

Comets in 1983

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Twenty-three cometary reports were given provisional designations in 1983. One of the reports proved to be erroneous, but the remaining real discoveries and recoveries constitute another new record, even if neither the 12 discoveries nor the 10 recoveries constitutes a record in itself. *IRAS*, the British–American–Dutch Infrared Astronomical Satellite, which was operational from January to November, proved to be exceptionally efficient at discovering comets, although it is proper to point out that only one of the six comets discovered by *IRAS* either was not or would not also have been discovered by ground-based observers. Furthermore, although curious circumstances were involved, *IRAS* specifically failed to discover a seventh comet. Two of the new discoveries were remarkable in that they approached the Earth to distances of 0.03 and 0.06 AU, and among the significant observations then made were the first really definite cometary detections by radar. Five of the new discoveries were short-period comets, and one of them now holds the record for shortest period for a comet with a retrograde orbit. The four ‘annual’ comets were also under observation during 1983, as well as six of the discoveries and recoveries of 1982 and one discovery from each of 1981 and 1980.

P/Schwassmann-Wachmann 1 experienced an outburst in February, being noted around mag 12.0 by J.-C. Merlin (Le Creusot, France, 0.26-m reflector) on the 19th and 20th and by J.D. Shanklin (Cambridge University) on the 23rd. Merlin photographed the comet at about mag 12.5 on March 6 but was unable to detect it a week later. T. Seki (Geisei, Japan, 0.40-m reflector) found the comet to be faint, near mag 18, on a pair of exposures on April 5 (the only astrometric observations reported of P/Schwassmann-Wachmann 1 during the year), and Merlin’s visual detection at mag 11.7 on April 29 was unconfirmed. Merlin was definitely able to photograph the comet, however, at mag 13.5–14.0, on July 12 and 13, with a 0.60-m reflector.

P/Encke, approaching perihelion in 1984 March, was quite faint but well placed for observation in the latter part of 1983. The only observations attempted seem to have been by E. Barker with the 2.7-m reflector at McDonald Observatory on December 8.

P/Gunn, at perihelion in 1982 November and near conjunction early in 1983, was recorded by E. Everhart on June 22 with the 0.40-m reflector at the Chamberlin Observatory’s field station near Denver. Merlin photographed the comet at mag 15 on July 11, and a pair of astrometric observations was secured on the 12th by A.C. Gilmore and P.M. Kilmartin

with the 0.6-m reflector at Mount John University Observatory. A final observation was obtained by Everhart on September 28.

P/Smirnova-Chernykh, noticeably brightening as it approached perihelion in 1984 February, was accidentally photographed near opposition in the course of minor-planet work being conducted by both E. Helin (Palomar, 1.2-m Schmidt) and E. Bowell (Lowell Observatory, 0.33-m astrograph) in January, the latter observer judging the magnitude as 16.5–17.0. The comet was also under observation in mid-February by Everhart and by R. E. McCrosky and his associates with the 1.5-m reflector at the Oak Ridge Observatory.

1980b, Bowell, was picked up by Everhart on its reappearance in the morning sky on June 8. The comet was observed on several occasions by the discoverer, who noted fading from mag 15.0 on July 17, to 15.5 on August 13, to 16.8 in early October. Comet 1980b was also under observation at Oak Ridge and by A. Mrkos and Z. Vávrová with the 0.6-m Maksutov telescope at the Kleť Observatory.

Observations 1980 February 11 to 1983 October 11, continuing

1981 XV (= 1981c), Elias, was recorded at Oak Ridge on February 16 and by J. Gibson with the 1.2-m Palomar Schmidt on April 2 and 3. This comet was last detected in mid-April at Oak Ridge.

Observations 1981 April 3 to 1983 April 14

1982d, P/Tempel 2, was reported at mag 10.8 by M. Clark (Tambellup, Western Australia, 0.41-m reflector) on its return to the morning sky on May 10 and at mag 10.4 by J. Bortle (Stormville, New York, 0.32-m reflector) some 3½ days later. By early June, a few days after the comet's perihelion passage, A. Pearce (Woodlands, Western Australia) was quoting the magnitude as around 8.5 (0.15-m reflector). This brightness was more or less maintained throughout July, some observers noting a tail up to 20 arcmin long, and there was fading by perhaps 0.5 mag by mid-August. Detections tentatively announced by the IRAS team in mid-July were first thought to be of discrete objects in the general direction of the comet, but it was soon realized that these observations were in fact of tail material associated with P/Tempel 2. Extending several degrees from the comet, this material was most prominent when the Earth was crossing the plane of the comet's orbit. Only a single astrometric observation was made during the early part of the apparition – by Everhart on June 19. Another position was obtained on August 20 by J. Tatum at the University of Victoria, and further astrometry was performed by Everhart, Tatum and McCrosky in September and October, as the comet faded from mag 9.4 on September 4 and mag 10.9 on October 1 (Pearce) to mag 11.4 on October 27 (Clark). Clark estimated the comet at mag 11.6 on November 8 and two final observations were made at Oak Ridge.

Observations 1982 February 3 to 1983 December 9

1982f, P/Churyumov-Gerasimenko, unexpectedly bright in late 1982, was still bright and widely observed early in the new year. On January 4 Bortle gave the magnitude as 10.0 and noted a 20 arcmin tail to the west. On the 22nd the comet was around mag 10.3, and the tail was perhaps 5 arcmin long. More substantial fading took place during February, and on

March 4 G.Keitch (Wrington, Avon, 0.30-m reflector) was quoting mag 12.8. There were astrometric observations into April by N.S.Chernykh with the 0.4-m double astrograph at the Crimean Astrophysical Observatory and into May at Oak Ridge.

Observations 1982 May 31 to 1983 May 13

1982g, Austin, a naked-eye object in 1982 July–August, was last reported visually on January 8 by Merlin, who then estimated the magnitude as 12.6. The comet was under observation photographically in January and February by Everhart and McCrosky, and a completely uncondensed image, some 110×100 arcsec, was obtained with the 0.15-m Cooke triplet at R.L.Waterfield's observatory in Woolston, Somerset, on February 13. The final observations were obtained by Gibson at the beginning of April, the magnitude being about 20.

Observations 1982 June 18 to 1983 April 3

1982i, P/Halley, recorded again by R.M.West and H.Pedersen with the 1.5-m Danish reflector and charge-coupled device at the European Southern Observatory on January 14, was measured at V mag 23.5, surprisingly brighter than it had been a month earlier. A pair of measurements were also obtained by M.J.S.Belton, P.A.Weinger and S.Wyckoff with the 4-m reflector and charge-coupled device at Kitt Peak National Observatory on February 13 and indicated a V mag of 24.5. When the comet returned to the morning sky in September it was detected for the first time with the 6-m reflector at the Special Astrophysical Observatory, and a direct observation of the comet was made by R.Racine with the Canada–France–Hawaii telescope on December 31, the magnitude being given as 23.2.

Observations 1982 October 16 to end of 1983, continuing

1982j, P/Tempel 1, was under observation with the Oak Ridge and Geisei reflectors in January and February, and it had brightened to mag 12.9 when Merlin detected it visually on March 3. Some observers noted a hint of a tail later in March, and by early April the comet was near opposition and widely reported at mag 10–11. A tail, essentially to the south and perhaps approaching 6 arcmin in length, was more prominent during April and May, and the comet remained at mag 9–10 from May until after perihelion passage in mid-July. The last observation from the northern hemisphere seems to have been obtained with the Oak Ridge reflector on July 15, although visual observations by Clark and Pearce continued in Australia. Clark gave magnitude estimates of 10.8 on August 7, 11.0 on September 4, 12.5 on September 25 and 12.8 on October 1.

Observations 1982 December 11 to 1983 October 1

1982k, P/Kopff, also under observation at Oak Ridge and Geisei and also at the Chamberlin station at the beginning of the year, was first detected visually by Bortle on March 16 at mag 11.9 (0.50-m reflector). Farther east than P/Tempel 1, this comet also brightened to mag 9–10 by early May, and at the end of that month some observers were finding it as bright as mag 8. This comet also had a short tail in May, and Clark described it as extending for 25 arcmin on June 9, 40 arcmin on July 4 and 35 arcmin on the 14th. Magnitude estimates by Bortle (15×80 binoculars)

were 8.1 on June 9, 7.8 on July 11 and 8.0 around the time of the comet's perihelion passage on August 10. It was still at mag 8.3 on September 9 (Bortle), but there seems to have been a fairly abrupt fading (by more than a magnitude in 24 hr, according to Clark) towards the end of the month. There was perhaps a slight recovery in early October, and the last visual observations were made by Clark: mag 11.6 on November 2 and mag 12.0 on November 8. An astrometric observation (the first anywhere since early September) was made by Gibson at the end of November.

