The comets of 1995

Jonathan Shanklin

A report of the Comet Section (Director: J. D. Shanklin)

This report is the sixth in the annual series[1,2,3,4,5] which gives for each comet: the discovery details, orbital data and general information, magnitude parameters and BAA Comet Section observations. Further details of the analysis techniques used in this report are given in an earlier paper.[6] Ephemerides for the comets predicted to return during the year can be found in the BAA or ICQ *Handbooks*.[7,8]

Introduction

At the beginning of 1995 the IAU introduced a new numbering scheme for comets, with newly discovered or returning comets allocated a letter and number depending on the half month of discovery. Periodic comets with well known orbits are now allocated a sequential number based on the date of determination of the orbit. This report follows previous practice and describes all comets allocated a discovery or recovery letter and number during the year, together with previously numbered periodic comets reaching perihelion during the year.

Observers' reports of the degree of condensation (DC) have become more consistent and it is hoped that the widespread use of the Section *Guide*[9] will improve this aspect of reporting further. The observation that some periodic comets do not follow the standard magnitude law should make predictions of the magnitude of these comets at future returns more accurate.

Table 1. List of visual observers

John Aldridge	Cambridge
Sandro Baroni	Italy
Alexandr R. Baransky	Ukraine
Sally Beaumont	Windermere, Cumbria
Stephan Beck	Germany
John E. Bortle	USA
Reinder Bouma	The Netherlands
Eric Broens	Belgium
Robert Bullen	Bognor Regis, Sussex
Paul Camilleri	Australia
Matyas Csukas	Romania
Haakon Dahle	Norway
Jose Guilherme de Souza Aguiar	Brazil
Alfons Diepvens	Belgium
Bjoern Haakon Granslo	Norway
Stephen Getliffe	Haverhill, Suffolk
Werner Hasubick	Germany
Roberto Haver	Italy
Trond Hillestad	Norway
Guy M. Hurst	Basingstoke, Hampshire
Albert F. Jones	New Zealand
Andreas Kammerer	West Germany
Graham Keitch	Manaton, Devon
Attila Kosa–Kiss	Romania
Martin Lehky	Czech Republic
Romualdo Lourencon	Brazil
Oernulf Midtskogen	Norway
Herman Mikuz	Slovenia
Giannantonio Milani	Italy
Stewart Moore	Fleet, Hampshire
Charles S. Morris	USA
Brian O'Halloran	Co Tipperary, Ireland
R. M. Owens	Cardiff, South Wales
Alexei Pace	Malta
Roy W. Panther	Walgrave, Northampton
Mieczyslaw L. Paradowski	Poland
Jonathan D. Shanklin	Cambridge
Oddleiv Skilbrei	Norway
Christopher E. Spratt	Canada
David Storey	Carterton, Oxfordshire
Tony Tanti	Malta
Melvyn D. Taylor	Wakefield, Yorkshire
Steinar Thorvaldsen	Norway
Alex Vincent	Worthing, Sussex
Graham W. Wolf	New Zealand
Mauro Vittorio Zanotta	Italy

Observers who only contributed observations of 1995 O1 are listed in the report for that comet.

Comets with recovery letter designations

P/1995 A1 (Jedicke)

Robert Jedicke of the Lunar and Planetary Laboratory discovered comet 1995 A1 on 1995 January 8.4 with the 0.9m Spacewatch telescope at Kitt Peak [*IAUC* 6124, 1995 January 9]. At discovery the comet was 19th magnitude and it turned out to be a distant comet, with a period of 14.3 years, some 17 months past perihelion. When discovered it was retrograding on the border of Gemini and Cancer and

Table 2. List of astrometric, CCD and photographic observers

Observer	*Site*	*IAU station no.*
R F Blay	Ramsgate, Kent	
Bev Ewen–Smith	Portugal	965
Maurice Gavin	Worcester Park, Surrey	
Francisco Hernandez	Tenerife	
Nick James	Chelmsford, Essex	970
Stephen Laurie	Church Stretton, Salop	966
Steven Lee	Australia	
Terry Lovejoy	Australia	
Brian Manning	Stakenbridge, Worcs	494
Herman Mikuz	Slovenia	106
Martin Mobberley	Galleywood, Essex	477
	Cockfield, Suffolk	480
David Strange	Worth Matravers, Dorset	
Alex Vincent	Worthing, West Sussex	

nearing opposition; it would only have been a little brighter at the previous opposition. It has made no close approaches to Jupiter in the last 100 years.

118P/1995 M1 (Shoemaker–Levy 4)

James V Scotti of the Lunar and Planetary Laboratory recovered comet Shoemaker–Levy 4 (P/1991 C2 = 1990 XII = 1991f) with the 0.9m Spacewatch telescope at Kitt Peak on June 22.45 [*IAUC* 6180, 1995 June 28]. The comet was of stellar appearance and around mag 22. After recovery it was given the permanent number 118. Details of the discovery are given in the report for 1991.[2]

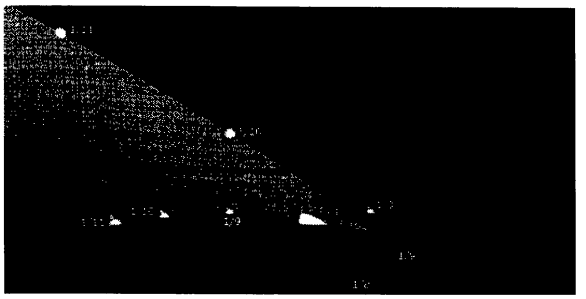

Figure 1. The orbit of comet 1995 Q1 (Bradfield) seen from a point 0.2 AU above the ecliptic plane at ecliptic longitude 150°. The bar on the Earth's orbit indicates the direction of the First Point of Aries, the bar on the comet's orbit joins the Sun to its perihelion point. The comet was discovered at T–14; observations used in the analysis cover the range T–11 to T+115. *Diagram by Nick James*

119P/1995 M2 (Parker-Hartley)

The next night Scotti also recovered comet Parker–Hartley (P/1989 E1 = 1986 TF = 1989 XXXVI = 1989i). Confirming images were obtained by Jedicke two nights later [*IAUC* 6180, 1995 June 28]. After recovery it was given the permanent number 119. The comet was discovered after a close approach to Jupiter in 1984 put it into its present orbit.

