim 14'$ across in August alone, and those observers seeing the larger coma diameters were also reporting considerably brighter magnitudes (see the *Tabulation of Comet Observations* elsewhere in this issue).

The *ICE* encounter with P/Giacobini-Zinner on September 11 (Brandt 1985) was quite a success, from first reports. As Fred L. Whipple has noted, this was really not so much a study of a comet as it was a study of plasma environments in space. The influence of the comet at the spacecraft's detectors prior to flyby was clear when *ICE* was still 0.8 million km from the comet's nucleus. Also, there now seems to be some question as to whether or not the comet has a bow shock, as observations suggest that "the comet plasma may act as a soft cushion that gradually slows the solar wind without a bow shock" (Kerr 1985). Speaking of an interaction region, then, instead of a bow shock, this was a considerable amount of turbulence in this region, with much plasma instability. Neutral gas molecules apparently move outward from the nucleus, unaffected by the solar wind, at relatively low velocities (~ 1 km/s), and are then ionized and quickly accelerated to high energies and velocities (~ 400 km/s) by the solar wind; the solar wind would also be gradually (not abruptly) deflected by the coma as it reaches denser regions of plasma closer to the comet's nucleus, and this interaction region may move back and forth, depending on varying gas production from the nucleus itself.

(Continued on page 108)

TABULATION OF COMET OBSERVATIONS

In the July issue, we began publishing A.L.P.O. data for comets observed in the 1960s. We will continue publishing such data from the 1960s and early 1970s over the course of the next several issues. Two large boxes of A.L.P.O. comet observations have been loaned to the Editor by Dennis Milon (former A.L.P.O. Comets Section Recorder) *en route* to their transfer to David Levy (the new Recorder), so that they can be published; most of these A.L.P.O. observations are being published for the first time. We also include more of Albert Jones' observations in this issue, as part of an on-going program in which he is submitting all of his *ICQ*-unpublished data (going back several decades) for publication.

DESCRIPTIVE INFORMATION CONCERNING COMETS (to complement the tabulated data):

P/Crommelin (1956 *VI*): Albert Jones (JON) observed the comet "low and in twilight" on 1956 Nov. 9.64.

P/Tempel 2 (1967 *X* = 1983 *X*): Jones (JON) noted (31.7-cm *f*/5 reflector, 86×) on 1967 Sept. 3.44, DC = 3; Sept. 4.48, coma size 3′, DC = 5, 11.9-magnitude "stellar nucleus"; Sept. 5.46, coma size 3′, DC = 5, small nucleus displaced in p.a. 135°; Sept. 27.45, small nucleus, DC = 5; Sept. 30.44, DC = 5, Oct. 1.47, DC = 4; and Oct. 4.44, DC = 4. On 1983 May 23.74, with the same instrument specifications, Jones found the coma diameter as 1.5′ − 2′, and DC = 0-1; on June 20.75, he found coma size 1.5′ and DC = 1; and on June 21.75, he found coma size 2′ and DC = 1.

P/Kopff (1983*XIII*): Jones (JON) found (31.7-cm reflector, 86×) on 1983 June 14.47, DC = 5; on June 15.33, coma size 3′, DC = 5-6; on June 30.33, coma size 2′ and DC = 5-6; July 3.33, coma size 3.5′, DC = 4; July 6.43, coma size 3.5′, DC = 2; July 11.45, DC = 5-6; July 12.35, DC = 3; Aug. 4.43, coma size 2′, DC = 2-3; Aug. 6.39, coma size 2′, DC = 2-3; Aug. 11.34, coma size 2′, DC = 2-3; and Aug. 13.43, coma size 1′, DC = 2.

Austin (1984*i*): C. E. Spratt (SPR) notes that on 1984 Sept. 29.42 the comet was "V-shaped".

P/Halley (1982*i*): Unsuccessful attempts to observe this comet were made by R. H. McNaught (MCN) on July 24 and 25 (32-cm reflector), "even though stars below magnitude 14 were visible near the comet's position" [from D. Seargent]. On 1985 Sept. 17.05 UT, Mauro Zanotta (ZAN) noted a disk-like condensation with a 30.5-cm reflector; the following night at 300×, he saw a smaller central condensation of magnitude about 14.5. J.-C. Merlin notes a nearly-one-magnitude difference between comparison stars on AAVSO SU Tau chart and IHW (Stanton revised) SU Tau chart. Charles S. Morris (MOR) notes of his Aug. 10 observation: "A stellar condensation (m_2 = 16 or fainter) was glimpsed ... slightly offset toward the northeast." On Aug. 25, Morris noted: "A faint condensation was glimpsed (m_2 = 15). Stephen J. O'Meara (OME) found an eastward fan in the inner coma on Sept. 14.3 (20.3-cm *f*/6 reflector, 116×), and noted jets in p.a. 40° (15″ long) and 130° (10″ long) on Sept. 26.3 (23-cm *f*/12 refractor, 240×).

P/Ashbrook-Jackson (1985*a*): McNaught (MCN) noted "coma possibly open to the east" on July 19.65, and on July 26.717, he found the comet "even smaller and fainter" than on previous nights and "almost like a star at 76×".

P/Giacobini-Zinner (1959 *VIII*): Albert Jones (JON) noted a 9.9-magnitude condensation on 1959 Oct. 31.41 in a 31.7-cm *f*/5 reflector at 86×; on Nov. 17.43, he noted a 10.5-mag condensation and 11.0-mag nucleus; and on Nov. 25.49 he noted an 11.3-mag nucleus.

P/Giacobini-Zinner (1984*e*): Morris (MOR) noted from July 17–Aug. 12 that the coma "showed a 'bulge' on the south side" and on Aug. 12 (61-cm Cassegrain) that a "condensation appeared bumpy, suggesting jets". During Aug. 18-25, Morris noted (20 × 80 binoculars) "a fan tail extending from the main tail ... toward the north (p.a. 30° − 40°) with a length of 10′ − 15′." Mauro V. Zanotta (ZAN) found the comet "circular and diffuse, with a star-like central condensation" on July 14.94; "diffuse with outer coma elongated toward p.a. 250°" and "at 94 × ... a star-like central condensation" on July 17.94; "at 300 × ... a circular central condensation whose diameter was 0.4′" on July 21.98; "at 250 × ... a circular central condensation whose diameter was 0.4′" on July 22.98; a "narrow straight tail and a central condensation of magnitude ≃ 12.0" on July 23.02; a fan-shaped coma with "a central condensation whose diameter was 0.5′ (94×), which at 150× became visible as a star-like nuclear region" on July 23.95; "a central condensation whose diameter was 1.2′" on Aug. 19.04; "at 60 × ... a circular central condensation with a star-like central point" on Aug. 21.07; and (in 30.5-cm *f*/5 Newtonian reflector at 60×) "a circular central condensation (diameter 0.9′) with a smaller and brighter concentric one" and "the coma appeared a little fan-shaped in p.a. 270°" on Aug. 28.07. Richard Ducoty (DUC) found a "star-like nuclear condensation in a parabolic head" and that the comet was "less well seen in UHC and Deep Sky filters" on June 16.42; he noted an "elongated parabolic head" and that the comet "was not seen well with UHC and Deep Sky filters" on June 21.38; he noted "more circular coma", and "stellar condensation with diffuse coma and faint outer coma" on June 30.45; he noted "faint stellar condensation" on July 10.32; he noted "coma flattened and parabolic" on Aug. 7.30; he noted "nucleus near leading edge of fan/parabolic coma" on Aug. 8.31; and he noted "tail not as evident" on Aug. 9.30 and "even less" so on Aug. 12.32. Spratt (SPR) noted a "distinct nucleus" on July 11.24; a "very diffuse center" on July 12.25; "nucleus", "hoods?", and comet "V-shaped" on July 13.27; and "much activity" on July 14.28, with comments similar to those on July 13.27. Andreas Kammerer (KAM01) noted a nuclear condensation near magnitude 12 on July 12.94; an "elliptical coma, major axis SW-NE; more diffuse in the SW" on July 21.91; a "nuclear condensation" of mag 11 on July 24.92; a 3′ "broad extension" as the tail on Aug. 8.90; and a broad fan tail spanning some 30° and a 2′ inner coma with a diffuse weak outer coma on Aug. 14.90. Merlin (MER) found a 0.01°-long tail in p.a. 125° on July 8.92 and p.a. 102° on July 9.89 (40.0-cm *f*/5 reflector, 254×); he found tails of length 0.03° (p.a. 226°) and 0.02° (p.a. 102°) on July 27.05 (same instrument).