Observations 1982 December 20 to 1983 November 28, continuing

1983a was the designation given to what appeared to be cometary images, of mag 15, obtained by J. Johnston and M.P. Candy at Perth on January 5 and 7 in the course of a search of periodic comet Metcalf, missing since its discovery in 1906. Further Perth exposures failed to show any comet on January 8 and 10, and McCrosky was unable to find it at Oak Ridge on the 9th. The position of another suspect image obtained at Perth on January 9 was not particularly consistent with the earlier ones, and it was concluded that all three were in fact plate defects.

1983b was periodic comet Pons-Winnecke, recovered independently by Everhart and by Seki on January 12.5 and 14.8, respectively. Both observers estimated the comet at mag 19, and while the former observer described its image as indefinite and extremely faint, the latter reported the comet as diffuse with condensation. Further positions were reported by the same observers on January 19 and 20, but in spite of the increasing elongation from the Sun and anticipated brightening no further observations were reported before the comet's perihelion passage on April 7. During the few months after perihelion the only astrometric observations were those made by Gilmore and Kilmartin on April 16 and May 22, although Pearce and Clark (each using a 0.41-m reflector) found the comet visually to be as bright as mag 12.3 and 12.1 on May 16 and 19, respectively. Using a 0.15-m reflector Pearce estimated mag 11.9 on May 24, but on June 9 Clark made the magnitude around 12.6 (0.41-m reflector). The comet continued to approach opposition, but the only subsequent observations were a single position by Everhart on September 5 and trail ends measured by K.S. Russell with the 1.2-m UK Schmidt a month later, the 60-min exposure showing the comet then to be of mag 19.

Observations 1983 January 12 to October 6

1983c was discovered by Bowell on plates taken by B.A. Skiff with the Lowell 0.33-m 'Pluto' telescope on February 11.3. An only slightly condensed object of mag 16.2 retrograding in Leo, the discovery was announced after further Lowell observations had been made on February 15, on which night the comet was also accidentally photographed by C. and E. Shoemaker with the 0.46-m Schmidt at Palomar. An Oak Ridge observation the following night gave the comet's magnitude as 18, and Barker made a similar estimate with the McDonald 2.7-m reflector on the 17th, when the comet's spectrum showed weak CN emission superposed on the continuum. It soon became clear that the comet was a short-period one, and a total of some 25 observations (including also some made at Geisei, Mount John, Denver and Kleť) had been obtained by the time

the comet passed perihelion in mid-March. P/Bowell-Skiff then faded much as expected, down to mag 19 at Oak Ridge on April 12 and at Denver on May 16. The final observations were obtained at Oak Ridge on June 6 and 9 and at Denver on the 10th.

Observations 1983 February 11 to June 10

1983d was an object first detected by *IRAS* near the junction of Draco, Cygnus and Lyra on April 25·9. In accordance with the arrangements to examine *IRAS* data for fast-moving minor planets in the vicinity of the Earth, the detection was made by John Davies and his colleagues at the preliminary analysis facility at the University of Leicester, and a request for confirmation was relayed to a few ground-based observatories. Only T.Oja, using the Kvistaberg Schmidt, was able to react reasonably quickly to this request, and in spite of full moonlight he was able to ascertain, 48 hr after the *IRAS* detection, that the object was in fact a comet. Oja obtained another plate on May 1, but communication to the *IRAS* facility both of the object's nature and of accurate positions from the April 27 plates was unfortunately delayed until May 3. A garbled recorded telephone message from Uppsala received at the IAU Central Bureau for Astronomical Telegrams in Cambridge, Massachusetts, mentioned that the *IRAS* object was a comet but provided no other information whatsoever; the Central Bureau had not been officially informed of the *IRAS* detection (although it had unofficially learned from Gibson at Palomar of the request for confirmation) so did not have even a rough position for the object. On May 3·6 Genichi Araki, of Yuzawa, Niigata, made an independent visual discovery of the comet, then of mag 7, and informed the Tokyo Observatory. Before the Tokyo Observatory was able to obtain confirmation the comet had also been discovered, on May 3·9, by George E.D. Alcock at Peterborough. Alcock's discovery, which was made with 15×80 binoculars from indoors and through a closed window(!), was quickly confirmed by G.M. Hurst at Wellingborough, and word of both English observations was received at the Central Bureau within the hour. The Central Bureau was still able only to suspect that *IRAS* and Alcock had observed one and the same comet. A quick consultation with Gibson in California confirmed the identity, however, and easily enabled him to find and measure the bright comet, some degrees from where he had been expecting to see a faint minor planet, on plates he had taken on May 2. Consultation at the Tokyo Observatory also eventually yielded images of the comet on May 2 plates taken by K. Ishida with the Kiso Schmidt in response to the *IRAS* request. Later still, predisccovery images of comet *IRAS*-Araki-Alcock were announced: one by T. Kumamori at Muro, Nara, on April 20, and a simultaneous pair (at mag 12) at the Sonneberg Observatory on April 17.

On May 4, only a matter of hours after the formal announcement of the comet's discovery, and in spite of the availability of only two independent accurate positions, it could also be confidently announced that on May 11 the comet would approach the Earth to within only 0·03 AU, closer than any other comet since the appearance of P/Lexell in 1770. So began a week of feverish activity, much of which has been described in detail elsewhere (e.g. Marsden & Green 1983, *Sky Telesc.*, **65**, 26). Having attained a declination of +74° on May 10, the comet was at the time of closest

approach moving south-southwestwards at some 2° hr^{-1} ; the diameter of the coma exceeded 3° , and the naked-eye total magnitude was 1.5–2.0. Although extensive physical observations were made at many wavelengths, the ones of greatest interest were those that made use of the unique opportunity to examine in detail the nuclear region of a comet. Visual observations by S.M. Larson at the Lunar and Planetary Laboratory (1.5-m reflector, magnifications up to $1000\times$) on May 11 resolved a steady disc-like object some 12 km across, while an apparent occultation of an eighth-magnitude star observed the following night by R. Nolthenius at Lockwood Valley, California, involved an object perhaps 30 km across. The comet's true nucleus was evidently still smaller (for Larson's disc was unaffected by phase), and experiments at Arecibo and at the Jet Propulsion Laboratory's Goldstone facility resulted in intense radar echoes from an object certainly no more than 5 km across; these nuclear echoes were accompanied by echoes from a surrounding 'skirt' of particles that must have been at least centimetre-sized. Spectroscopic observations by Larson, and also by P.D. Feldman and M.A'Hearn with the *International Ultraviolet Explorer* satellite, showed for the first time emissions of S_2 , these being confined to the region within 100 km of the nucleus.

During a 24-hr period beginning on May 12, comet 1983d faded by more than a magnitude, and it also became the preserve of observers in the southern hemisphere. The comet was last reported with the naked eye by Clark on the 18th, and a near simultaneous observation by Pearce (0.15-m reflector) put the comet at mag 6.0. Pearce subsequently reported the comet at mag 7.2 on May 30, 7.7 on June 12, 9.6 on July 1 and 10.5 on July 10. After the end of May the only astrometric observations to be made were those by Gilmore and Kilmartin. Their observations, made on June 16, July 11 and 12, August 14 and October 4, were crucial for establishing that the comet's revolution period is around 1000 yr. When last detected the comet was of mag 18.6.