C/1995 O1 (Hale-Bopp)

Alan Hale and Thomas Bopp discovered this celebrated comet in July 1995 [*IAUC* 6187, 1995 July 23]. It was one of the most spectacular comets in recent years and a full report will be published separately. At the time of writing there are 734 days with observations, spread over 1349 days and magnitude parameters over this interval are given for completeness.

Current information on the comet is available on the CBAT (href=http://cfa-www.harvard.edu/cfa/ps/HaleBopp.html), ESO (http://www.eso.org/comet-hale-bopp/comet-hale-bopp.html) or the Section Web pages. A preliminary report on the comet appeared as a *TA* Special Publication.[14]

Table 3. Orbital data for the comets of 1995[8,10]

Comet	*T*	*q*	*e*	*P*	*ω*	*Ω*	*i*
6P/d'Arrest	1995 07 27.3186	1.345815	0.614045	6.51	178.0475	138.9885	19.5236
15P/Finlay	1995 05 05.0418	1.035564	0.710306	6.76	323.5402	42.0480	3.6739
18D/Perrine–Mrkos	1995 12 06.0517	1.293160	0.638484	6.77	166.5301	240.6306	17.8323
29P/Schwassmann–Wachmann 1	1989 09 13.5043	5.757565	0.043305	14.8	46.6924	312.8212	9.3818
30P/Reinmuth 1	1995 09 03.3308	1.873605	0.502492	7.31	13.2906	119.7398	8.1292
41P/Tuttle–Giacobini–Kresak	1995 07 28.7984	1.065281	0.656364	5.46	61.6818	141.4964	9.2252
45P/Honda–Mrkos–Pajdusakova	1995 12 25.9845	0.532052	0.824243	5.27	326.0550	89.1545	4.2483
54P/de Vico–Swift	1995 04 09.4660	2.145450	0.430681	7.32	1.9290	359.0175	6.0961
58P/Jackson–Neujmin	1995 10 06.6057	1.381174	0.661418	8.24	200.3500	160.7184	13.4783
71P/Clark	1995 05 31.0972	1.552577	0.501967	5.50	208.8491	59.7232	9.5049
73P/Schwassmann–Wachmann 3	1995 09 22.8912	0.932733	0.694839	5.34	198.7713	69.9465	11.4234
77P/Longmore	1995 10 09.3201	2.398970	0.343060	6.98	195.7973	15.6559	24.4099
A1 P/Jedicke	1993 08 17.3790	4.082675	0.308139	14.3	295.9357	116.0167	19.8755
M1 118P/Shoemaker–Levy 4	1997 01 12.1152	2.021112	0.420517	6.51	301.9808	152.0967	8.4735
M2 119P/Parker–Hartley	1996 06 24.8017	3.045217	0.290596	8.89	181.0985	244.2260	5.1858
O1 Hale–Bopp	1997 04 01.1372	0.914144	0.995079		130.5886	282.4707	89.4299
O2 120P/Mueller 1	1996 04 24.6661	2.739482	0.337378	8.41	29.9207	4.5613	8.7956
Q1 Bradfield	1995 08 31.4185	0.436388	0.998022		331.1616	178.0544	147.3942
Q2 Hartley–Drinkwater	1995 08 02.7271	1.889153	0.966518	424.00	314.0000	300.7506	168.0075
Q3 121P/Shoemaker–Holt 2	1996 08 20.0450	2.664304	0.336728	8.05	6.1268	99.7199	17.6967
S1 122P/de Vico	1995 10 06.0232	0.658889	0.962738	74.4	12.9755	79.6173	85.3898
S2 123P/West–Hartley	1996 05 12.8961	2.132957	0.447784	7.59	102.9725	46.6660	15.3463
S3 124P/Mrkos	1996 11 09.0781	1.412898	0.554249	5.64	180.5222	1.6528	31.4708
Y1 Hyakutake	1996 02 24.2874	1.054614	1.000242		46.3489	195.7612	54.4659

The epoch of the elements for each comet is the Julian date ending in zero and exactly divisible by 40, closest to the date of perihelion, except for those of 29P, which is for 1995 July 2.

Table 4a. Standard magnitude parameters of comets observed by the Comet Section

Comet		No. observations	R (AU)	H1	dev	K1	H10	dev	H15	dev
O1	Hale–Bopp	(734)	0.9–8.1	−0.69±0.03	0.4	7.66±0.06				
Q1	Bradfield	119	0.4–2.2	7.1±0.0	0.5	7.1±0.3	7.1±0.1	0.6	7.0±0.1	1.3
Q2	Hartley–Drinkwater	1	1.9				9.3		7.9	
Q3	121P/ Shoemaker–Holt 2	2	2.9				6.3±0.2	0.3	4.0±0.2	0.3
S1	122P/ de Vico	327	0.7–1.9	7.1±0.0	0.4	10.6±0.3	7.1±0.0	0.4	7.7±0.0	0.5
S2	123P/ West–Hartley	5	2.1–2.2				7.8±0.1	0.2	6.1±0.1	0.3
Y1	Hyakutake	99	1.1–1.4	7.3±0.1	0.4	4.6±1.4	7.1±0.0	0.4	6.9±0.1	0.5
	6P/ d'Arrest	139	1.3–1.9				9.0±0.1	1.6	8.3±0.1	1.6
	29P/ Schwassmann–Wachmann 1	9	6.2–6.3				1.0±0.2	0.5	−3.0±0.2	0.5
	41P/ Tuttle–Giacobini–Kresak	5	1.1				7.2±0.4	0.9	7.0±0.4	0.9
	45P/ Honda–Mrkos–Pajdusakova	49	0.5–1.3	10.7±0.1	0.8	11.1±0.8	10.7±0.1	0.8	11.0±0.1	1.0
	58P/ Jackson–Neujmin	20	1.4–1.6				11.1±0.4	1.7	10.3±0.4	1.8
	71P/ Clark	16	1.6–2.0				9.6±0.1	0.5	8.6±0.1	0.4
	73P/ Schwassmann-Wachmann 3	108	0.9-2.1	5.5±0.1	0.7	7.0±0.7	5.2±0.1	0.8	4.8±0.1	1.0

The magnitude of the comets can be calculated from the standard equation:

$$m = H1 + 5.0 * \log(\Delta) + K1 * \log(r)$$

For most comets there are insufficient observations to calculate K1 accurately and so a value of 10 or 15 is assumed, which gives the constant H10 or H15 respectively. Some comets do not follow the standard equation and are best fitted with a linear equation:

$$m = H1 + 5.0 * \log(\Delta) + K1 * \mathrm{abs}(t - T + \Delta t)$$

where t is the Julian date, T the Julian date of perihelion and Δt an offset.