Machholz (1985e): Morris (MOR) noted that the comet must have been fainter than magnitudes 7 and 10 on July 8.17 and 12.18, respectively (25.6-cm reflector). Terry J. Lovejoy (LOV) notes that on June 6.805, 8.805, and 10.809, a tail was suspected with averted vision in a 20-cm $f/6.3$ reflector (50×). With the same telescope, Lovejoy saw tails of lengths $0.17^{o}, 0.5^{o}, 0.3^{o}, 0.5^{o}, 0.5^{o} - 1.0^{o}$, and 0.5^{o} on June 11.81, 12.802, 14.802, 15.808, 16.805, and 17.808, respectively; he also notes: "Negative daylight search June 27.1 and 29.1; comet fainter than −2 on first date and fainter than −3 on second." Ian Dixon (DIX01) found a possible jet in the coma with his June 8.76 observation. Maurice Clark (CLA) found "tail mostly faint and narrow (type I) but first 3′ bright and broad (type 2)" on June 13.91. Don Machholz (MAC) searched unsuccessfully for the comet (visually with a 25.4-cm reflector) on July 6.2, 7.2, 10.2, 12.2, 14.2, and 21.2.

P/Hartley (1985f): From David Seargent: "R. H. McNaught (MCN) also reports unsuccessful attempts to observe P/Hartley on June 23.486 and July 19.444 with a 32-cm $f/6.7$ reflector at 76× (also at 214× on July 19). He noted that, on the first night, NGC 4030 was easily seen and, on the second, IC 3831 was observed."

Hartley-Good (1985l): Robert H. McNaught (MCN) found (32-cm $f/6.7$ reflector, 76× and 214×) a condensation as large as ∼ 0.5′ with a coma ∼ 3.5′ diameter on Sept. 13.465.

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A complete explanation to the columns used in the tabulation below, as well as complete Keys to all of the codes and abbreviations used, are available from the Editor for US$4.00 postpaid (use information given on page 86 of this issue for ordering these pages).

NEW ADDITION TO THE OBSERVER KEY (*cf.* ICQ 7, 51):

KAM01 Andreas Kammerer, West Germany

NEW ADDITIONS TO THE REFERENCE KEY:

D = Dutch Comet Halley Handbook (E. P. Bus)
W = International Halley Watch (IHW) version of unspecified AAVSO chart
WA = Special IHW version of AAVSO chart for SU Tauri
WB = Special IHW version of AAVSO chart for CZ Orionis
WC = Special IHW verison of AAVSO chart for Y Tauri
WD = Special IHW version of AAVSO chart for V Tauri

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Comet Austin (1984i)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1984 09 29.42	S	7.9	A	20.0	C	10	65	6.5	4	?	290	SPR
1984 09 30.44	S	8.1	A	14.0	S	4	20	6.0	5	?		SPR

Comet Levy-Rudenko (1984t)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1984 12 01.09	S	8.8	A	20.0	C	10	65	4.5	5			SPR
1984 12 02.09	S	9.0	A	20.0	C	10	65	3.5	4			SPR
1984 12 18.09	S	8.2	A	20.0	C	10	65	4.0	4			SPR

Comet Shoemaker (1984f)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1985 03 17.46	S	12.1	AA	20	L	6	122	0.6	7			HAL
1985 03 30.50	S	11.7	AA	20	L	6	122		6/			HAL
1985 04 11.35	S	11.3	AA	20	L	6	122	1	6/			HAL
1985 05 19.23	M	10.8	AA	20	L	6	122					HAL
1985 05 27.20	S	11.2:	AA	20	L	6	122					HAL
1985 06 08.20	S	11.1:	AA	20	L	6	122					HAL
1985 06 10.43	S	11.3	AA	15.2	L	5	29					SEA
1985 06 13.45	S	11.3	AA	15.2	L	5	29					SEA
1985 06 17.47	S	10.7	VN	20.3	L	6	49	1.0	2/			PEA
1985 06 18.47	S	10.7	VN	20.3	L	6	49	1.2	3	0.15	65	PEA

Comet Shoemaker (1984f) Cont.

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1985 06 19.46	S	10.9	VN	20.3	L	6	49	1	2			PEA
1985 06 20.42	S	11.6:	AA	15.2	L	5	29					SEA
1985 06 23.42	S	11.3	AA	15.2	L	5	29					SEA

Comet Machholz (1985e)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1985 05 28.47	S	9.1	S	20	L	6	61					HAL
1985 05 29.80	S	9 :	AA	8.0	B		15	4	4			LOV
1985 05 30.78	S	9.1	AA	8.0	B		15	3.5	4			LOV
1985 05 31.89	S	8.7	AA	20.3	L	6	38		4			PEA
1985 06 01.47	S	8.8	AA	20	L	6	61					HAL
1985 06 01.89	S	8.6	AA	20.3	L	6	38	3	4			PEA
1985 06 05.80	S	8.4	AA	8.0	B		15	2.2	5/			LOV
1985 06 06.80	S	8.5	AA	8.0	B		15		5			LOV
1985 06 07.80	S	8.4	AA	8.0	B		15	1.9	5/			LOV
1985 06 07.81	S	7.8:	AA	8.0	B		15					SEA
1985 06 08.76	S	7.5	AA	20	T	10	50		5			DIX01
1985 06 08.80	S	8.0	AA	8.0	B		15	3.7	6			LOV
1985 06 10.81	S	7.6	AA	8.0	B		15		6			LOV
1985 06 11.81	S	7.6	AA	8.0	B		15		6/			LOV
1985 06 11.82	S	7.0	AA	8.0	B		15		6			SEA
1985 06 11.90	S	7.1	AA	20.3	L	6	49	2	6			PEA
1985 06 12.80	S	7.1	AA	8.0	B		15	1.6	7			LOV
1985 06 13.80	S	6.9	AA	8.0	B		15		7			LOV
1985 06 13.91	S	6.3	D	41	L	4	86	2	7	0.41	67	CLA
1985 06 13.91	S	6.8	AA	20.3	L	6	49	1.8	6	0.08	245	PEA
1985 06 14.80	S	6.8	AA	8.0	B		15		7			LOV
1985 06 14.83	S	7 :	AA	8.0	B		15					SEA
1985 06 15.33	S	6.8:	S	12.0	B		20	2				BOR
1985 06 15.81	S	8.4	S	12	B		20	& 1.5	7			MCN
1985 06 15.81	S	6.5:	AA	8.0	B		15	1.5	7/			LOV
1985 06 16.80	S	6.6	AA	8.0	B		15		7			LOV
1985 06 16.82	S	6.8	AA	8.0	B		15					SEA
1985 06 16.83	S	7.6	S	12	B		20	& 1	6	&0.07	254	MCN
1985 06 17.81	S	6.2	AA	8.0	B		15	1.5	7/			LOV
1985 06 17.91	S	5.9	AA	20.3	L	6	49	1.5	7	0.13	255	PEA
1985 06 17.92	S	5.9	D	41	L	4	86	2	7			CLA
1985 06 19.83	M	8.0	S	12	B		20	< 1	9	&0.05		MCN
1985 06 23.84		[5		12	B		20					MCN
1985 06 29.08		[-1 :		15.2	L	5	29					SEA
1985 07 08.17	S	[7	AC	25.6	L	4	111					MOR
1985 07 12.18	S	[10	AA	25.6	L	4	156					MOR
1985 07 16.38		[11		12	B		20					MCN
1985 07 19.40		[11		12	B		20					MCN