Observations 1983 April 17 to October 4

1983e was a seventh-magnitude object independently discovered over the course of an hour on May 8.8 by three Japanese amateur astronomers: Masuo Sugano (discoverer also of an unusual variable star in Orion in late 1982) at Minami Oda, Hyogo; Yoshikazu Saigusa (one of the discoverers of comet 1975 X) of Kofu, Yamanashi; and Shigehisa Fujikawa (also involved in the discoveries of comets 1968 IV, 1968 VI, 1969 VII, 1970 I, 1975 XII and 1978 XIX), of Onohara, Kagawa. Sugano was using a 0.15-m reflector at $29\times$ and had spent 450 hr comet hunting since 1968; Saigusa used a 0.20-m reflector at $37\times$ and has hunted about 100 hr annually since 1970; Fujikawa, using 12×120 binoculars, has searched 150–200 hr annually since 1966. Having passed perihelion at a heliocentric distance of 0.5 AU a week earlier, the comet was moving into the morning sky in Andromeda, and an exposure by Skiff and C. Lugenbuhl with the Pluto telescope on May 9 showed a tail more than $1^\circ.5$ long, in pa 315° according to an observation by Everhart around the same time. By strange coincidence, just as comet 1983d was passing 0.03 AU from the Earth, it became apparent that comet 1983e would also make an unusually close passage, to some 0.06 AU on June 12. Bortle detected the tail visually ($0^\circ.3$ long in pa

310°) on May 14, and he estimated the total magnitude then to be 8.2. The comet faded slightly as the month progressed, and according to Merlin it was down to mag 8.7 on the 23rd, with the tail then extending for $0^{\circ}.1$ in pa 326° . The comet was expected to show some brightening as June began, and Merlin obtained mag 8.2 on June 5; the tail was still apparent, but it had shifted around to pa 252° , and the coma had increased to a diameter of 9 arcmin. Some 24 hr later the Dutch observer E.P. Bus was able to trace the coma with 7×50 binoculars to a diameter of 15 arcmin, and he indicated the magnitude as 6.6. As the comet approached the Earth, it became extremely diffuse, however, and several observers using large telescopes were completely unable even to detect the object, although they must have been looking right through it. A visual observation by Barker on June 9 at the McDonald Observatory showed a very weak, but essentially stellar, condensation of mag 18–19. A handful of observers did report seeing the comet with the naked eye on June 11–13, suggesting that the magnitude attained about 5.5 and the coma diameter about 1° . Radar observations at Arecibo were successful in detecting the comet's nucleus around that time, but the diameter was found to be perhaps an order of magnitude smaller than that of comet 1983d. Spectroscopic observations by Wyckoff and Wehinger on June 13 with the Steward Observatory's 2.3-m reflector had a spatial resolution of 160 km and showed the usual emissions of OH, NH, CN, C_2 , C_3 and strong [O I]. The last visual observation of comet 1983e appears to have been that by D.A.J. Seargent (The Entrance, New South Wales, 7×50 binoculars) at mag 7.8 on the 16th, the coma still being 17 arcmin across. The comet was then moving rapidly southwards, and the last known detection altogether was made by Gibson with the 1.2-m Palomar Schmidt less than a day later; at declination -38° the comet's image was badly affected by seeing, but a tolerably satisfactory positional measurement – the only one since the close approach on the 12th – was obtained.

Observations 1983 May 8 to June 17

1983f was a second detection by *IRAS*, on May 13.2, and this time the observers recognized the object, in Hydra, as possibly extended. K.S. Russell confirmed the object's cometary nature on May 18, when he recorded with the UK 1.2-m Schmidt just a trace of nebulosity, perhaps 1 arcmin across and of total mag 17, surrounding an almost stellar condensation. *IRAS* detected the comet again on May 23, and the orbit computation, based heavily on the rather rough *IRAS* positions, showed that the comet was receding from both the Sun and Earth. Exposures on May 18 and 20 with the Palomar Schmidt showed images of the comet that were weak in the moonlight, but these were successfully measured by Gibson, who was also responsible for picking up the comet again when the Moon was out of the way on May 31. Comet 1983f was observed by Gilmore and Kilmartin at Mount John on June 8 and 10, the magnitude being around 19.0 on the latter night, and the comet was last recorded two nights later with the UK Schmidt.

Observations 1983 May 13 to June 12

1983g, periodic comet du Toit-Neujmin-Delporte, was recovered by Gibson on May 20.4 and 21.4 as an essentially stellar condensation of mag

19 with a trace of coma. The comet was recorded by Everhart on June 9 and July 10, and observations were made during September 4–14 by Everhart, at Oak Ridge, and accidentally by E. Bowell with the Pluto telescope at mag 16.0–16.5. The comet was last observed at Oak Ridge in October.

Observations 1983 May 20 to October 8

1983h was periodic comet Johnson, recovered by Gilmore and Kilmartin on June 7.6 as a stellar object of mag 19. A photograph by Merlin on July 10 showed the object definitely to be cometary, and on the following nights the comet was recorded at Oak Ridge and again at Mount John. At its last pre-perihelion observation in October (Mount John) the comet had brightened to mag 17.1.

Observations 1983 June 7 to October 4, continuing

1983i was a new short-period comet, discovered by Kenneth S. Russell with the UK Schmidt on June 14.7. P/Russell 3 was slowly retrograding on the Aquarius-Aquila border, at mag 16, with a noticeable tail some 3–4 arcmin long at right angles to the direction of motion. A 10-min exposure by Gibson on June 17 showed the comet at mag 17, with a weak tail extending 2 arcmin in pa 250°. Seki, Gilmore and Mrkos agreed that the comet was around mag 16.0–16.5 into August, although Merlin suggested it was as bright as mag 13.5 (still with a 1-arcmin tail in pa 235°) on July 13. Everhart recorded the comet on September 1, and as the comet faded several further observations were made at Oak Ridge.

Observations 1983 June 14 to October 31

1983j was another *IRAS* discovery, and this also turned out to be a short-period comet. Following the *IRAS* detection in Cetus on June 28.8 Gibson confirmed the existence of a 'soft' but otherwise essentially stellar image of mag 15 on a 1.2-m Schmidt exposure on June 30. Further exposures with the same instrument on the following three nights still failed to show the object as obviously cometary, although the object's nature seemed clear from observations at Mt John on July 4, 5 and 6. By August 15, four days before perihelion passage, P/*IRAS* has become bright enough for visual detection with moderate telescopes, Bortle (0.32-m reflector) and Clark (0.41-m reflector) then judging the magnitude as 12.5 and 11.2, respectively. The comet brightened slightly more as it approached opposition in late September, Pearce (0.15-m reflector) noting it at mag 10.5 on several occasions. A number of observers also remarked on a tail up to 6 arcmin in the south-western quadrant. The comet was followed visually by C.S. Morris (Harvard, Massachusetts, 0.25-m reflector) until November 2 (mag then about 13.0), and the comet was still being followed by photographic observers at the end of the year.

Observations 1983 June 28 to end of year, continuing

1983k, yet another *IRAS* discovery, was first detected on July 11.5 and was confirmed by Russell on a plate taken by J. Dawe with the UK Schmidt on July 14 to be a comet of mag 18. In Centaurus, the comet was again recorded with the UK Schmidt on the 19th, and further approximate positions were provided by another *IRAS* detection on the 22nd. The orbit determined from these observations was sufficient to allow Gilmore and

Kilmartin to observe the comet with the small-field Mt John telescope on August 10, and a further Schmidt observation was obtained on August 5.
Observations 1983 July 11 to August 10, continuing

1983l was a twelfth-magnitude comet discovered visually by Kazimeras Černis with a 0.48-m reflector (at 65 $\times$) at the Vilnius Observatory's Majdanak Mountain Station in Uzbekistan on July 19.0. A morning object in Aries, the comet was picked up again by the discoverer 24 hr later, and thanks to the recent installation of an international telex machine at the Institute for Theoretical Astronomy in Leningrad, appropriate information about the comet could be communicated outside the USSR much more quickly than had been the case when the same observer and J. Petrauskas had discovered comet 1980k. D. di Cicco observed comet 1983l visually in Sudbury, Massachusetts, at mag 11.5 (0.28-m reflector) on the morning of July 21, and within the following eight hours the first astrometric observations had been made by Gibson and by Gilmore. Morris estimated the comet at mag 10.5 on July 22. At the Infrared Telescope Facility at Mauna Kea during August 9–11 M. Hanner noted for the first time a prominent absorption feature at 2.9–3.0 μm that could be due to scattering by ice grains in the coma of a distant comet. Travelling in a retrograde orbit with the rather large perihelion distance of 3.3 AU, the comet had in fact passed perihelion on the day of its discovery and could be expected to brighten a little more as it approached opposition in October. Indeed, the brightness did level off around mag 9.0–9.5 during October, and several observers reported a tail extending almost due northwards and to a maximum length of possibly 45 arcmin. The comet was still around mag 10.0–10.5 throughout November, and estimates by Clark (0.41-m reflector) on December 7 and 10 gave mag 11.1 and 11.4, respectively.

Observations 1983 July 19 to end of year, continuing

1983m, periodic comet Wolf, was recovered by Gibson on August 1.2 as an essentially stellar object of mag 20. He confirmed his recovery 48 hr later.