Some well documented CCD V observations have been used to augment the visual light curves. A correction for aperture of 0.0033 mm^{-1} and the observer corrections derived in previous papers[11,12] have been applied and the H values are reduced to zero aperture. With a large aperture telescope a comet will appear fainter than the magnitude given by the equation. No comet had a sufficiently large coma to warrant including a coma correction. For Comet Hale–Bopp the 'number of observations' is the number of days with observations.

Table 4b. Linear magnitude parameters of comets observed by the Comet Section

Comet	No	Days	H1	K1	ΔT	Dev
6P/d'Arrest	139	−60 to +118	8.3±0.1	0.0563±0.0031	−52.8±1.9	0.8
58P/Jackson-Neujmin	20	−63 to +77	9.9±0.5	0.0415±0.0060	−72.9±11.1	0.8

120P/1995 O2 (Mueller 1)

James Scotti recovered comet Mueller 1 (P/1987 U2 = 1987 XXXI = 1987 a_1) with the 0.9m Spacewatch telescope at Kitt Peak on July 30.4 [*IAUC* 6199, 1995 August 3]. The comet was slightly diffuse and around 22nd magnitude. The prediction by S Nakano on MPC 22030 required a correction of −0.75 day. The comet, which was subsequently given the permanent number 120, made a moderately close approach to Jupiter in 1958. It is intrinsically quite faint and does not approach closer to the Earth than 1.7 AU.

C/1995 Q1 (Bradfield)

William A. Bradfield of Dernancourt, near Adelaide discovered his seventeenth comet, a mag 6 object with a tail over 1° long, on August 17.4 [*IAUC* 6206, 1995 August 18]. The comet was in Crater, two weeks from perihelion, and was well placed for some time prior to discovery. The ephemeris suggests that it would have been within easy reach of amateur telescopes from June onwards, and could have been dimly seen with the naked eye in July.

Section observations span the period T−11 to T+115 days (i.e. from 11 days before to 115 days after perihelion) running from August to December 1995. After moving into solar conjunction in early September, the elongation rapidly increased as the comet moved nearly due north through Leo and Ursa Major, then into Camelopardalus and Cassiopeia.

It was initially a southern hemisphere object and Albert Jones reported the first Section observation, making it mag 5.8 in 11×80B on August 20.32. It slowly brightened over the next 10 days until it was lost in the Sun's glow, Graham Wolf making it 5.3 in 7×50B on August 30.28. Jonathan

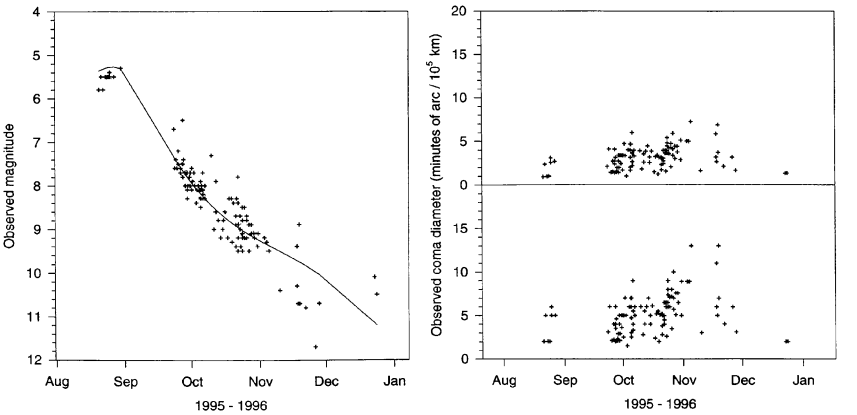

Figure 2. a) *(left)*. The observed magnitude of comet Bradfield C/1995 Q1. The curve is a best fit over the apparition, with no corrections applied. Tick marks indicate the first of each month from 1995 August. **b)** *(right)*. The coma diameter of comet C/1995 Q1. The lower panel shows the observed coma diameter in arc minutes and the upper panel the true diameter in 100,000km.

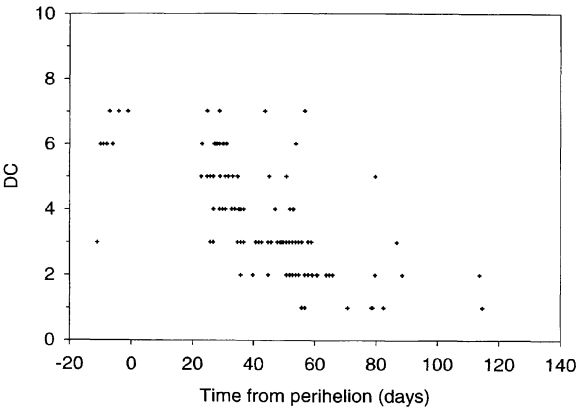

Figure 3. The DC of comet Bradfield C/1995 Q1.

Shanklin recovered it after perihelion, making it 6.7 with a strongly condensed coma in 14×100B on September 23.19. It slowly faded and became less condensed, with Chris Spratt making the last observation on Christmas Eve, when it was 10.5 in his 0.20m Schmidt–Cassegrain.

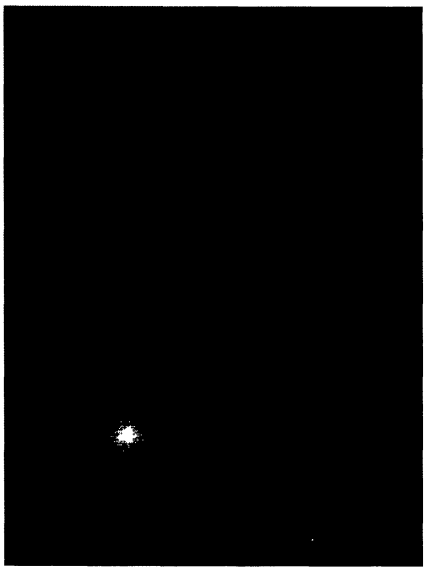

Figure 4. Comet Bradfield C/1995 Q1 imaged by Martin Mobberley on 1995 September 28.19. 80 second CCD exposure with 0.49m f4.5 Newtonian. The field is 4'×6'.