Comet Hartley-Good (1985l)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1985 09 13.46	M	11.1:	VN	12.0	B		20		0			MCN
1985 09 13.46				32	L	7	76	& 3.5				MCN
1985 09 14.30	S	10.9	AA	20.3	L	6	38	& 1.3	1/			GRE
1985 09 17.26	S	9.5	AA	20.3	L	6	38	& 8.0	4/			GRE

Periodic comet Encke (1961 I = 1974 V = 1977 XI)

DATE (UT)		MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1961 02 16.70		S	8.2	V	7.8	R	8	30					JON
1961 02 16.70		S	9.2	V	31.7	L	5	48		3/			JON
1961 02 19.69					31.7	L	5	48	1.5	3/	?	80	JON
1961 02 19.69		S	8.4	V	7.8	R	8	30					JON
1974 05 25.76		S	8.3	V	7.8	R	8	30					JON
1974 06 01.76		S	8.8	V	7.8	R	8	30					JON
1974 06 02.76		S	8.8	V	7.8	R	8	30					JON
1974 06 17.76		S	12.3	V	31.7	L	5	86	2	2			JON
1974 06 19.77		S	12.5	V	31.7	L	5	86	3	1			JON
1977 09 08.32	*	S	9.6	S	31.7	L	5	86					JON

Periodic comet Grigg-Skjellerup (1977 VI)

DATE (UT)		MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1977 03 19.48	*	S	12.8	V	31.7	L	5	86		1/			JON
1977 03 20.42	*	S	12.5	V	31.7	L	5	86		1			JON
1977 04 02.72	*	S	12.0	V	31.7	L	5	86		1			JON
1977 04 14.71	*	S	11.4	V	31.7	L	5	86		1			JON
1977 04 20.74	*	S	11.7	V	31.7	L	5	86		1			JON

Periodic comet Tuttle-Giacobini-Kresák (1973 VI)

DATE (UT)		MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1973 07 10.32		S	8.9	S	31.7	L	5	86	2.5	1			JON
1973 07 11.33		S	8.9	S	31.7	L	5	86	2.5			110	JON
1973 07 19.32		S	10.6	V	31.7	L	5	86					JON

Periodic comet Tempel 1 (1972 V = 1983 XI)

DATE (UT)		MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1972 06 04.41		S	12.1	V	31.7	L	5	86		1			JON
1972 06 05.33		S	12.1	V	31.7	L	5	86		1			JON
1972 06 06.41		S	12.0	V	31.7	L	5	86		3			JON
1972 06 07.40		S	12.1	V	31.7	L	5	86		2			JON
1972 06 14.39		S	12.1	V	31.7	L	5	86		2			JON
1972 07 02.34		S	12.8	V	31.7	L	5	86		0/			JON
1972 07 08.35		S	12.7	V	31.7	L	5	86		0/			JON
1983 06 02.36		S	11.4	V	31.7	L	5	86	1	2			JON
1983 06 03.33		S	11.3	V	31.7	L	5	86	2	2			JON
1983 06 06.33		S	11.2	V	31.7	L	5	86	1	2			JON
1983 06 14.31		S	11.5	V	31.7	L	5	86	1				JON
1983 06 15.31		S	11.4	V	31.7	L	5	86	1	2			JON
1983 06 25.35		S	9.9	S	31.7	L	5	86					JON
1983 06 30.32		S	11.4	A	31.7	L	5	86		2			JON
1983 07 03.22		S	11.4	A	31.7	L	5	86	1	2/			JON
1983 07 12.33		S	11.8	A	31.7	L	5	86	1	1			JON
1983 08 06.35		S	12.1	A	31.7	L	5	86		3			JON

Periodic comet Tempel 2 (1967 X = 1983 X)

DATE (UT)		MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1967 08 07.41	*	S	9.3	V	7.8	R	8	30					JON
1967 08 07.41	*				31.7	L	5	86	2	2			JON
1967 08 12.45	*	S	9.4	S	31.7	L	5	86		3			JON
1967 09 05.46	*	S	8.1	V	4.5	R	5	7					JON

Periodic comet Tempel 2 (1967 X = 1983 X) Cont.

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1967 09 27.45	* S	8.9	V	7.8	R	8	30					JON
1967 09 30.44	* S	9.5	V	7.8	R	8	30					JON
1967 10 01.47	* S	9.2	V	7.8	R	8	30					JON
1967 10 04.44	* S	9.5	V	7.8	R	8	30					JON
1967 10 18.44	* S	11.3	V	31.7	L	5	86					JON
1967 10 25.47	* S	11.3	V	31.7	L	5	86		4			JON
1967 10 28.46	* S	11.4	V	31.7	L	5	86		3			JON
1967 10 30.42	* S	11.4	V	31.7	L	5	86	2	3			JON
1967 11 01.43	* S	11.3	V	31.7	L	5	86		3/			JON
1967 11 06.44	* S	12.0	V	31.7	L	5	86		3			JON
1967 11 25.49	* S	12.1	V	31.7	L	5	86		1/			JON
1983 05 22.76	S	9.5	S	31.7	L	5	86	1.5	0/			JON
1983 05 22.76	S	9.0	S	7.8	R	8	30					JON
1983 05 23.74	S	9.0	S	7.8	R	8	30					JON
1983 06 06.74	S	9.5	S	31.7	L	5	86	1	1			JON
1983 06 13.75	S	9.0	S	7.8	R	8	30					JON
1983 06 18.77	S	9.0	S	7.8	R	8	30					JON
1983 06 19.75	S	9.0	S	7.8	R	8	30					JON
1983 06 19.75	S	9.3	S	31.7	L	5	86	2	1/			JON
1983 06 20.75	S	9.2	S	7.8	R	8	30					JON
1983 06 21.75	S	9.1	S	7.8	R	8	30					JON
1983 06 23.78	S	9.1	S	7.8	R	8	30		1			JON
1983 07 12.77	S	10.5	A	31.7	L	5	86	1.25	1			JON
1983 07 18.72	S	9.5	S	31.7	L	5	86		1			JON
1983 07 20.75				31.7	L	5	86	2	0			JON
1983 07 21.77	S	10.5	A	31.7	L	5	86	2	0			JON
1983 08 06.75	S	10.6	A	31.7	L	5	86					JON
1983 08 11.75	S	10.6	A	31.7	L	5	86	1	0			JON
1983 08 13.74	S	10.9	A	31.7	L	5	86					JON
1983 08 14.74	S	11.0	A	31.7	L	5	86	1.25	1			JON
1983 08 15.74	S	11.0	A	31.7	L	5	86		0			JON
1983 08 16.69	S	10.9	A	31.7	L	5	86	1.25	1			JON
1983 08 17.69	S	11.0	A	31.7	L	5	86	1	1			JON
1983 08 18.72	S	10.9	A	31.7	L	5	86	& 1.25	1			JON
1983 09 17.72	S	12.4	A	31.7	L	5	86		1			JON

Periodic comet Schwassmann-Wachmann 3 (1979 VIII)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1979 08 21.31	S	11.3	V	31.7	L	5	86		4/			JON
1979 09 25.33	* S	12.6	V	31.7	L	5	86		2			JON

Periodic comet Honda-Mrkos-Padjušáková (1985c)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1985 04 20.88		11 :		41	L	4	165					PEA

Periodic comet Finlay (1960 VIII)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1960 08 21.74	S	10.2	V	31.7	L	5	86	2.5	2/			JON
1960 08 22.74	S	10.2	V	31.7	L	5	86	2.5				JON