Observations 1983 August 1 and 3, continuing

1983n, periodic comet Crommelin, recovered at its second predicted return (but its fifth apparition) independently by L. Kohoutek with the 0.8-m Hamburg Schmidt at Calar Alto on August 9.0 and by Wyckoff and Wehinger with the No. 1 0.9-m reflector at Kitt Peak National Observatory on August 13.5. Using a charge-coupled device, the Kitt Peak observers obtained several 3-min exposures in *V* and *R* over an interval of 3 hr, and they measured the *V* and *R* magnitudes of the stellar object as 19.7 and 19.1, respectively. The stellar image obtained with the Hamburg Schmidt was very near the limit for that telescope, but a further observation on August 10 confirmed that the motion was consistent with that of P/Crommelin. At its previous apparitions P/Crommelin has brightened and then faded very rapidly within an interval of no more than two months surrounding perihelion passage, and its recovery more than six months before perihelion passage on 1984 February 20 was somewhat unexpected. Further observations were made by Gibson at Palomar on August 30 and 31, and a series of 21 positions were obtained using a micro-channel device on the 2-m reflector at Pic du Midi on the single night of September 4.

Kohoutek observed P/Crommelin again on September 27 and Everhart a month later. The comet was certainly then no brighter than before, and during the November dark of the Moon several observers, including Gibson, searched for the comet in vain. On the other hand, P/Crommelin seems to have brightened enough for visual detection at the end of December, Merlin reporting it at mag 12.3 (0.26-m reflector) and M. Verdenet (Bourbon-Lancy, France, telescope unspecified) at about mag 12.9 on the 29th.

Observations 1983 August 9 to end of year, continuing

1983o was recognized by Davies and Simon Green at the Rutherford-Appleton Laboratory as a possible comet shortly after its detection by *IRAS* on July 27.5, the presumed visual magnitude being 18. The object was in Carina, only 23° from the south celestial pole, and a long spell of bad weather in New South Wales prevented definite confirmation with the UK Schmidt. On September 1 *IRAS* made another independent detection of a possible comet in Centaurus, and from the motion and infrared colours (although the object was 1–2 mag brighter than before) Davies suggested identity with the July object. A rough orbital computation by C.M. Bardwell tended to support this hypothesis, and further attempts were made to obtain optical confirmation. Bad weather again prevented immediate confirmation, but Gilmore and Kilmartin picked up an object of mag 16 on September 11 with the expected position and motion. The seeing was so bad that it could not be ascertained whether the object was cometary or asteroidal, although a further pair of Mt John observations on September 16 confirmed the object's cometary nature. A mag 16 image of the comet was also subsequently measured on a UK Schmidt plate taken on August 4.

Observations 1983 July 27 to September 16, continuing

1983p was discovered on exposures with the 0.46-m Schmidt at Palomar on September 7.3 in the course of the patrol conducted by Carolyn and Eugene Shoemaker for unusual minor planets. The comet was in fact found on September 12 as Carolyn Shoemaker was examining films for possible pre-discovery images of 1983 RD, an Apollo object discovered that day by R.S. Dunbar with the 1.2-m Schmidt. Although she described the comet's magnitude as 16, observations by Skiff and Bowell with the Pluto telescope on September 14 suggested that the magnitude was closer to 12, and visual observations by Morris on the two following nights confirmed the magnitude as 12.3. Dunbar's 1.2-m Schmidt plates on the 14th showed a tail extending 2 arcmin to the north-east. On October 3 Merlin noted a 10-arcmin tail pa 248° and the magnitude as 12.2. Clark made the same magnitude estimate (but using a larger telescope) on November 5, but he found that the comet had faded to mag 12.8 on the 26th. Astrometric observations were being made into December by Everhart and McCrosky.

Observations 1983 September 7 to December 9, continuing

1983q was periodic comet Arend, recovered by Gibson on September 16.5 as a well-condensed object of mag 20.5 with a hint of a tail 15 arcsec long in pa 285°. He confirmed the recovery the next night and observed the comet again in December.

Observations 1983 September 16 to December 14

1983r, periodic comet Harrington-Abell, was recovered, again by Gibson, on September 17.5. Again, confirmation was obtained the next night, and this comet, essentially of stellar appearance, was also of mag 20.5. P/Harrington-Abell was also observed in December, this time by Everhart.

Observations 1983 September 17 to December 3, continuing

1983s was periodic comet Wild 2, making its first predicted return and three recoveries in as many nights for Gibson. The object was no brighter than mag 20 on the single exposure obtained on September 18.4, but its nature was clear from the appearance of a short tail. Gibson recorded P/Wild 2 again in mid-October, and an observation was made at Oak Ridge on November 8. Although not due at perihelion until 1984 August, P/Wild 2 had brightened enough by late November to be accidentally picked up with the Pluto telescope, magnitude estimates by Bowell giving 16.0 on November 28, 15.5 on December 9 and 15.0 on December 29.

Observations 1983 September 18 to end of year, continuing

1983t was the designation given to a comet discovered by Charles T. Kowal in mid-September on exposures he had obtained with the 1.2-m Palomar Schmidt in May. In Libra, the comet was of mag 16 with a short tail, and Kowal's observations, on May 8.2, 9.3 and 15.3, were just sufficient to obtain an orbit suggesting that the comet was a short-period one, although the period was completely indeterminate. It soon became clear that the object had in fact already been reported in May by Zdeňka Vávrová, although she had not noticed any diffuseness or tail, and the pair of Kleť images of mag 16.5 on May 14.9 had been accorded the minor-planet designation 1983 JG. By September the comet was in the region of the sky being scanned by *IRAS*, and a cometary candidate, in more or less the right position but not having the right motion, was picked up by the *IRAS* team on September 20 and 22. On September 28 Russell therefore took plates with the UK Schmidt on two assumptions: (a) that the September 20 and 22 detections were of a single comet, and (b) that the September 20 detection was of P/Kowal-Vávrová. No comet could immediately be detected on the September 28 plates, but as luck would have it, Mrkos was able to locate P/Kowal-Vávrová on another pair of Kleť exposures obtained on May 31; the comet was then of mag 16.0, and Mrkos remarked that all the Kleť images were in fact somewhat larger than those of genuine minor planets on the same plates. This information was not available until late October, by which time the comet had become impossible in evening twilight. Nevertheless, the improved orbit did enable Russell to identify a very faint, but definite, mag 18 trail of the comet on one of the September 28 Schmidt plates. This showed that the September 22 *IRAS* detection was much closer to the position of P/Kowal-Vávrová than was the September 20 detection, but there was still an unacceptable discordance of more than 15 arcmin. The *IRAS* observations remain unexplained, but they were essential for the September 28 observation of P/Kowal-Vávrová, and that observation was crucial if there is a hope that the comet can be recovered at future returns.

Observations 1983 May 8 to September 28

1983u, periodic comet Taylor, was recovered by Everhart on November 3.4 as a not obviously condensed object of mag 20. A second image on November 7 showed probable slight condensation, and there had been perhaps brightening by 0.5 mag. Gibson recorded P/Taylor on November 11 as a rather well exposed, diffuse and condensed image of mag 19, and the comet was again under observation by Everhart and at Oak Ridge in early December.

Observations 1983 November 3 to December 2, continuing

1983v was the sixth and last *IRAS* discovery, not in fact announced until after the *IRAS* cooling system had broken down and the satellite had ceased operation on November 22. The *IRAS* detection in Capricornus on November 10.4 was not obviously of a comet, and bright moonlight prevented a satisfactory attempt at confirmation with the UK Schmidt on November 14. Nevertheless, Malcolm Hartley had previously noted but not confirmed a cometary image of mag 15 on a single Schmidt exposure on November 4.5, and it occurred to Russell that the Hartley and *IRAS* objects might be identical. It still proved impossible to identify any object on the November 14 plate, but confirmation was eventually possible on the 23rd. Gibson recorded comet 1983v with the Palomar Schmidt on November 27 and 28, the short exposure on the former night showing only a weak image, although the longer exposure on the latter night yielded a strong condensation and even a hint of tail. By November 30 the comet had evidently undergone substantial brightening, for an accidental discovery was then made visually by David Levy with a 0.41-m reflector near Tucson, Arizona. Observations that same night by Skiff showed the comet at mag 12. A magnitude estimate by Levy early on December 1 gave about 11.5, while late that same day Bortle estimated mag 10.6. By that time a suspicion was developing that 1983v was yet another short-period comet. This was a startling possibility since the comet's orbit was not only retrograde, but was inclined almost perpendicularly to the ecliptic. Observations during the first week of December confirmed that P/Hartley-*IRAS* has a revolution period of only 20.7 yr and that it therefore replaces the Leonid comet P/Tempel-Tuttle (33 yr, 163°) as the retrograde comet of shortest period. An estimate by Morris gave mag 10.7 on December 8, and Merlin gave mag 10.8 on both December 28 and 29.