Figure 5. Comet Bradfield C/1995 Q1 photographed by Alex Vincent on 1995 September 29.18. One minute exposure on Fujichrome 400 with 135mm lens.

There is nothing unusual in the light curve to suggest why the comet was not discovered earlier, and this perhaps just reflects the lack of active comet seekers in the southern hemisphere. The coma diameter increased from around 3′ at discovery to 13′ at the time of closest approach to Earth in mid-November. There is little significant change to the true diameter, which remained at around 300,000km. The DC decreased from around 7 at the time of discovery and shortly after perihelion to around 1 when last seen.

C/1995 Q2 (Hartley–Drinkwater)

Malcolm Hartley discovered comet 1995 Q2 in Aquarius on a film taken by Michael J. Drinkwater with the 1.2m UK Schmidt at Siding Spring on August 29.5 [*IAUC* 6217, 1995 August 30]. The comet was at its brightest, a month past perihelion and at opposition on the border of Aquarius and Piscis Austrinus. Visually 13th magnitude, the comet faded after discovery as it receded from the earth and Sun. Only Charles Morris was able to view the comet, making it 12.9 in his 0.26m reflector on September 3.2.

121P/1995 Q3 (Shoemaker–Holt 2)

Also on August 29, James Scotti of the Lunar and Planetary Laboratory recovered comet Shoemaker–Holt 2 (P/1989 E2 = 1988 XI = 1989j) with the 0.9m Spacewatch telescope at Kitt Peak. The comet was of stellar appearance at mag 21 [*IAUC* 6219, 1995 September 1]. The prediction by Dan Green on MPC 22032 required a correction of –1.2 days. The comet was subsequently given the permanent number 121. It made a moderately close approach to Jupiter in 1984 and does not approach closer to the Earth than 1.7 AU.

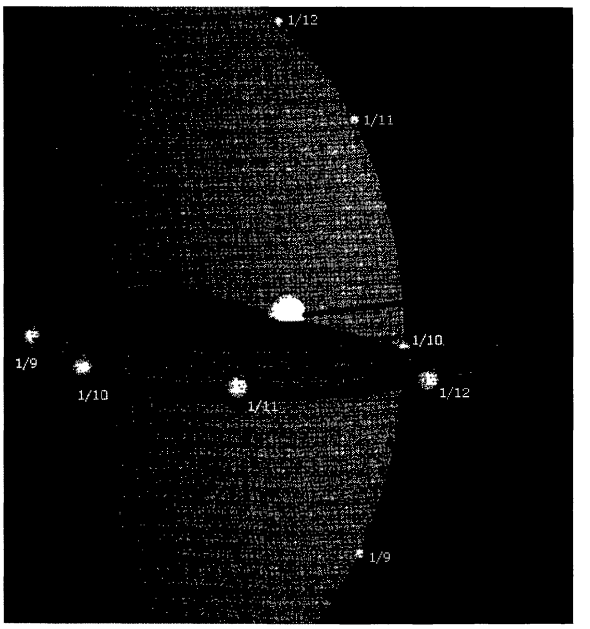

Figure 6. The orbit of comet 122P/de Vico seen from a point 0.5 AU above the ecliptic plane at ecliptic longitude 45°. The bar on the Earth's orbit indicates the direction of the First Point of Aries, the bar on the comet's orbit joins the Sun to its perihelion point. The comet was discovered at T–19; observations used in the analysis cover the range T–18 to T+104. *Diagram by Nick James*

Werner Hasubick made a couple of observations of the comet in early March 1997 when it was 14th magnitude in his 0.44m reflector.

122P/1995 S1 (de Vico)

Three Japanese observers, Yuji Nakamura (Suzuka, Mie), Masaaki Tanaka (Iwaki, Fukushima), and Shougo Utsunomiya (Minamioguni, Kumamoto) made independent visual discoveries of a comet on September 17, which turned out to be the lost comet P/de Vico. All were using large binoculars of between 120 and 150mm aperture. [*IAUC* 6228, 1995 September 18]. The comet was subsequently numbered 122. A prediction in the *Journal* by Richard J. Buckley[13] had given a predicted perihelion date of 1996 July 3 with an uncertainty of several years. The comet should have returned on 1922 April 8, but was not seen, despite the circumstances being relatively favourable.

Section observations cover the period T–18 to T+104 days. When discovered the comet was brightening rapidly towards perihelion, though it would have been visible to southern hemisphere observers for a couple of months earlier. Generally it was at poor solar elongations, moving NW from its discovery in Hydra, through Leo and Coma, reaching its most northerly position in Canes Venatici. It then began to drift south, moving through Boötes and Corona Borealis and was last seen in Hercules.

The comet was initially an early morning object, and *TA* contributor Charles Morris reported the first observation on September 18.5, soon after discovery, when it was 6.5 in 20×80B, highly condensed with a 1° tail. As it moved north, UK observers were able to pick it up and Jonathan Shanklin sighted it on September 23.17 in 20×80B at 5.9. It was imaged by Nick James on 1995 September 29.19.[15] By perihelion on October 6 it was at its brightest and becoming widely observed. Roy Panther made it 5.4 in 7×50B on October 5.19 and observers in more favourable locations were estimating tail lengths of several degrees. By early November it was fading, but becoming visible in the evening sky, Robert Bullen estimating it at 6.7 in his 0.21m reflector ×64 on November 2.76. Visual observers lost the comet at the end of the month, Attila Kosa–Kiss making the last observation on November 27.72 when it was 9.2 in his 0.06m refractor ×52, with a weakly condensed coma. Herman

Table 5. Ephemeris for comet Bradfield (C/1995 Q1)

Magnitudes calculated from m = 7.1 + 5.0 * Log(Δ) + 7.1 * Log(r)
Latitude: 53.0°N Longitude: 0.0°W