Periodic comet Kopff (1983 XIII)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1983 05 19.42	S	10.8	V	31.7	L	5	86	1	1/			JON
1983 05 20.41	S	11.0	V	31.7	L	5	48	1	1/			JON
1983 05 22.71	S	10.8	V	7.8	R	8	30					JON
1983 05 22.71	S	11.0	V	31.7	L	5	86	0.75	3			JON
1983 05 23.71	S	11.2	V	31.7	L	5	86	1				JON
1983 06 02.47	S	10.8	V	31.7	L	5	86	2	3			JON
1983 06 02.47	S	9.5	V	7.8	R	8	30					JON
1983 06 03.36	S	9.6	V	7.8	R	8	30	3				JON
1983 06 03.36	S	10.2	V	31.7	L	5	86	2	4			JON
1983 06 06.35	S	10.2	V	31.7	L	5	86	1.5	3			JON
1983 06 06.35	S	9.2	V	7.8	R	8	30	2.5				JON
1983 06 14.47	S	9.5	V	7.8	R	8	30					JON
1983 06 15.33	S	8.6	V	7.8	R	8	30					JON
1983 06 25.36	S	10.0	V	31.7	L	5	86		3			JON
1983 06 30.33	S	8.7	V	7.8	R	8	30					JON
1983 07 02.40	S	8.9	V	7.8	R	8	30					JON
1983 07 03.33	S	8.3	V	7.8	R	8	30					JON
1983 07 06.43	S	8.3	V	7.8	R	8	30					JON
1983 07 11.45	S	8.5	V	7.8	R	8	30					JON
1983 07 12.35	S	8.3	V	7.8	R	8	30		3			JON
1983 08 04.43	S	8.9	V	7.8	R	8	30					JON
1983 08 06.39	S	9.7	V	7.8	R	8	30					JON
1983 08 07.35	S	9.7	V	31.7	L	5	86	2	2/			JON
1983 08 11.34	S	8.9	V	7.8	R	8	30					JON
1983 08 13.43	S	9.5	V	7.8	R	8	30					JON
1983 08 29.48	S	11.4	V	31.7	L	5	86	1	1/			JON
1983 08 31.40	S	11.4	V	31.7	L	5	86	1	2			JON
1983 09 01.37	S	11.5	V	31.7	L	5	86	0.75	1/			JON
1983 09 02.42	S	11.4	V	31.7	L	5	86	1.5	1/			JON
1983 09 11.36	S	11.5	V	31.7	L	5	86	1	0/			JON
1983 09 29.44	S	12.7	V	31.7	L	5	86		1/			JON

Periodic comet Giacobini-Zinner (1959 VIII = 1972 VI = 1984e)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1959 10 22.36				31.7	L	5	48	2.5	5	0.20	85	JON
1959 10 22.36	S	7.9	V	7.8	R	8	30					JON
1959 10 28.37	S	8.5	A	7.8	R	8	30					JON
1959 10 31.41				31.7	L	5	86	3		0.17	90	JON
1959 10 31.41	S	8.0	A	7.8	R	8	30					JON
1959 11 01.41	S	8.0	A	7.8	R	8	30					JON
1959 11 01.41				31.7	L	5	86			0.34	90	JON
1959 11 09.39	S	8.4	V	7.8	R	8	30					JON
1959 11 17.43				31.7	L	5	86	1.5		0.14	70	JON
1959 11 17.43	S	8.4	V	7.8	R	8	30					JON
1959 11 25.49	S	8.7	V	7.8	R	8	30					JON
1959 11 25.49				31.7	L	5	86			0.25	70	JON
1959 11 29.47				31.7	L	5	48	2.5		0.25	65	JON
1959 11 29.47	S	8.6	V	7.8	R	8	30					JON
1959 11 29.47	S	7.8	V	4.5	R	5	7					JON
1959 12 31.56				20	L	8	54	2	5	0.08	25	JON
1959 12 31.56	S	9.7	V	7.5	R	12	23					JON
1972 09 10.73	S	11.4	V	31.7	L	5	86					JON
1972 09 11.71	S	11.4	V	31.7	L	5	86		4			JON

Periodic comet Giacobini-Zinner (1959 VIII = 1972 VI = 1984e) Cont.

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1972 09 12.71	S	11.4	V	31.7	L	5	86		4			JON
1972 09 17.72	S	11.6	V	31.7	L	5	86		2			JON
1972 09 19.70	S	11.5	V	31.7	L	5	86		5			JON
1972 09 20.72	S	11.5	V	31.7	L	5	86		4			JON
1972 09 29.69	S	12.0	V	31.7	L	5	86					JON
1972 10 04.69	S	11.9	V	31.7	L	5	86					JON
1972 10 14.68	S	11.9	V	31.7	L	5	86		4			JON
1972 10 17.67	S	12.1	V	31.7	L	5	86		4			JON
1985 05 20.31	S	[12.5	A	31.7	L	6	110					BOR
1985 05 26.46	S	13.2	AA	20	L	6	122		4/			HAL
1985 05 30.31	S	12.0	A	31.7	L	6	88	1.5	3			BOR
1985 06 08.30	S	12.9	AA	20	L	6	122		3/			HAL
1985 06 11.15	S	11.2	A	31.7	L	6	88	2.8	4			BOR
1985 06 15.16	S	11.2	A	31.7	L	6	88	1.3	3/			BOR
1985 06 16.42	* S	12.3	AA	40.6	L	4	140	0.7	3			DUC
1985 06 18.37	S	11.7	AA	20	L	6	61					HAL
1985 06 18.85	S	12.4	AC	20.3	L	6	116		2			PEA
1985 06 19.31	S	10.8	A	31.7	L	6	68	2.6	4			BOR
1985 06 21.38	* S	11.6	AA	40.6	L	4	140	1.0	4			DUC
1985 06 26.44	M	10.9	AC	25.6	L	4	45	3.4	5			MOR
1985 06 30.45	S	11.4	AA	40.6	L	4	140	1.3	4			DUC
1985 07 06.92	S	10.5	AC	40.0	L	5	81	1.5	3	0.04	243	MER
1985 07 07.26	S	10.7	AA	20	L	6	61					HAL
1985 07 08.24	M	10.2	NP	25.6	L	4	67	2.2	5	0.03	225	MOR
1985 07 08.92	S	10.4	AC	40.0	L	5	81	2.5	3	0.08	243	MER
1985 07 09.11	S	10.4	A	31.7	L	6	68	2.2	6			BOR
1985 07 09.89	S	10.4	AC	40.0	L	5	81	& 2	3	0.02	268	MER
1985 07 10.32	S	10.5	AA	40.6	L	4	140	2	4			DUC
1985 07 11.24	S	9.4	A	20.0	C	10	81	2.5	2			SPR
1985 07 12.25	M	10.0	NP	25.6	L	4	67	3.2	5			MOR
1985 07 12.25	S	9.7	A	20.0	C	10	81	2.0	4			SPR
1985 07 12.94	S	9.3	AG	20.3	T	10	63	2.2	5			KAM01
1985 07 12.95	S	9.9	AC	10.0	R	15	60	3.0	3	0.03	267	MER
1985 07 13.02	S	9.7	AC	11.5	L	8	45					MER
1985 07 13.27	S	9.3	A	20.0	C	10	81	3.0	5			SPR
1985 07 13.41	S	9.6	S	25.4	L	4	32	2	4	0.07	289	MAC
1985 07 13.90				25.7	L	5	47	3.3	3	0.06	251	MER
1985 07 13.97	S	9.8	AC	15.0	L	5	23					MER
1985 07 14.28	S	9.2	A	20.0	C	10	81	2.5	3			SPR
1985 07 15.45	M	10.0	AA	20	L	6	61		5			HAL
1985 07 17.17	S	9.3	A	8.0	B		20	5	3			BOR
1985 07 17.17	S	9.9	A	31.7	L	6	68	2.7	6			BOR
1985 07 17.24	S	9.1	NP	8.0	B		20	8	2			MOR
1985 07 17.25	M	9.4	NP	25.6	L	4	45	3.0	5	0.03	240	MOR
1985 07 17.34	S	9.5	S	13.1	R	7	27	3	5			MAC
1985 07 17.92	S	10.5	AC	20	L	4	76	1.8	9		215	GUA
1985 07 17.92	S	9.3	S	40.0	L	5	81	& 2	3	0.09	240	MER
1985 07 17.94	S	9.6	AC	30.5	L	5	60	1.9	5			ZAN
1985 07 18.15	S	9.2	A	8.0	B		20	5.8	3/			BOR
1985 07 18.15	S	9.6	A	31.7	L	6	68	2.9	7	?	225	BOR
1985 07 18.22	S	9.2	NP	8.0	B		20	8	2			MOR
1985 07 18.22	M	9.4	NP	25.6	L	4	45	3.0	5	0.10	250	MOR

Periodic comet Giacobini-Zinner (1959 VIII = 1972 VI = 1984e) Cont.