Observations 1983 November 4 to end of year, continuing

1983w, periodic comet Clark, was recovered, again by Gibson, on a single exposure with the 1.2-m Palomar Schmidt on December 15.5. The comet was diffuse with a condensation of mag 19.5, and there was an indication of a tail between pa 270 and 290°.

Observation 1983 December 15, continuing

Searches for P/Faye at Oak Ridge and Palomar during July–September were not obviously successful at the time. Of several candidates picked up in the crowded field where the comet was expected to be, the mag 20.5 object on a pair of Palomar Schmidt exposures by Gibson on August 31 seemed the most promising, but the comet could not be confirmed on another plate taken the following night. The reality of the August 31 detection was finally confirmed after the comet had definitely been recovered as a bright object around its perihelion passage in 1984.

In the expectation that the brightness of the 'asteroidal' comet P/Neujmin 1 might follow an inverse-square law, Gibson made a search for this object, not due at perihelion until 1984 October, on 1983 April 1 and 2. A couple of candidates were noted near the limit of detectability with the 1.2-m Schmidt, but these had to be rejected following the successful recovery of the comet in 1984.

When P/Gehrels 3 was discovered in 1975 it was anticipated that, with an orbital eccentricity of only 0.14, it might be followed around its orbit. The comet's initial brightness, however, was evidently due to its decreased heliocentric distance following a very close approach to Jupiter, and just one year after its perihelion passage in 1977 the comet had become very faint. Unsuccessful attempts to recover the comet as it approached its perihelion passage in 1985 were made by Gibson on 1983 September 1 and 2, and a candidate detected by Kohoutek with the Hamburg Schmidt at Calar Alto also proved not to be the comet.

The following continuation of the numerical designations of comets (in order of perihelion passage) is taken from *Minor Planet Circ. No. 8438* (1984):

Comet	<i>T</i>		Name	Year/letter
1982 I	March	12.3	Bowell	1980b
II	March	30.4	P/du Toit-Hartley	
III	May	9.3	P/Peters-Hartley	1982h
IV	May	15.0	P/Grigg-Skjellerup	1982a
V	July	30.6	P/Väisälä 1	1981l
VI	August	24.7	Austin	1982g
VII	September	14.3	P/d'Arrest	1982e
VIII	November	12.1	P/Churyumov-Gerasimenko	1982f
IX	November	23.2	P/Russell 3	1983i
X	November	26.9	P/Gunn	

On the following pages some recently computed orbital elements are tabulated. The times are in Ephemeris Time, and the angles are referred to the ecliptic and mean equinox 1950.0. The column headed 'Obs.' gives the number of observations on which the calculation is based, the symbol p indicating predicted elements only; an asterisk means that non-gravitational acceleration terms were included.

REFERENCES AND NOTES TO TABLE OF ELEMENTS

(1) *Nakano Note No. 427* (1983).
 (2) *Ibid.*, No. 426 (1983).
 (3) *Ibid.*, No. 432 (1983).
 (4) *Ibid.*, No. 428 (1983).
 (5) *Ibid.*, No. 430 (1983).
 (6) *Ibid.*, No. 429 (1983).
 (7) *Ibid.*, No. 442 (1983).
 (8) *Ibid.*, No. 443 (1983).
 (9) *Ibid.*, No. 444 (1983).
 (10) *Ibid.*, No. 433 (1983).
 (11) *Minor Planet Circ. No. 8386* (1983).
 (12) *Nakano Note No. 434* (1983).

- (13) *Minor Planet Circ. No. 8051* (1983).
- (14) *Nakano Note No. 441* (1983).
- (15) *Minor Planet Circ. No. 7773* (1983).
- (16) *Nakano Note No. 439* (1983).
- (17) *Minor Planet Circ. No. 8052* (1983).
- (18) *Nakano Note No. 435* (1983).
- (19) *Minor Planet Circ. No. 8272* (1983).
- (20) *Ibid.*, No. 7021 (1982). $\Delta T < 0.01$ day.
- (21) *Handb. Br. astr. Ass.*, 1982, p. 79. $\Delta T < 0.01$ day.
- (22) *Nakano Note No. 440* (1983).
- (23) *Minor Planet Circ. No. 8381* (1983).
- (24) *Nakano Note No. 399* (1981). $\Delta T = +0.03$ day.
- (25) *Minor Planet Circ. No. 7659* (1983). $\Delta T < 0.01$ day.
- (26) *Ibid.*, No. 7454 (1982). $\Delta T = -0.11$ day.
- (27) *Ibid.*, No. 8387 (1983).
- (28) *Ibid.*, No. 7659 (1983). $\Delta T = +0.01$ day.
- (29) *Nakano Note No. 417* (1982). $\Delta T = -0.3$ day.
- (30) *Handb. Br. astr. Ass.*, 1984, p. 84. $\Delta T = -0.3$ day.
- (31) *Minor Planet Circ. No. 7022* (1982). $\Delta T = +0.02$ day.
- (32) $\Delta T = +0.01$ day.
- (33) *Handb. Br. astr. Ass.*, 1983, p. 87. $\Delta T = -0.2$ day.
- (34) *Minor Planet Circ. No. 7657* (1983). $\Delta T = -0.94$ day.
- (35) *Ibid.*, No. 8465 (1984).
- (36) *IAU Circ. No. 3886* (1983).
- (37) *Minor Planet Circ. No. 7454* (1982).
- (38) *Nakano Note No. 372* (1979).
- (39) *Ibid.*, No. 416 (1982). $\Delta T < 0.01$ day.
- (40) *Minor Planet Circ. No. 7455* (1982). $\Delta T < 0.01$ day.
- (41) *Ibid.*, No. 7658 (1983). $\Delta T < 0.01$ day.
- (42) *Nakano Note No. 413* (1982). $\Delta T = +0.04$ day.
- (43) Author Kazimirchak-Polonskaya; *Trudy Inst. Teor. Astr.*, 18, 64 (1982). $\Delta T = +0.02$ day.
- (44) *Minor Planet Circ. No. 7658*. $\Delta T = -0.02$ day.
- (45) *IAU Circ. No. 3767* (1983).