Day	*R.A.* *hh mm.m* *(2000.0)*	*Dec* *°.mm*	*Mag*	*Δ* *AU*	*R* *AU*	*Observable* *hh.mm* *to hh.mm*	*Elong.* *°*
1995 May							
02/03	00 04.8	–09.47	12.0	2.91	2.32	Not observable	46
12/13	00 14.9	–09.55	11.6	2.63	2.18	Not observable	53
22/23	00 25.9	–10.19	11.1	2.33	2.03	Not observable	60
1995 June							
01/02	00 38.0	–11.09	10.6	2.01	1.87	Not observable	68
11/12	00 52.3	–12.37	9.9	1.68	1.72	Not observable	74
21/22	01 10.5	–15.10	9.1	1.35	1.55	Not observable	81
1995 July							
01/02	01 37.4	–19.45	8.1	1.02	1.39	Not observable	86
11/12	02 28.0	–28.25	7.0	0.71	1.21	Not observable	87
21/22	04 42.1	–42.25	5.7	0.49	1.03	Not observable	78
31/32	08 45.3	–38.34	5.1	0.51	0.85	Not observable	57
1995 August							
10/11	10 34.1	–21.50	5.2	0.74	0.67	Not observable	41
20/21	11 09.1	–10.24	5.1	1.05	0.51	Not observable	29
30/31	11 17.6	–01.04	5.2	1.33	0.44	Not observable	14
1995 September							
09/10	11 15.4	07.22	5.9	1.51	0.50	Not observable	2
19/20	11 12.2	14.32	6.8	1.56	0.65	Not observable	16
29/30	11 10.6	20.57	7.5	1.54	0.83	03.40 to 04.37	30
1995 October							
09/10	11 09.9	27.24	8.0	1.49	1.02	02.28 to 04.55	43
19/20	11 08.8	34.30	8.4	1.41	1.20	01.03 to 05.12	57
29/30	11 05.7	42.51	8.7	1.32	1.37	17.59 to 18.05 23.03 to 05.29	71
1995 November							
08/09	10 56.7	52.48	8.9	1.25	1.54	17.42 to 05.45	86
18/19	10 32.3	64.09	9.1	1.21	1.70	17.29 to 06.01	101
28/29	09 15.6	75.14	9.4	1.22	1.86	17.21 to 06.15	115
1995 December							
08/09	05 30.4	79.33	9.8	1.30	2.01	17.17 to 06.27	123
18/19	02 53.9	73.17	10.3	1.44	2.16	17.18 to 06.35	125
28/29	02 09.2	65.35	10.8	1.64	2.31	17.24 to 06.39	121
1996 January							
07/08	01 55.6	59.15	11.2	1.88	2.45	17.34 to 06.39	114
17/18	01 52.9	54.24	11.7	2.14	2.59	17.47 to 03.30	106
27/28	01 55.3	50.47	12.1	2.42	2.73	18.02 to 01.39	98

The observable period is defined for the given location as the time when the Sun is below –13° altitude and the comet above an altitude that depends on its magnitude. The comet may be visible outside this period under good conditions or from a different location.

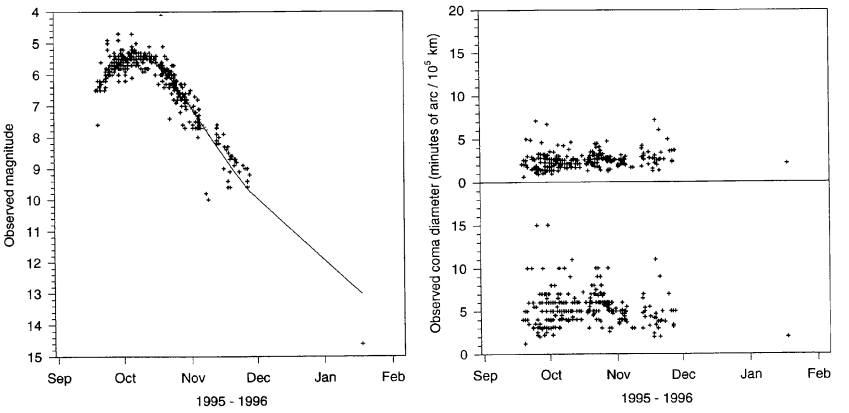

Figure 7. a) *(left).* The observed magnitude of comet 122P/de Vico. The curve is a best fit over the apparition, with no corrections applied. Tick marks indicate the first of each month from 1995 September. **b)** *(right).* The observed coma diameter of comet 122P/de Vico. The tick marks indicate the first of each month from 1995 September. The lower panel shows the observed coma diameter in arc minutes and the upper panel the true diameter in 100,000km.

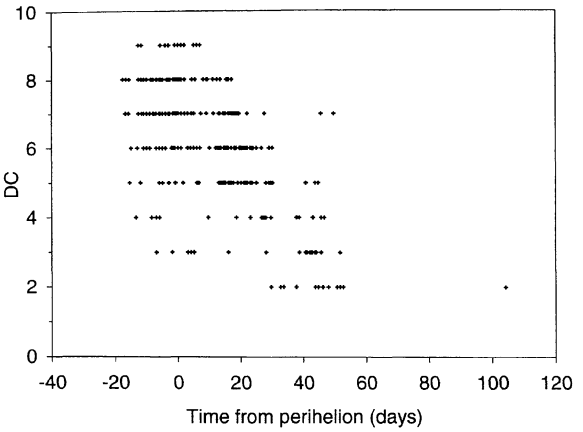

Figure 8. The DC of comet 122P/de Vico.

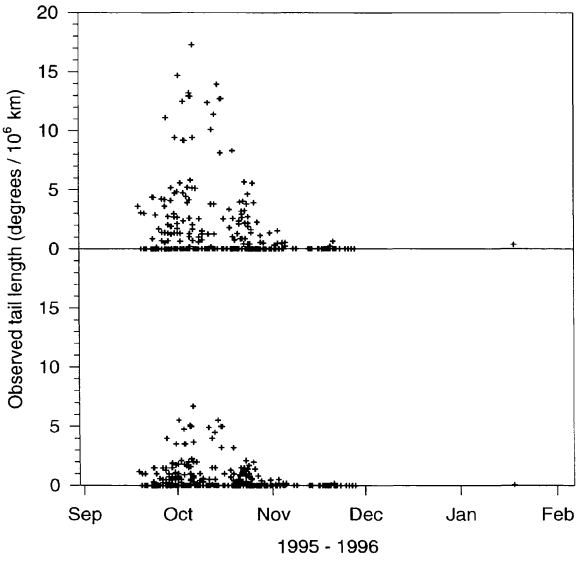

Figure 9. The observed tail length of comet 122P/de Vico. The tick marks indicate the first of each month from 1995 September. The lower panel shows the observed tail length in degrees and the upper panel the true length in 1,000,000km.