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1985 07 20.08	S	9.0	S	40.0	L	5	81	& 2.0	3/	0.08	253	MER
1985 07 20.1	M	10.5	AC	20	L	4	76	2.1	7			GUA
1985 07 20.42	S	9.5	NP	5.0	B		10			0.05		HAL
1985 07 20.94	S	9.1	S	40.0	L	5	81	2.4	3	0.06	233	MER
1985 07 21.44	S	9.1	NP	8.0	B		20	6	2			MOR
1985 07 21.91	S	8.9:	S	20.3	T	10	81	& 2.2	6	?		KAM01
1985 07 21.98	S	9.5	AC	30.5	L	5	60	1.6	5/	0.03	250	ZAN
1985 07 22.00	S	9.5	AC	25.4	L	4	46	1.9	5			ZAN
1985 07 22.02	S	9.6	AC	8.0	B		20	4.3	4			ZAN
1985 07 22.42	S	9.1:	NP	8.0	B		20					MOR
1985 07 22.92	S	9.0	S	40.0	L	5	81	2.8	3	0.06	252	MER
1985 07 22.93	S	9.3	AA	8.0	B		20	4	3			MIL02
1985 07 22.98	S	9.5	AC	30.5	L	5	60	2.5	5/	?	255	ZAN
1985 07 23.00	S	9.4	AC	8.0	B		20	3.5	4			ZAN
1985 07 23.02	S	9.4	AC	25.4	L	4	46	2.9	4	0.05	252	ZAN
1985 07 23.26	S	9.8:	AA	40.6	L	4	76	2	4			DUC
1985 07 23.91	S	8.9	S	40.0	L	5	81	2.6	4	0.05	240	MER
1985 07 23.94	S	9.3	AA	8.0	B		20	4	4			MIL02
1985 07 23.95	S	9.5	AC	30.5	L	5	60	2.1	4/			ZAN
1985 07 24.92	S	8.9:	S	20.3	T	10	81	& 2.0	5			KAM01
1985 07 25.34	S	9.3	S	25.4	L	4	32	2	6	0.13	248	MAC
1985 07 26.23	S	8.0	A	5.0	B		10	12.5	3/			BOR
1985 07 26.23	S	8.8	A	31.7	L	6	68	3.4	7	0.1	250	BOR
1985 07 27.05	S	8.5	S	40.0	L	5	81	2.5	3/	0.05	255	MER
1985 07 27.35	S	9.2	S	25.4	L	4	32	2	5	0.08	249	MAC
1985 07 27.41	M	8.3	AA	8.0	B		20	7	4	0.35	242	MOR
1985 07 27.43	S	8.2	AA	5.0	B		12	9	3			MOR
1985 07 27.44	S	9.0	AA	5.0	B		10			0.13		HAL
1985 07 28.05	S	8.5	S	40.0	L	5	81	2.5	3	0.10	239	MER
1985 07 28.40	S	9.2	S	25.4	L	4	32	2	6	0.08	253	MAC
1985 07 28.41	M	8.7	AA	8.0	B		20	6.5	6	0.12	260	MOR
1985 07 29.44	S	9.0	S	25.4	L	4	32	3	6	0.05	263	MAC
1985 07 31.36	S	9.6	AA	40.6	L	4	140	2	4			DUC
1985 08 03.07	S	8.6	A	31.7	L	6	68	2.8	7	0.1	240	BOR
1985 08 03.11	S	8.4	AA	22.9	R	12	86	& 3.25	5			GRE
1985 08 03.30	S	9.5	AA	40.6	L	4	140	2.5	4			DUC
1985 08 04.85	S	9.5	AC	20	L	4	76	1	9	0.03	235	GUA
1985 08 04.88	S	9.3	AC	25.4	L	4	79		8			CAV
1985 08 04.90	S	8.3	S	40.0	L	5	81	2.7	3	0.17	246	MER
1985 08 06.30	S	9.4	A	40.6	L	4	76	2.5	4			DUC
1985 08 06.30	S	8.9	AA	5.0	B		10			0.08		HAL
1985 08 06.45	M	8.1	S	8.0	B		20	8.5	4	0.28		MOR
1985 08 07.25	S	8.3	AC	8.0	B		20	& 7.5	4			MOR
1985 08 07.30	S	9.2	A	40.6	L	4	140	2.5	4			DUC
1985 08 07.90	S	8.1	S	40.0	L	5	81	3.6	3	0.13	251	MER
1985 08 08.29	S	8.8	AC	25.4	L	4	32	3.2	5	0.10	263	MAC
1985 08 08.31	S	9.1	AA	40.6	L	4	70	3	4	0.15	225	DUC
1985 08 08.89	S	8.1	S	40.0	L	5	81	3.8	3	0.15	261	MER
1985 08 08.90	S	8.7	AA	20.3	T	10	81	2.2	6	0.05	260	KAM01
1985 08 09.24	S	8.1	AC	8.0	B		20	9	4/			MOR
1985 08 09.30	S	8.9	AA	40.6	L	4	70	3	4	0.08	235	DUC
1985 08 09.85	M	9.0	AC	20	L	4	40	4	6			GUA
1985 08 10.08	O	9.4	AC	31.8	L	5	40	2.0	3			SIM
1985 08 10.16	S	8.0	A	8.0	B		20	8	4			BOR

Periodic comet Giacobini-Zinner (1959 VIII = 1972 VI = 1984e) Cont.