Ref.	Comet	T	q	e	P	ω	Ω	i	Epoch	Obs.	Arc	Author
1682 I	P/Halley	82 Sept. 15, 2811	0.582624	0.967930	77.4	109.2039	54.8509	162.2616	82 Aug. 31	*	1682	Landgraf
1759 I	P/Halley	59 Mar. 13, 0609	0.584468	0.967688	76.9	110.6898	56.3288	162.3694	59 Mar. 21	*	1682	Landgraf
1815 III	P/Olbers	15 Apr. 26, 4920	1.212914	0.967420	74.9	65.5783	83.3407	144.4987	15 Apr. 17	99*	1815	Yeomans
1835 III	P/Halley	35 Nov. 16, 4394	0.586564	0.967400	76.3	110.6838	56.8006	162.2554	35 Oct. 9	*	1682	Landgraf
1846 III	P/Brorsen	46 Feb. 25, 8685	0.650123	0.793070	5.57	13.8021	104.1241	30.9164	46 Mar. 5	102*	1846	Landgraf
1847 V	P/Brorsen-Metcalf	47 Sept. 10, 0474	0.487918	0.972093	73.1	129.3575	311.2639	19.1458	47 Sept. 16	112*	1847	Yeomans
1857 II	P/Brorsen	57 Mar. 29, 7462	0.620514	0.801707	5.54	14.0209	103.0522	29.7992	57 Mar. 27	102*	1846	Landgraf
1868 I	P/Brorsen	68 Apr. 17, 9212	0.597025	0.807964	5.48	14.8250	102.3287	29.3708	68 Apr. 18	102*	1846	Landgraf
1873 VI	P/Brorsen	73 Oct. 10, 9803	0.593765	0.808805	5.47	14.8310	102.3088	29.4058	73 Oct. 9	127*	1868	Landgraf
1879 I	P/Brorsen	79 Mar. 31, 0341	0.589847	0.809796	5.46	14.9341	102.2801	29.3840	79 Apr. 1	127*	1868	Landgraf
1887 V	P/Olbers	87 Oct. 8, 9728	1.199085	0.930978	72.4	65.3456	83.3654	44.5724	87 Oct. 16	99*	1815	Yeomans
1900 III	P/Giacobini-Zimmer	00 Nov. 28, 4965	0.931576	0.731570	6.46	171.0507	197.4331	189.8536	00 Dec. 7	57*	1900	Yeomans
1910 II	P/Halley	10 Apr. 20, 1787	0.587208	0.967303	76.1	111.7180	54.8459	162.2157	10 May 9	*	1682	Landgraf
1911 VII	P/Schumasse	11 Nov. 13, 5247	1.225776	0.693863	8.01	44.1415	94.2025	17.6983	11 Nov. 20	19*	1911	Marsden
1913 V	P/Giacobini-Zimmer	13 Nov. 2, 5664	0.976007	0.720616	6.53	171.4861	196.3666	30.7461	13 Nov. 9	57*	1913	Yeomans
1919 III	P/Brorsen-Metcalf	19 Oct. 17, 3629	0.484870	0.971971	72.0	129.4738	311.1982	19.2178	19 Oct. 9	112	1847	Yeomans
1919 IV	P/Schumasse	19 Oct. 20, 9048	1.168332	0.706471	7.94	45.8070	91.0446	14.7429	19 Oct. 9	19*	1919	Marsden
1926 VI	P/Giacobini-Zimmer	26 Dec. 11, 7071	0.993737	0.717004	6.58	171.7543	196.2422	30.7385	26 Dec. 31	62*	1926	Yeomans
1927 VIII	P/Schumasse	27 Oct. 1, 3552	1.172085	0.705854	7.95	46.0174	90.9144	14.7185	27 Oct. 7	19*	1927	Marsden
1933 III	P/Giacobini-Zimmer	33 July 15, 1475	0.999529	0.715984	6.60	171.7702	196.2437	30.6838	33 July 27	29*	1933	Yeomans
1933 IV	P/Whipple	33 Aug. 1, 4374	2.496921	0.348190	7.50	190.5565	188.8013	10.2127	33 July 27	97*	1933	Marsden
1937 I	P/Daniel	37 Jan. 27, 8455	1.533656	0.573200	6.83	6.0425	70.4783	19.8245	37 Jan. 27	26*	1937	Marsden
1940 I	P/Giacobini-Zimmer	40 Feb. 17, 2088	0.995604	0.716705	6.59	171.7916	196.2500	30.7414	40 Feb. 21	61*	1937	Yeomans
1941 III	P/Whipple	41 Jan. 22, 3861	2.464800	0.350154	7.48	190.4493	188.8153	10.2230	41 Jan. 6	26*	1937	Marsden
1943 IV	P/Daniel	43 Nov. 22, 5188	1.524813	0.574618	6.80	6.1065	70.4403	19.8521	43 Nov. 12	97*	1937	Marsden
1943 V	P/Schumasse	43 Nov. 26, 1948	1.202128	0.704682	8.21	50.9072	86.9927	12.0433	43 Nov. 12	66*	1944	Marsden
1946 V	P/Giacobini-Zimmer	46 Sept. 18, 4864	0.995706	0.716675	6.59	171.8105	196.2936	30.7269	46 Sept. 17	84*	1939	Yeomans
1947 XIII	P/Wirtanen	47 Dec. 2, 9379	1.634969	0.540478	6.71	343.5229	86.5101	13.3560	47 Dec. 1	36*	1948	Yeomans
1948 VI	P/Whipple	48 June 25, 7395	2.448889	0.355573	7.41	190.1115	188.5963	10.2475	48 June 18	57*	1933	Marsden
1950 V	P/Daniel	50 Aug. 23, 9098	1.464540	0.586273	6.66	7.2409	69.7465	19.7023	50 Aug. 27	26*	1964	Marsden
1950 VII	P/Arend-Rigaux	50 Dec. 18, 9221	1.386439	0.610266	6.71	326.2704	124.7140	17.1880	50 Dec. 25	98	1951	Marsden
1951 X	P/Arend	51 Nov. 23, 4098	1.820972	0.535569	7.76	44.4876	257.6950	21.6997	51 Nov. 10	56*	1951	Marsden
(1) 1952 II	P/Wolf-Harrington	52 Feb. 6, 6837	1.599119	0.540671	6.50	186.9046	354.2764	18.4944	52 Jan. 29	110*	1951	Nakano
1952 III	P/Schumasse	52 Feb. 10, 6534	1.194203	0.706676	8.17	51.8307	86.3817	12.0315	52 Jan. 29	66*	1944	Marsden
1954 XI	P/Wirtanen	54 Aug. 13, 5089	1.625248	0.542051	6.69	343.5243	86.4855	13.3767	54 Aug. 6	36*	1948	Marsden
(2) 1955 XI	P/Faye	55 Mar. 4, 6586	1.618852	0.565383	7.41	200.5784	206.3120	10.5544	55 Feb. 22	182*	1954	Nakano
1955 VIII	P/Whipple	55 Nov. 29, 7487	2.449709	0.355620	7.41	190.4510	188.5103	10.2506	55 Nov. 29	99*	1947	Marsden
1956 IV	P/Olbers	56 June 19, 1395	1.178458	0.930338	69.6	64.6356	83.4123	44.6114	56 June 16	99*	1956	Yeomans
1957 VII	P/Arend-Rigaux	57 Sept. 6, 5864	1.385813	0.610427	6.71	326.3988	124.6219	17.2002	57 Aug. 30	98	1951	Marsden
1957 VII	P/Arend-Rigaux	57 Sept. 6, 5881	1.385809	0.610428	6.71	326.3990	124.6222	17.2000	57 Aug. 30	98	1951	Milbourn
(1) 1958 V	P/Wolf-Harrington	58 Aug. 11, 4174	1.604504	0.539854	6.51	187.0264	254.2253	18.4791	58 Aug. 25	110*	1951	Nakano
1959 V	P/Arend	59 Sept. 1, 2030	1.831535	0.533958	7.79	44.5929	357.6089	21.6488	59 Aug. 20	56*	1951	Marsden
1959 VIII	P/Giacobini-Zimmer	59 Oct. 26, 9171	0.935967	0.728953	6.42	172.8419	196.0301	30.9037	59 Nov. 8	87*	1965	Yeomans
1960 III	P/Schumasse	60 Apr. 18, 0552	1.195943	0.705434	8.18	51.9464	86.2406	12.0187	60 Apr. 16	66*	1944	Marsden
1961 IV	P/Wirtanen	61 Apr. 15, 2325	1.618051	0.543293	6.67	343.5028	86.4671	13.3891	61 Apr. 11	36*	1948	Marsden
(2) 1962 VII	P/Faye	62 May 14, 6965	1.608091	0.575713	7.38	203.5508	189.1258	9.0953	62 May 16	183*	1954	Nakano
1963 II	P/Whipple	63 Apr. 28, 7438	2.471069	0.352740	7.46	189.9977	188.3916	10.2437	63 May 11	90*	1947	Marsden
1963 IV	P/Jolmon	63 June 9, 1695	2.247230	0.377499	7.66	206.0417	118.1548	13.8685	63 June 20	37*	1963	Milbourn
1964 III	P/Daniel	64 Apr. 21, 2447	1.661645	0.549917	7.09	10.7835	68.5118	20.1410	64 May 5	26*	1937	Marsden
1964 V	P/Arend-Rigaux	64 June 5, 6504	1.437136	0.600263	6.82	328.8726	121.5866	17.8471	64 June 14	98	1978	Marsden