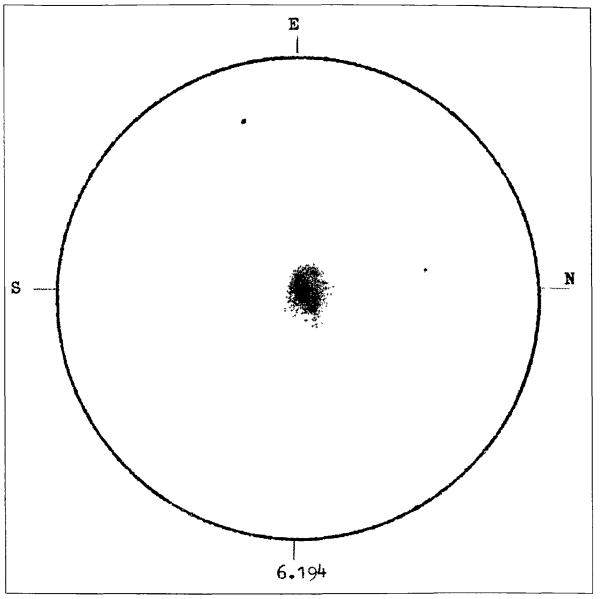

Figure 11. Comet 122P/de Vico drawn by Robert Bullen on 1995 October 6.2. He used a 0.21m f7 reflector ×64.

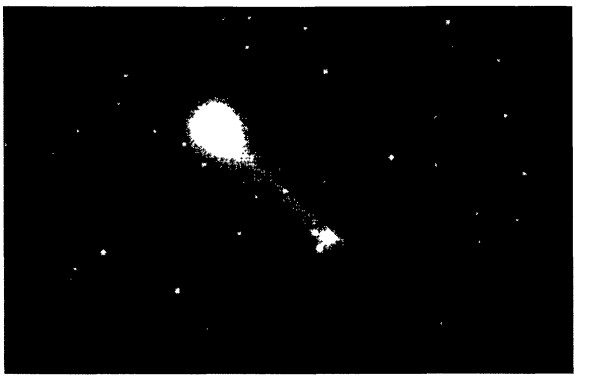

Figure 12. Comet 122P/de Vico imaged in a 90 second integration by Denis Buczynski on 1995 October 5.19, using a 0.125m f3.5 Celestron Comet Catcher and SX framestore CCD. The field is 45'×30' with NE up and NW right.

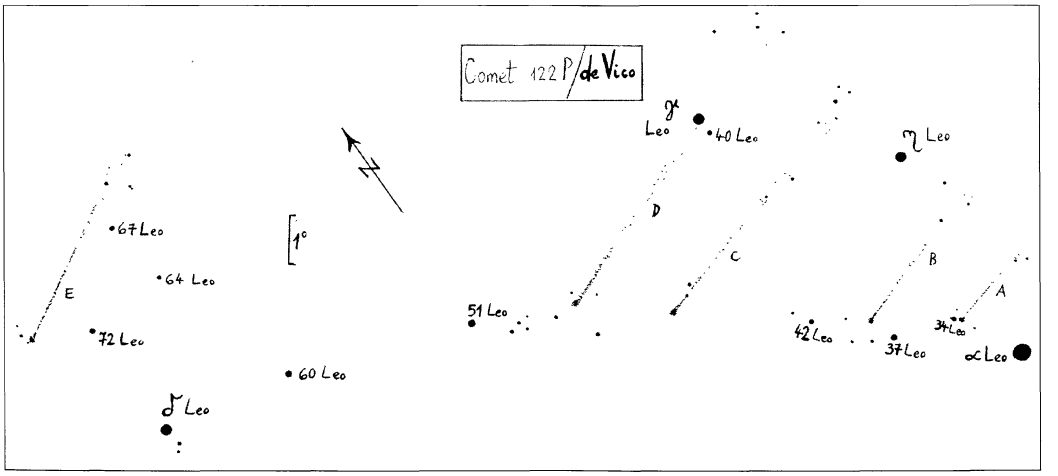

Figure 10. The tail development of comet 122P/de Vico drawn by Attila Kosa–Kiss using 7×50 binoculars. **A:** October 2.11; **B:** October 3.13; **C:** October 5.12; **D:** October 6.11.

Table 6. Ephemeris for comet 122P/de Vico (1995 S1)

Magnitudes calculated from m = 7.1 + 5.0 * Log(Δ) + 10.6 * Log(r)
Latitude: 53.0°N Longitude: 0.0°W