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1985 08 10.16	S	8.4	A	31.7	L	6	55	5.7	6	0.2	260	BOR
1985 08 10.26	M	8.0	AC	8.0	B		20	6	4			MOR
1985 08 10.94	S	7.8	S	15.0	L	5	25	4.5	3	0.18	255	MER
1985 08 11.35	M	7.9	AC	8.0	B		20	6	6	0.50	255	MOR
1985 08 11.89	M	8.9	AC	10	L	6	28	3.3	7			GUA
1985 08 11.93	S	7.8	S	15.0	L	5	25	4.5	3	0.15	253	MER
1985 08 11.97	S	7.8	S	6.0	B		9					MER
1985 08 11.97	S	8.2	S	40.0	L	5	81	4.5	3	0.13	267	MER
1985 08 12.31	S	7.9	A	8.0	B		20	8.5	4			BOR
1985 08 12.31	B	8.6	A	31.7	L	6	68	4.7	7	0.2	250	BOR
1985 08 12.32	S	8.9	AA	40.6	L	4	70	3.5	4	0.05	235	DUC
1985 08 12.33	S	8.7	AC	25.4	L	4	32	3.0	6	0.08	255	MAC
1985 08 12.35	M	8.3	AA	5.0	B		10			0.9	265	HAL
1985 08 12.40				8.0	B		20			0.83	275	MOR
1985 08 12.40	M	8.1	AC	8.0	B		20	5	6	0.83	264	MOR
1985 08 12.89	M	8.8	AC	10	L	6	28	4	8			GUA
1985 08 13.32	S	8.1	NO	8.0	B		20	7.5	5			BOR
1985 08 13.87	S	7.6	S	15.0	L	5	25	5.4	2	0.20	270	MER
1985 08 14.90	S	8.3	AA	6.3	B		9					KAM01
1985 08 14.90				20.3	T	10	51	3.6	6	0.17	280	KAM01
1985 08 14.91	M	8.8	AC	10	L	6	28	3.7	8			GUA
1985 08 14.98				40	L	4	90	2.2	7	0.23		CAV
1985 08 14.98	S	8.6	AC	5.0	B		10	4.3		0.35	270	CAV
1985 08 15.35	S	8.7	S	25.4	L	4	32	3.0	4	0.10	267	MAC
1985 08 15.93	M	8.7	AC	10	L	6	28		8			GUA
1985 08 16.02	S	7.4	S	15.0	L	5	25	6.4	2	0.25	265	MER
1985 08 16.41	M	7.8	AC	8.0	B		20	6	5	0.83	268	MOR
1985 08 17.04	S	7.3	S	15.0	L	5	25	5.9	2	0.27	288	MER
1985 08 17.16				15.0	B		25			0.3	275	BOR
1985 08 17.16	S	7.7	NO	5.0	B		10	10	5			BOR
1985 08 17.42	S	8.7	S	25.4	L	4	32	3.5	6	0.20	262	MAC
1985 08 18.37	S	8.6	S	25.4	L	4	32	4.0	5	0.23	260	MAC
1985 08 18.41	M	7.2	AA	8.0	B		20	8.5	6	1.5	262	MOR
1985 08 18.85	S	7.4	S	5.0	B		7	14.0	3	0.42	253	MER
1985 08 18.92	S	8.5	AC	8.0	B		20	4.7	7	0.22	267	CAV
1985 08 19.04	S	8.4	AC	8.0	B		20	8.5	6			ZAN
1985 08 20.41	M	7.9	AC	8.0	B		20	6.5	5	2.0	271	MOR
1985 08 20.85	S	7.4	S	5.0	B		7	9.0	3	0.47	282	MER
1985 08 21.02	S	8.2	AA	6.3	B		9					KAM01
1985 08 21.02				20.3	T	10	81	2.5	5	0.08	280	KAM01
1985 08 21.04	S	8.3	AC	8.0	B		20	6.2	4/			ZAN
1985 08 21.22	S	7.6	AA	8.0	B		20	& 8	2/			GRE
1985 08 21.24	S	8.3	AA	22.9	R	12	86	& 2.5	7/			GRE
1985 08 21.24	M	8.1	AA	22.9	R	12	86	& 2.5	7/			GRE
1985 08 21.44	M	7.5	AA	8.0	B		20	8	6	1.25	270	MOR
1985 08 21.44				8.0	B		20			0.33	312	MOR
1985 08 21.44				8.0	B		20			0.67	250	MOR
1985 08 21.85	S	7.4	S	5.0	B		7	11.0	3	0.57	271	MER
1985 08 23.05	S	8.2	AC	8.0	B		20	7.8	4/			ZAN
1985 08 23.08	M	8.1	AC	10	L	6	28	4	7	0.17	270	GUA
1985 08 23.32	S	7.7	NO	8.0	B		20	8.5	5			BOR
1985 08 23.32	S	7.6	NO	5.0	B		10	11	5			BOR
1985 08 23.43	M	7.5	AA	8.0	B		20	8	6	1.0	275	MOR

Periodic comet Giacobini-Zinner (1959 VIII = 1972 VI = 1984e) Cont.

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1985 08 24.13	S	7.6	S	15.0	L	5	25	5.0	3	0.13	289	MER
1985 08 24.43	M	7.5	AA	8.0	B		20	8	7	0.83	281	MOR
1985 08 24.45	S	7.4	AA	5.0	B		10			0.6	260	HAL
1985 08 25.30	B	8.3	S	7.0	B		10			0.12	270	DEA
1985 08 25.44	M	7.4	AA	8.0	B		20	6	7	0.67	275	MOR
1985 08 27.43	M	7.3	AA	8.0	B		20	8	7	1.5	290	MOR
1985 08 27.46	S	7.3	AA	5.0	B		10			0.6	275	HAL
1985 08 28.07	S	8.0	AC	8.0	B		20	7.4	4/			ZAN
1985 08 28.33	S	7.6	NO	8.0	B		20	6.5	5			BOR
1985 09 12.30	S	8.2	AA	8.0	B		20	& 4.5	3/			GRE
1985 09 14.39	S	8.4:	AA	8.0	B		20	& 5.5	2			GRE
1985 09 17.28	S	8.8	AA	20.3	L	6	38	& 7.2	5			GRE
1985 09 17.29	S	8.3	AA	8.0	B		20	&10.2	2/			GRE
1985 09 21.40	S	8.8	AA	22.9	R	12	86	& 4	3/			GRE

Periodic comet Tsuchinshan 1 (1984p)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1985 03 17.38	S	11.7	AA	20	L	6	61		1			HAL
1985 03 24.41	S	11.9	AA	20	L	6	61					HAL

Periodic comet Takamizawa (1984j)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1984 08 03.23	S	8.9	A	20.0	C	10	65	3.0	5	?		SPR
1984 08 05.25	S	9.0	A	20.0	C	10	65	2.75	5	?		SPR
1984 08 21.21	S	9.2	A	20.0	C	10	65	2.0	3			SPR
1984 08 25.20	S	9.6	A	20.0	C	10	65	2.0	3			SPR

Periodic comet Faye (1969 VI)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1969 11 07.64	S	11.7	V	31.7	L	5	86		6			JON
1969 11 12.62	S	12.2	V	31.7	L	5	86		4			JON
1969 11 15.62	S	12.2	V	31.7	L	5	86					JON
1969 12 05.60	S	11.4	V	31.7	L	5	86		4			JON
1970 01 02.51	S	12.9	V	31.7	L	5	86		2			JON

Periodic comet Ashbrook-Jackson (1985a)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1985 07 19.65				32	L	7	214	& 0.28				MCN
1985 07 19.65	S	13.3	AC	32	L	7	76		3			MCN
1985 07 23.56				32	L	7	214	& 0.20				MCN
1985 07 23.56	S	13.7	AC	32	L	7	76		0			MCN
1985 07 24.72	S	13.7	AC	32	L	7	76		0			MCN
1985 07 24.72				32	L	7	214	& 0.17				MCN
1985 07 26.72				32	L	7	214	0.17				MCN
1985 07 26.72	S	14.0	AC	32	L	7	76					MCN
1985 08 06.24	S	12.8	AA	20	L	6	122					HAL
1985 08 07.24	S	12.8	AA	20	L	6	122		2			HAL
1985 08 09.60	S	13.8	AC	32	L	7	76	0.17	2/			MCN
1985 08 10.24	M	13.4	AC	61.0	C	16	390	0.45	3/			MOR
1985 08 11.27	M	13.0	AC	61.0	C	16	177	0.68	4			MOR

Periodic comet Ashbrook-Jackson (1985a) Cont.

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1985 08 11.30	M	13.4	AC	61.0	C	16	139	0.55	5			MOR
1985 08 11.31	M	13.0	AC	61.0	C	16	390	0.55	3			MOR
1985 08 12.25	M	13.2	AC	61.0	C	16	390	0.46	4			MOR

Periodic comet Russell 1 (1985b)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1985 06 16.2	* T	[16		154	C	14						MOR