Ref.	Comet	T	q	e	P	ω	Ω	i	Epoch	Obs.	Arc	Author
(1)	1964 V	64 June 5.6524	1.437134	0.600264	6.82	328.8729	121.5868	17.8470	64 June 14	1958	-	Milbourn
	1964 X	64 Nov. 15.9306	2.346939	0.378899	7.35	21.8022	329.5543	19.5180	64 Nov. 21	1964	-	Marsden
	1965 III	65 Feb. 15.5527	1.614447	0.538114	6.53	187.0201	254.2150	18.4593	65 Feb. 9	1951	-	Nakano
	1966 I	66 Mar. 28.2844	0.933501	0.723934	6.41	177.9199	195.9650	30.9443	66 Mar. 16	1959	-	Yeomans
	1966 VII	67 Jan. 12.6998	1.502850	0.518074	5.51	179.1250	68.3733	10.5387	67 Jan. 30	1967	-	Marsden
	1967 VI	67 June 13.6578	1.822119	0.535165	7.76	44.6843	357.5272	21.6625	67 May 30	1951	-	Marsden
(3)	1967 XIV	67 Dec. 15.6498	1.612347	0.544236	6.65	343.6080	86.4026	13.4023	67 Dec. 16	1948	-	Marsden
	1969 II	69 Apr. 18.8964	2.441466	0.619514	6.80	171.1199	68.0377	10.3940	69 Apr. 9	1982	-	Marsden
	1969 V	69 Sept. 22.9775	0.558688	0.814284	5.22	184.1650	233.1049	13.1698	69 Sept. 16	1958	-	Nakano
	1969 VI	69 Oct. 7.5867	1.616294	0.574669	7.41	203.6676	199.0500	9.0825	69 Oct. 26	1954	-	Nakano
(1)	1970 IV	70 Mar. 30.0356	2.199967	0.385436	6.77	205.9988	117.8578	13.9021	70 Apr. 4	1963	-	Milbourn
	1970 XII	70 Oct. 7.0513	1.630835	0.514851	6.16	198.1076	281.1436	4.0914	70 Oct. 21	64	-	Marsden
	1970 XIV	70 Oct. 9.4190	2.479504	0.351136	7.47	189.8179	188.3932	10.2355	70 Oct. 21	90*	-	Marsden
	1971 IV	71 Apr. 6.0171	1.444372	0.599095	6.84	328.9364	121.5552	17.8334	71 Mar. 30	1951	-	Marsden
	1971 IV	71 Apr. 6.0182	1.444369	0.599096	6.84	328.9367	121.5554	17.8333	71 Mar. 30	1958	-	Milbourn
	1971 VI	71 Sept. 1.1802	1.621816	0.536763	6.55	187.0126	254.2006	18.4345	71 Sept. 6	1951	-	Nakano
	1972 I	72 Jan. 30.8250	2.155172	0.413637	7.05	23.4370	327.4615	19.2182	72 Feb. 13	1964	-	Marsden
	1972 V	72 July 15.3954	1.946682	0.519615	5.50	179.1902	68.3488	10.5493	72 July 22	99	-	Marsden
	1972 VI	72 Aug. 4.8849	0.994007	0.715089	6.52	171.9039	195.1311	31.7092	72 July 22	82*	-	Yeomans
	1974 IX	74 May 19.8551	1.533079	0.555072	6.40	259.9187	25.2009	4.6248	74 June 2	1965	-	Marsden
(3)	1974 XI	74 July 5.6730	1.255683	0.614273	5.87	351.8297	83.5407	12.2662	74 July 12	36*	-	Marsden
	1974 XVI	74 Dec. 28.1443	0.578870	0.89080	5.28	184.5680	232.9806	13.1339	74 Dec. 19	58*	-	Nakano
	1975 I	75 Jan. 5.6218	1.093596	0.799338	1.0	11.1136	26.9745	5.9118	74 Dec. 19	35 Feb.	8 - 75	Marsden
	1975 VI	75 May 24.6925	1.846923	0.537636	7.98	46.9207	355.6585	19.9555	75 May 28	56*	-	Marsden
	1976 III	76 Feb. 10.8258	2.444530	0.319080	6.80	197.4793	37.9772	10.3879	76 Jan. 23	88*	-	Marsden
	1976 VIII	76 Apr. 21.8196	1.775958	0.540097	7.59	138.4562	336.7806	10.1648	76 Apr. 12	13	-	Marsden
	1977 I	77 Jan. 8.4282	2.195668	0.386062	6.76	206.2088	117.7951	13.9067	77 Jan. 17	37	-	Milbourn
	1977 IV	77 Feb. 27.8254	1.609779	0.575610	7.39	203.6591	199.0860	9.0913	77 Feb. 26	156*	-	Landgraf
	1977 IV	77 Feb. 27.8303	1.609778	0.575612	7.39	203.6605	199.0859	9.0912	77 Feb. 26	182*	-	Nakano
	1977 VII	77 Apr. 23.2320	3.424332	0.151856	8.11	231.4818	242.5508	1.1012	77 Apr. 7	32 75 Oct.	27 - 78	Marsden
(1)	1978 II	78 Jan. 11.0158	1.496850	0.519502	5.50	179.0778	68.3402	10.5448	78 Jan. 12	99	-	Marsden
	1978 III	78 Feb. 2.4829	1.441665	0.599574	6.83	328.9863	121.5234	17.8557	78 Feb. 21	98	-	Marsden
	1978 III	78 Feb. 2.4875	1.441661	0.599555	6.83	328.9891	121.5241	17.8554	78 Jan. 12	98	-	Milbourn
	1978 VI	78 Mar. 15.8940	1.614583	0.538013	6.53	186.9816	254.2134	18.4587	78 Apr. 2	110*	-	Nakano
	1978 VIII	78 Mar. 27.5485	2.468632	0.352247	7.44	189.9770	188.3389	10.2461	78 Apr. 2	90*	-	Marsden
	1978 X	78 Mar. 27.5915	2.398637	0.392915	7.85	348.3744	154.2590	10.8818	78 Apr. 12	64	-	Marsden
	1978 XI	78 May 24.5915	2.398637	0.392915	7.85	348.3744	154.2590	10.8818	78 May 12	94	-	Marsden
	1978 XI	78 June 15.8783	1.910777	0.556714	6.17	59.8771	136.1152	3.2751	78 June 21	94	-	Marsden
	1978 XII	78 July 8.5320	1.661498	0.549980	7.09	10.8446	68.4983	20.1363	78 June 21	6	-	Marsden
	1978 XX	78 Oct. 9.4963	1.101421	0.665320	5.97	240.4365	131.5856	5.9516	78 Oct. 19	49 78 Aug.	9 - 78	Marsden
(4)	1978 XX	78 Oct. 9.4964	1.101421	0.665322	5.97	240.4365	131.5856	5.9516	78 Oct. 19	54 78 Aug.	9 - 78	Nakano
	1978 XX	78 Oct. 9.4964	1.101421	0.665322	5.97	240.4365	131.5856	5.9516	78 Oct. 19	54 78 Aug.	9 - 78	Nakano
(5)	1978 XXII	78 Nov. 21.1692	1.731831	0.511533	6.68	247.1912	141.5449	8.5409	78 Nov. 28	67	-	Nakano
	1978 XXV	78 Dec. 25.8097	1.123761	0.642951	5.58	49.3761	153.3285	9.9409	79 Jan. 7	37	-	Marsden
	1979 I	79 Jan. 13.7912	1.520842	0.563618	6.51	189.4150	247.1648	15.8047	79 Jan. 7	14	-	Marsden
	1979 III	79 Feb. 12.7740	0.996045	0.621735	6.52	171.9735	195.0694	31.7000	79 Feb. 16	82*	-	Yeomans
	1979 III	79 Feb. 12.6681	2.160006	0.413115	7.06	23.6013	327.3804	19.2047	79 Feb. 16	33	-	Marsden
	1979 VIII	79 Sept. 2.7820	0.940736	0.692962	5.36	198.7401	69.2872	11.4074	79 Sept. 4	37	-	Nakano
	1979 X	79 Sept. 21.5992	0.545164	0.987598	2.91	257.5730	102.5103	148.6038	80 Jan. 2	122	-	Nakano
	1980 I	80 Apr. 11.0826	0.580609	0.808624	5.28	184.6323	232.9288	13.1186	80 May 1	58*	-	Nakano
	1980 II	80 Apr. 19.8558	2.583897	1.000164	334.9707	178.8224	232.9288	13.1186	80 May 1	55	-	Nakano
	1980 IV	80 June 22.4547	1.002248	1.002248	337.9725	259.8713	232.9288	13.1186	80 June 10	19	-	Nakano