Day	*R.A.* *hh mm.m* *(2000.0)*	*Dec* *°.mm*	*Mag*	*Δ* *AU*	*R* *AU*	*Observable* *hh.mm* *to hh.mm*	*Elong.* *°*
1995 June							
01/02	04 47.9	–53.56	12.6	2.25	2.24	Not observable	76
11/12	05 17.0	–50.05	12.2	2.16	2.10	Not observable	73
21/22	05 43.8	–46.09	11.8	2.08	1.97	Not observable	70
1995 July							
01/02	06 08.6	–42.10	11.4	2.00	1.83	Not observable	66
11/12	06 31.7	–38.12	10.9	1.92	1.69	Not observable	61
21/22	06 53.4	–34.13	10.4	1.85	1.55	Not observable	57
31/32	07 14.1	–30.10	9.9	1.76	1.41	Not observable	53
1995 August							
10/11	07 34.1	–25.54	9.3	1.67	1.26	Not observable	49
20/21	07 54.2	–21.13	8.6	1.56	1.12	Not observable	45
30/31	08 15.4	–15.47	7.8	1.44	0.97	Not observable	43
1995 September							
09/10	08 39.7	–09.02	6.9	1.30	0.84	Not observable	40
19/20	09 11.5	–00.19	6.0	1.16	0.74	03.59 to 04.18	39
29/30	09 58.3	10.44	5.3	1.03	0.67	03.02 to 04.37	39
1995 October							
09/10	11 09.7	22.27	5.1	0.96	0.66	02.24 to 04.55	40
19/20	12 43.3	30.10	5.6	1.00	0.72	18.18 to 19.16 02.26 to 05.12	42
29/30	14 13.0	31.29	6.4	1.12	0.82	17.59 to 20.06 03.17 to 05.29	45
1995 November							
08/09	15 20.2	29.08	7.4	1.31	0.95	17.42 to 20.00 04.18 to 05.45	46
18/19	16 07.3	25.58	8.4	1.51	1.09	17.29 to 19.30 05.03 to 06.01	46
28/29	16 41.4	23.07	9.2	1.71	1.23	17.21 to 18.52 05.32 to 06.15	45
1995 December							
08/09	17 07.5	20.51	10.0	1.91	1.38	17.17 to 18.09 05.47 to 06.27	44
18/19	17 28.4	19.10	10.6	2.09	1.52	17.18 to 17.25 05.54 to 06.35	43
28/29	17 45.7	18.00	11.2	2.25	1.66	05.54 to 06.39	43
1996 January							
07/08	18 00.2	17.18	11.7	2.38	1.80	05.49 to 06.39	44
17/18	18 12.4	16.58	12.1	2.50	1.94	05.40 to 06.34	46
27/28	18 22.7	16.58	12.5	2.59	2.08	05.26 to 06.24	49
1996 February							
06/07	18 31.1	17.16	12.9	2.66	2.21	05.08 to 06.10	53

Figure 13. The orbit of comet C/1995 Y1 (Hyakutake) seen from a point 0.4 AU above the ecliptic plane at ecliptic longitude 175°. The bar on the Earth's orbit indicates the direction of the First Point of Aries, the bar on the comet's orbit joins the Sun to its perihelion point. The comet was discovered at T–60; observations used in the analysis cover the range T–38 to T+58. *Diagram by Nick James*

Mikuz made a final CCD observation in mid January 1996 when it had faded to 14.6. Several images of the comet were published in *TA*.[16,17]

The coma diameter increased from around 4′ at discovery to around 6′ a week after perihelion, decreasing back to 4′ when last observed visually two months later. Some estimates were larger than this, over 10′ in diameter being reported. The true diameter increased from around 200,000km at discovery to perhaps 300,000km in late October, before shrinking back again. The DC increased a little between discovery and perihelion, from around 7 to 8. It then became steadily less condensed until it was around 2 when last observed visually. Tail development was maximum around the time of perihelion, with a maximum reported length of 5°–6°, corresponding to a real length of between 10 and 15 million km.

123P/1995 S2 (West–Hartley)

James Scotti and Tom Gehrels of the Lunar and Planetary Laboratory recovered comet West–Hartley (P/1989 E3 = 1988 XVI = 1989k) with the 0.9m Spacewatch telescope at Kitt Peak on September 21 [*IAUC* 6249, 1995 October 21]. The comet had a nuclear magnitude of 21, with a 10′ diameter coma and tail around 30′ long in pa 270. The prediction by S Nakano on MPC 22031 required a correction of 0.91 days. The comet has made no recent close approaches to Jupiter.

Werner Hasubick and Herman Mikuz were able to observe the comet in late February 1996, making it between 13th and 14th magnitude. Reinder Bouma estimated it at a similar magnitude in April. The poor spring weather and competition from comet Hyakutake probably contributed to the lack of observations.

124P/1995 S3 (Mrkos)

C. W. Hergenrother and Warren Offutt made CCD recoveries of comet Mrkos (P/1991 F1 = 1991 IV = 1991k) on September 20 and 28 respectively [*IAUC* 6250, 1995 October 23]. The comet was identified and measured by C. W. Hergenrother on an image taken by Steven M. Larson (Lunar & Planetary Laboratory) using the 2.3m f/2 Steward reflector, Kitt Peak. It had a stellar appearance and was nuclear magnitude 22 in the red. Offutt is an amateur astronomer from Cloudcroft, New Mexico and used a 0.6m f/7 Ritchey–Chretien. The comet, which was discovered at a favourable return in 1991, was subsequently numbered 124.

C/1995 Y1 (Hyakutake)

Yuji Hyakutake of Hayato, Aira-gun, Kagoshima-ken, discovered an 11th magnitude comet in twilight on

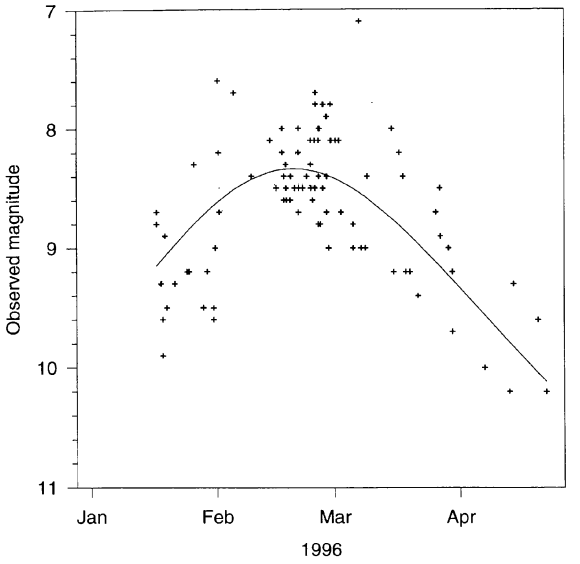

Figure 14. The observed magnitude of comet C/1995 Y1 (Hyakutake). The curve is a best fit over the apparition, with no corrections applied. Tick marks indicate the first of each month from 1996 January.