Periodic comet Halley (1982i)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1985 07 27.10	I	[14.0	AC	40.0	L	5	170					MER
1985 07 27.47	S	[12.5	AA	20	L	6	122					HAL
1985 07 27.48	S	15.0:	WA	61.0	C	16	390	& 0.17	1			MOR
1985 07 28.10	I	[14.0	AC	40.0	L	5	170					MER
1985 07 28.48	S	15.0:	WA	61.0	C	16	390	& 0.17	1			MOR
1985 08 10.48	S	14.5	AA	61	L	16	390		2			HAL
1985 08 10.48	S	14.5	WA	61.0	C	16	390	0.30	2/			MOR
1985 08 11.48	S	14.5	WA	61.0	C	16	390	0.25	2			MOR
1985 08 12.48	S	14.3	AA	61	L	16	390		2			HAL
1985 08 12.48	S	14.3	WA	61.0	C	16	390	0.42	2/			MOR
1985 08 14.12	S	14.3	AC	40.0	L	5	170	0.5	3			MER
1985 08 14.12	S	15.2	WA	40.0	L	5	170	0.5	3			MER
1985 08 17.08	S	14.2	AC	40.0	L	5	170	0.5	3/			MER
1985 08 17.08	S	15.1	WA	40.0	L	5	170	0.5	3/			MER
1985 08 17.34	S	14.1	A	61.0	L	4	270	0.45	5			BOR
1985 08 18.48	S	13.9:	AA	20	L	6	244					HAL
1985 08 18.49	S	14.0	WA	25.6	L	4	156	0.30				MOR
1985 08 19.49	S	13.9	AA	20	L	6	244					HAL
1985 08 21.49	S	13.9	WA	25.6	L	4	156	0.52	3			MOR
1985 08 23.49	S	13.5	WA	25.6	L	4	156	1.0	2			MOR
1985 08 24.09	S	14.8	WA	40.0	L	5	170	0.6	4	0.01	276	MER
1985 08 24.09	S	13.8	AC	40.0	L	5	170	0.6	4	0.01	276	MER
1985 08 24.35	S	13.6	A	50.0	L	5	241	0.45	4			BOR
1985 08 24.49	S	13.4	AA	20	L	6	122	0.9	2			HAL
1985 08 24.49	S	13.4	WA	25.6	L	4	156	1.0	3			MOR
1985 08 25.45	S	13.6	WA	32	L	4	66	0.8	2			KEE
1985 08 25.48	S	13.2	WA	25.6	L	4	156	0.9	3/			MOR
1985 08 27.49	S	13.4	WA	47	L	4	204	0.75	4			MOR
1985 08 27.49	S	13.5	AA	20	L	6	244					HAL
1985 08 27.50	S	13.4	WA	25.6	L	4	156	0.75	3/			MOR
1985 08 28.08	S	13.4	AC	40.0	L	5	170	0.5	2/			MER
1985 08 28.35	S	13.3	A	50.0	L	5	241	0.50	5			BOR
1985 09 11.43	S	12.8	WA	32	L	4	66	2.0	1			KEE
1985 09 12.11	S	13.5	W	30.5	L	5	150	0.3	0			ZAN
1985 09 12.3	M	13.5	L	20.3	L	6	116	& 1	4			OME
1985 09 12.36	I	14.4	L	20.3	L	6	116	& 0.1	5			GRE
1985 09 14.3	M	13.1	L	20.3	L	6	116	1	5			OME
1985 09 14.36	S	13.2	L	20.3	L	6	116	& 0.5	3			GRE
1985 09 17.05	S	13.1	WB	30.5	L	5	94	1.8	3			ZAN
1985 09 17.3	M	13.0	L	20.3	L	6	116	1.2	5	&0.25	270	OME
1985 09 17.33	S	12.8	L	20.3	L	6	116	& 1.2	3			GRE
1985 09 17.37	M	12.5	L	20.3	L	6	116	& 1.2	3			GRE
1985 09 17.37	S	12.6	L	20.3	L	6	116	& 1.2	3			GRE

Periodic comet Halley (1982i) Cont.

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1985 09 18.13	S	13.0	WB	30.5	L	5	60	2.0	2/			ZAN
1985 09 21.37	S	12.3	L	22.9	R	12	261	& 0.8	1/			GRE
1985 09 26.3	M	12.0	L	22.9	R	12	261	1.5	6	&0.33	314	OME
1985 09 26.33	S	11.9	L	22.9	R	12	261	& 1.6	4/			GRE
1985 09 28.35	S	12.0	L	22.9	R	12	261	& 1.0	5			GRE
1985 09 29.34	S	11.7	L	22.9	R	12	261	& 1.7	4/			GRE
1985 09 29.38	M	11.8	L	22.9	R	12	261	& 1.7	4/			GRE

Periodic comet Schwassmann-Wachmann 1

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1985 03 17.49	S	[12.5	AA	20	L	6	122					HAL
1985 07 09.92	I	[13.0	AC	40.0	L	5	170					MER

Periodic comet Crommelin (1956 VI = 1983n)

DATE (UT)	MM	MAG.	RF	AP.	T	F/	PWR	COMA	DC	TAIL	PA	OBS.
1956 11 09.64	S	10.1	V	20	L	8	54	2.5	4			JON
1984 03 22.36	S	8.9	S	31.7	L	5	86	2.5	3			JON
1984 03 23.37	S	9.5	V	31.7	L	5	86	1.5	3			JON
1984 04 01.36	S	9.6	S	31.7	L	5	86		2			JON
1984 04 02.37	S	9.2	S	31.7	L	5	86	2	1/			JON

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*** P/HALLEY 1982i

Orbital elements by W. Landgraf, Max-Planck-Institut fuer Aeronomie, Lindau, West Germany (from a manuscript to be published in Astronomy and Astrophysics), from 1,739 observations during 1835-1985 (mean error 1.6"):

(angles are for equinox 1950.0) Epoch 1986 Feb. 19.0

T = JD 2446470.96113 ET = 1986 Feb. 9.46113 ET

Argument of Perihelion = 111°.84691 Node = 58°.14386

i = 162°.23938 q = 0.58710227 AU

e = 0.96727534 P = 75.99 years

nongravitational parameters: A1 = +0.0746, A2 = +0.015566

The ephemeris was produced at the Smithsonian Astrophysical Observatory from the above elements; the total visual magnitudes given below are from the pre-perihelion formula by Morris and Green (1982, A. J. 87, 918).

Date ET	R. A. (1950)	Decl.	Delta	r	Elong.	Phase	Mag.
1985 11 11	04 29.39	+22 13.4	0.818	1.778	158°.9	11.5	7.8
1985 11 16	03 48.81	+21 46.6					
1985 11 21	02 58.09	+20 18.8	0.651	1.632	169.3	6.4	6.9
1985 11 26	02 01.13	+17 30.5					
1985 12 01	01 05.44	+13 39.4	0.631	1.483	131.8	29.7	6.4
1985 12 06	00 17.56	+09 35.5					
1985 12 11	23 39.67	+05 59.7	0.751	1.331	99.3	46.9	6.3
1985 12 16	23 10.71	+03 06.1					
1985 12 21	22 48.58	+00 51.0	0.939	1.177	75.4	54.0	6.1
1985 12 26	22 31.34	-00 54.3					
1985 12 31	22 17.49	-02 18.3	1.140	1.022	57.0	53.8	5.9
1986 01 05	22 05.94	-03 27.8					
1986 01 10	21 55.86	-04 28.0	1.324	0.872	41.2	48.0	5.4
1986 01 15	21 46.66	-05 23.2					
1986 01 20	21 37.87	-06 16.7	1.470	0.735	26.5	36.7	4.9
1986 01 25	21 29.13	-07 11.7					

EPHEMERIS FOR COMET HARTLEY-GOOD (1985l), from elements on IAUC 4113 (S. Nakano).

Date	ET	R. A. (1950)	Decl.	Delta	r	Elong.	Mag.
1985 11 01		19 05.47	+03 44.7	0.699	1.026	72.3	7.3
1985 11 06		18 47.42	+06 52.6				
1985 11 11		18 31.84	+09 28.0	0.828	0.896	58.2	7.1
1985 11 16		18 17.79	+11 35.0				
1985 11 21		18 04.56	+13 15.8	0.948	0.787	47.9	6.8
1985 11 26		17 51.69	+14 30.2				
1985 12 01		17 38.94	+15 16.8	1.044	0.714	41.1	6.6
1985 12 06		17 26.31	+15 34.2				
1985 12 11		17 13.93	+15 21.9	1.106	0.695	38.3	6.6
1985 12 16		17 02.01	+14 41.4				
1985 12 21		16 50.70	+13 35.7	1.127	0.736	40.1	6.9
1985 12 26		16 40.06	+12 09.1				
1985 12 31		16 29.98	+10 25.6	1.109	0.825	45.9	7.4
1986 01 05		16 20.25	+08 28.7				
1986 01 10		16 10.57	+06 20.7	1.061	0.944	54.8	7.9
1986 01 15		16 00.56	+04 03.0				
1986 01 20		15 49.79	+01 35.8	0.991	1.078	66.2	8.3
1986 01 25		15 37.82	-01 01.0				
1986 01 30		15 24.16	-03 47.8	0.913	1.221	80.0	8.7
1986 02 04		15 08.32	-06 44.1				
1986 02 09		14 49.79	-09 48.0	0.842	1.367	96.4	9.0
1986 02 14		14 28.19	-12 55.3				
1986 02 19		14 03.42	-15 58.4	0.798	1.512	115.3	9.3
1986 02 24		13 35.82	-18 46.7				

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THE LAST 15 COMETS TO RECEIVE PROVISIONAL LETTER DESIGNATIONS

Listed below, for handy reference, are the last 15 comets which have been given letter designations (1985a is the first comet to be discovered or recovered in 1985, 1985b is the second comet..., etc.). Room is given after the first "equal sign" for the Roman numeral designation (usually not yet given for the last 15 comets), which gives the year of perihelion. After the second "equal sign" is given the name, preceded by an asterisk (*) if the comet is a new discovery (as opposed to a recovery from predictions of a previously-known short-period comet). Also given parenthetically are such values as the date of perihelion, T (month/date), and the perihelion distance, q (in AU).