Ref.	Comet	T	q	e	P	ω	Ω	i	Epoch	Obs.	Arc	Author
(10)	1980 VI P/Forbes	80 Sept. 24	7736	1.479049	0.564884	6.27	262.5404	23.0172	80 Oct. 8	58*	1961	Marsden
(11)	1980 VII P/Wild 3	80 Oct. 5	1718	2.287566	0.367971	6.89	179.3282	72.0473	80 Oct. 8	33	80 Apr. 11	Nakano
(12)	1981 V Russell	81 Mar. 16	1641	2.124441	1.001723		297.1998	232.0948	81 Mar. 17	16	80 Sept. 6	Nakano
(13)	1981 IV Elias	81 Aug. 18	2254	4.742514	1.000659		310.2410	176.0068	81 Aug. 24	24	81 Apr. 3	Nakano
(13)	1981 IV Elias	81 Aug. 18	2257	4.742518	1.000659		310.2410	176.0068	81 Aug. 24	24	81 Apr. 3	Nakano
(13)	1982 I Bowell	82 Mar. 12	2926	3.363951	1.057318		134.8863	114.0562	82 Mar. 12	91	80 Feb. 11	Marsden
(13)	1982 I Bowell	82 Mar. 12	2934	3.363944	1.057314		134.8865	114.0562	82 Mar. 12	146	80 Feb. 11	Nakano
(14)	1982 VI Austin	82 Aug. 24	7293	0.647881	0.999401		33.8260	325.5637	82 Aug. 19	97	80 Feb. 11	Nakano
(11)	1982 IX P/Russell 3	82 Nov. 23	2427	2.510209	0.344602	7.50	353.4530	248.0013	82 Nov. 7	36	83 June 14	Marsden
(15)	1982 X P/Gunn	82 Nov. 26	8850	2.459137	0.316371	6.82	196.9812	67.8886	82 Nov. 7	88*	1954	Marsden
(16)	1983f IRAS	83 Jan. 18	9948	1.416806	1.0		227.0958	118.9476	83 May 18	7	83 May 18	Nakano
(17)	1983f IRAS	83 Jan. 19	0304	1.416480	1.0		227.0958	118.9476	83 May 18	7	83 May 18	Nakano
(17)	1983f IRAS	83 Jan. 19	0304	1.416480	1.0		227.0958	118.9476	83 May 18	7	83 May 18	Nakano
(18)	1983c P/Bowell-Skiff	83 Mar. 15	1704	1.944792	0.689395	15.7	168.9968	345.6048	83 Mar. 7	31	83 Feb. 11	Marsden
(18)	1983c P/Bowell-Skiff	83 Mar. 15	1716	1.944803	0.689412	15.7	168.9973	345.6048	83 Mar. 7	31	83 Feb. 11	Marsden
(19)	1983t P/Kowal-Vavrova	83 Apr. 2	1856	2.608181	0.588380	16.0	19.4261	201.8442	83 Apr. 16	12	83 May 8	Marsden
(20)	1983b P/Pons-Willecke	83 Apr. 7	5319	1.253991	0.634714	6.36	172.3194	92.7481	83 Apr. 16	46	83 May 9	Carey
(21)	1983b P/Pons-Willecke	83 Apr. 7	5319	1.253998	0.634713	6.36	172.3208	92.7469	83 Apr. 16	46	83 May 9	Carey
(17)	1983e Sugano-Saigusa-F.	83 May 1	3288	0.471081	1.000020		82.1661	82.3423	83 Apr. 16	5	83 July 14	Nakano
(22)	1983k IRAS	83 May 2	6604	2.417576	1.0		265.5528	171.0908	83 Apr. 16	6	83 July 14	Nakano
(11)	1983k IRAS	83 May 2	6749	2.417754	1.0		265.5643	171.0949	83 Apr. 16	6	83 July 14	Marsden
(19)	1983d IRAS-Araki-Alcock	83 May 21	2529	0.901341	0.990115		192.8439	48.4053	83 May 26	90	83 Apr. 27	Marsden
(23)	1983d IRAS-Araki-Alcock	83 May 21	2549	0.901340	0.989823	961	192.8435	48.4053	83 May 26	215	83 Apr. 27	Landgraf
(24)	1983q P/Arend	83 May 22	3696	1.856883	0.536397	8.02	46.9307	335.6266	83 May 26	p *	1951	Nakano
(25)	1983q P/Arend	83 May 22	3906	1.856901	0.536392	8.02	46.9284	335.6267	83 May 26	p *	1951	Marsden
(26)	1983g P/dn Toit-N.-D.	83 June 1	4256	1.708247	0.502844	6.37	115.2074	188.4063	83 May 26	p *	1951	Marsden
(19)	1983j P/Tempel 1	83 July 9	7981	1.491118	0.520897	5.49	179.0422	68.3282	83 July 5	99	1967	Marsden
(19)	1983j P/Tempel 1	83 July 21	1569	3.317706	1.001593		186.2042	208.8825	83 July 5	72	83 July 21	Marsden
(11)	1983j P/IRAS	83 Aug. 23	8021	1.696830	0.655573	13.2	356.8916	357.1602	83 July 5	70	83 June 30	Marsden
(27)	1983p Shoemaker	83 Nov. 23	7387	3.345017	1.000391		176.0240	163.9880	83 Aug. 14	67	83 Sept. 7	Marsden
(19)	1983e IRAS	83 Nov. 28	0267	2.254646	1.0		333.9918	200.5600	83 Dec. 12	5	83 Aug. 4	Marsden
(28)	1983r P/Harrington-Abell	83 Dec. 1	6603	1.785058	0.538840	7.62	138.5776	336.7210	83 Dec. 12	p	1968	Marsden
(29)	1983r P/Harrington-Abell	83 Dec. 1	9901	0.538783	0.538783	7.62	138.5741	336.7163	83 Dec. 12	p	1955	Nakano
(30)	1983r P/Harrington-Abell	83 Dec. 2	0028	1.785416	0.538784	7.62	138.5741	336.7163	83 Dec. 12	p	1955	Carey
(31)	1983h P/Johnson	83 Dec. 3	2110	2.302018	0.367493	6.94	208.1525	116.7240	83 Dec. 12	p *	1956	Nakano
(32)	1983h P/Johnson	83 Dec. 3	2244	2.302028	0.367493	6.94	208.1536	116.7242	83 Dec. 12	p *	1956	Nakano
(33)	1983u P/Taylor	84 Jan. 7	2729	1.956307	0.464110	6.97	355.8917	108.1400	83 Dec. 12	p	76 Nov. 23	Milbourn
(34)	1983v P/Taylor	84 Jan. 7	5267	1.956291	0.463899	7.00	355.6123	108.1882	84 Jan. 21	p	76 Nov. 23	Nakano
(35)	1983v P/Hartley-IRAS	84 Jan. 8	7386	1.282169	0.833661	21.3	47.1424	0.8051	84 Jan. 21	22	83 Nov. 4	Nakano
(36)	1983n P/Crommelin	84 Feb. 20	1679	0.734522	0.919195	27.4	195.8527	250.1926	84 Mar. 1	34	1956	Marsden
(37)	1983n P/Smirnova-Cher.	84 Feb. 21	4205	3.557419	0.146215	8.51	90.8715	77.0412	84 Mar. 1	1	75 Mar. 4	Marsden
(38)	1983n P/Smirnova-Cher.	84 Feb. 21	4891	3.557427	0.146222	8.51	90.8744	77.0417	84 Mar. 1	1	75 Mar. 4	Marsden
(39)	1983n P/Encke	84 Mar. 27	6792	0.340998	0.846335	3.31	185.9963	334.1823	84 Mar. 10	p *	75 Mar. 4	Nakano
(40)	1983n P/Encke	84 Mar. 27	6794	0.341000	0.846338	3.31	185.9975	334.1823	84 Mar. 10	p *	75 Mar. 4	Nakano
(41)	1983w P/Clark	84 May 29	0554	1.551184	0.502363	5.50	209.0120	59.0777	84 Apr. 20	p	1957	Marsden
(42)	1983m P/Wolf	84 May 31	8130	2.415294	0.406754	8.21	162.1752	203.5135	84 May 20	p	1973	Nakano
(43)	1983m P/Wolf	84 May 31	8333	2.415310	0.406752	8.21	162.1787	203.5132	84 May 20	p	1973	Nakano
(43)	1983s P/Wild 2	84 Aug. 20	1711	1.494005	0.556110	6.17	40.0464	136.0403	84 Aug. 8	84	1978	Marsden
(44)	1983s P/Wild 2	84 Aug. 20	1882	1.494014	0.556110	6.17	40.0460	136.0399	84 Aug. 8	84	1978	Marsden
(45)	1982i P/Halley	86 Feb. 9	4439	0.587103	0.967276	76.0	111.8480	58.1438	86 Feb. 19	625*	78 Jan. 6	Yeomans
(45)	1982i P/Halley	86 Feb. 9	5320	0.587103	0.967276	76.0	111.8468	58.1438	86 Feb. 19	625*	78 Jan. 6	Landgraf