1984t = 1984 = * Levy-Rudenko (T = 12/14, q = 0.92)
1984u = 1984 = * P/Shoemaker 2 (T = 9/26, q = 1.3)
1984v = 1985 = * Hartley (T = 9/29, q = 4.0)
1985a = 1986 = P/Ashbrook-Jackson (T = 1/24, q = 2.3)
1985b = 1985 = P/Russell 1 (T = 7/5, q = 1.6)

1985c = 1985 = P/Honda-Mrkos-Pajdušáková (T = 5/23, q = 0.54)
1985d = 1985 = P/Tsuchinshan 2 (T = 7/21, q = 1.8)
1985e = 1985 = * Machholz (T = 6/28, q = 0.1)
1985f = 1985 = * P/Hartley (T = 6/11, q = 1.5)
1985g = 1985 = P/Giclas (T = 10/3, q = 1.8)

1985h = 1986 = P/Whipple (T = 6/25, q = 3.1)
1985i = 1986 = P/Shajn-Schaldach (T = 5/27, q = 2.3)
1985j = 1985 = P/Daniel (T = 8/4, q = 1.7)
1985k = 1985 = * P/Maury (T = 6/8, q = 2.0)
1985l = 1985 = * Hartley-Good (T = 12/9, q = 0.69)

(Continued from page 94)

ICE did pass through both magnetic lobes which had been theoretically proposed as being results of the solar wind draping around the comet, and a 100-km-thick non-magnetic sheet region was also found to lie between the two lobes. The width of the tail (10,000–15,000 km) and the magnetic field strength were both found to be considerably greater than expected. The ion composition instrument (of Keith Ogilvie and colleagues) indicated that P/Giacobini-Zinner's nucleus is seemingly predominantly water ice with a small amount of *CO* ice. There were also indications of less dust in the comet's tail.

Periodic comet Hartley (1985*f*) has only been observed at two observatories (Siding Spring and Palomar), with less than 20 observations reported to the Minor Planet Center during June and July, permitting Brian Marsden (1985) to refine the orbital elements: perihelion occurred last June 11.608 ET at a distance $q = 1.54$ AU; its orbital period is 5.61 years and orbital inclination is 24.9° with respect to the ecliptic. It will probably be magnitude 18–19 in October and November as it moves rapidly away from the sun and earth.

Comet 1985*g* was P/Giclas, recovered independently by three groups of observers in June and July; this comet is making its first predicted return to perihelion (T = 1985 Oct. 1 at $q = 1.84$ AU) following its discovery in 1978. Edgar Everhart and John Briggs found the comet at $m_1 = 20$ on a photograph exposed on June 22.4 with a 16-inch reflector in Colorado. C.-Y. Shao and Gunther Schwartz roughly estimated the total magnitude as 18 on July 18 and 21, from plates exposed with the 61-inch Oak Ridge Observatory reflector in Harvard, Massachusetts; the comet's image was then strongly condensed and nearly stellar in appearance. T. Seki also independently recovered P/Giclas from Geisei, Japan, estimating $m_1 = 18.5$ on a July 22 photograph. The correction to the predicted time of perihelion was −0.66 day (*IAUC* 4086).

P/Whipple was recovered as comet 1985*h* by James Gibson at Palomar Mountain Observatory (CCD + 60-inch reflector, stellar images of comet with some frames showing a tail 3″ – 4″ long, $m_1 = 20$ on July 10) and by Tom Gehrels (with J. V. Scotti) at Kitt Peak National Observatory (CCD + 0.91-m reflector, $m_1 = 19$ on July 25, "some slight indication of diffuseness"). This is the eighth return of P/Whipple, which orbits the sun every 7.4 years or so, but it will not get much brighter ($q = 3.1$ AU) at this return.

P/Shajn-Schaldach (1985*i*) was recovered by Gehrels (with Scotti) at $m_1 = 19$ on July 25, the comet being very slightly diffuse (*IAUC* 4089). This is the 4th return of this comet (P = 7.2 years), and it, too, will remain quite faint.

Comet 1985*j* is P/Daniel, recovered by Gibson at $m_2 = 20$ on July 27; the comet was "stellar in appearance within the limits of seeing", although a July 28 CCD image shows two 5″ streamers (*IAUC* 4092). This comet is making its seventh observed return, having been first found in 1909 (P = 7.1 years). While its total visual magnitude may have reached 15 or 16 in August, it is now fading following its August 4 perihelion.

Alain Maury discovered a new short-period comet (1985*k*) on plates exposed by J. Schombert with the 48-inch Palomar Schmidt telescope on August 16. The comet was described as being diffuse with condensation and a short tail, and $m_1 \sim 16$. An orbit by Brian Marsden (1985) indicates that perihelion occurred on June 8.6 ET at a heliocentric distance of 2.01 AU, and the orbital period is ∼ 8.8 years. P/Maury will be fading in brightness through the end of the year.

Malcolm Hartley and Andy Good teamed to make a new discovery of a long-period comet on objective-prism plates taken September 11.69 with the 48-inch Schmidt telescope at Siding Spring in Australia. They described the new object in Sculptor as being magnitude 12. Early visual observations of comet Hartley-Good 1985*l* indicated that the comet was quite large (> 6′) and diffuse, with a noticeable condensation, and near $m_1 = 9.5$ (the size caused some early discrepancies in the reported total magnitudes). The comet was near $\delta = -28°$ for the first few weeks around discovery, but is now gradually moving northward as it nears its December 9 perihelion ($q = 0.694$ AU, $i = 79.9°$; *cf.* Marsden 1985), and it should brighten to near $m_1 = 7$ by December; it will gradually fade thereafter, but should remain observable to northern-hemisphere observers for a few months.

P/Smirnova-Chernykh was observed by Carolyn and Eugene Shoemaker in May with the 18-inch Palomar Schmidt telescope, and they estimated $m_1 = 17$ on May 14.35. This comet can be observed throughout its entire orbit, and is not given a provisional letter designation.

P/Wild 2, one of the chief candidates for the proposed NASA *Comet Rendezvous/Asteroid Flyby (CRAF)* mission, has been observed during the past several months at various observatories. Anita Cochran and Ed Barker, using the 2.7-m reflector at McDonald Observatory, found the comet on April 17.45 as a fuzzy image some 5″ – 10″ in diameter and at $m_1 \simeq 17.5$ (*MPC* 9603). David J. Tholen and others observed P/Wild 2 with the 2.24-m reflector at Mauna Kea on, finding $m_1 = 19.2$ (with stellar central condensation, coma diameter 7″, and tail length 9″) on September 10.33 and $m_1 = 19.0$ on September 11.34.

P/Arend-Rigaux 1984*k* was observed on March 24.13 at $m_1 \simeq 17.2$ by observers at Lowell Observatory with the 0.33-m photographic telescope. It was last observed April 21 by observers at the Smithsonian's Oak Ridge Observatory.

CORRIGENDUM: On page 71 of the July issue, column 1, line -4, "1984*c*" should be "1985*c*".

(1985 Sept. 30)

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UNIVERSAL TIME (UT): This time based on the Greenwich meridian is used throughout the *ICQ*; it is 24-hour time, from midnight to midnight. In North America, add the following numbers to standard times to convert to UT: EST, 5; CST, 6; MST, 7; PST, 8. For daylight savings time, add 4, 5, 6, and 7 hours, respectively.