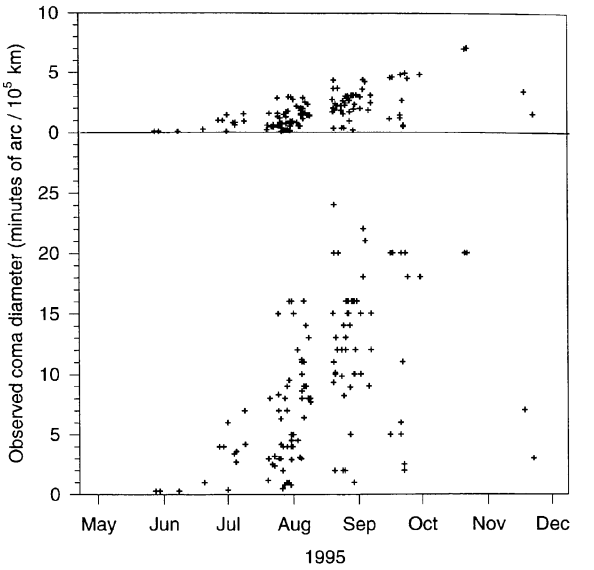

Figure 16. The coma diameter of comet 6P/d'Arrest. The lower panel shows the observed coma diameter and the upper panel the true diameter in 100,000km. Tick marks indicate the first of each month from 1995 May.

December 25.9 using 25×150B [*IAUC* 6279, 1995 December 26]. It was confirmed the next day by other Japanese observers. The comet was two months from perihelion, but remained at a generally poor elongation.

Section observations span the period T–38 to T+58, and the combination of the poor spring weather of 1996, an early morning apparition and the attractions of the more spectacular comet Hyakutake 1996 B2 seem to have put off many observers. At discovery the comet was moving west in Hydra, but soon began moving north, passing through Libra, Ophiuchus, Aquila, Vulpecula and was last seen in April in Pegasus.

The comet was not observed from Europe until mid-January, Victorio Zanotta estimating it at 9.3 in 25×150B on January 18.19, with a moderately condensed coma of 4' diameter. Herman Mikuz imaged the comet the same night.[18] Martin Mobberley imaged the comet on 1996 February 1.26.[19] It was brightest in late February, near perihelion, and Jonathan Shanklin made it 7.8 in 14×100B on February 27.21. Graham Wolf recorded it at near 9th magnitude in March using a variety of instruments. The comet faded to around mag 10 in April according to estimates by Bjorn Granslo and Reinder Bouma. No later observations were received, although the ephemeris suggests that the comet should have been easily observable until at least May. It must have faded quite rapidly and this is borne out by the few observations reported in the *ICQ*. The coma diameter was generally reported around 4'–5' throughout the apparition, with a DC of 4.

The numbered comets at perihelion in 1995

6P/d'Arrest

The comet made its 17th observed return, which was a good one with the comet reaching perihelion when near opposition. It was first observed by La Hire in 1678 and only three other periodic comets (Halley, Swift–Tuttle and Tempel–Tuttle) have a longer observational interval. At a good return it can reach naked eye brightness, but orbital perturbations have increased its perihelion distance over the past few returns and predictions suggested that it was unlikely that it would get brighter than 11th magnitude at this return.

Section observations covered the apparition very well and it was observed from 1995 May until November, which covers the period from T–60 to T+118. Beginning the

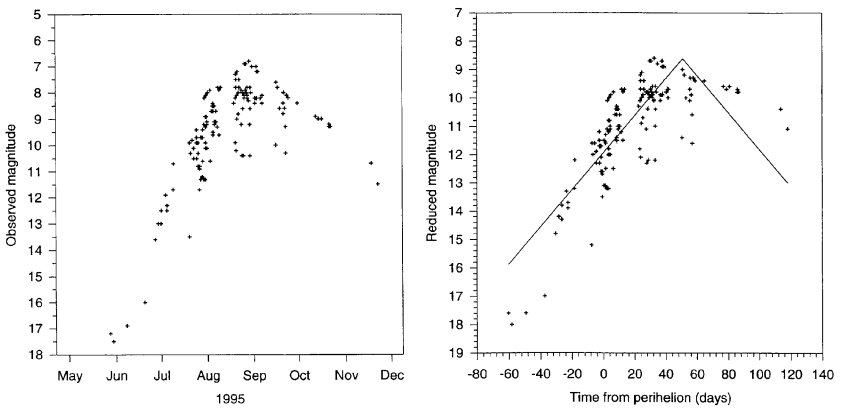

Figure 15. a) *(left)*. The observed magnitude of comet 6P/d'Arrest. Tick marks indicate the first of each month from 1995 May. **b)** *(right)*. The reduced magnitude of comet 6P/d'Arrest. The curve is a best fit over the apparition, with corrections for aperture and observer applied.

Table 7. Ephemeris for comet Hyakutake (C/1995 Y1)

Magnitudes calculated from m = 7.3 + 5.0 * Log(Δ) + 4.6 * Log(r)
Latitude: 53.0°N Longitude: 0.0°W

Day	*R.A. hh mm.m (2000.0)*	*Dec °.mm*	*Mag*	*Δ AU*	*R AU*	*Observable hh.mm to hh.mm*	*Elong. °*
1995 October							
09/10	10 51.4	−22.57	11.4	3.07	2.33	Not observable	35
19/20	11 12.2	−23.46	11.2	2.92	2.21	Not observable	37
29/30	11 34.3	−24.34	11.0	2.76	2.09	Not observable	39
1995 November							
08/09	11 57.9	−25.18	10.7	2.60	1.97	Not observable	42
18/19	12 23.1	−25.54	10.5	2.42	1.86	Not observable	45
28/29	12 50.5	−26.15	10.2	2.25	1.74	Not observable	47
1995 December							
08/09	13 20.4	−26.14	9.9	2.07	1.63	Not observable	50
18/19	13 53.2	−25.40	9.5	1.90	1.51	Not observable	52
28/29	14 29.5	−24.19	9.2	1.73	1.41	Not observable	55
1996 January							
07/08	15 09.5	−21.55	8.8	1.57	1.31	06.13 to 06.39	56
17/18	15 53.5	−18.10	8.5	1.43	1.22	05.23 to 06.34	57
27/28	16 41.0	−12.51	8.2	1.32	1.15	04.41 to 06.24	57
1996 February							
06/07	17 31.1	−06.05	8.0	1.26	1.09	04.03 to 06.10	57
16/17	18 22.2	01.32	7.9	1.24	1.06	03.30 to 05.53	56
26/27	19 12.4	09.05	7.9	1.27	1.06	03.01 to 05.33	54
1996 March							
07/08	19 59.8	15.44	8.1	1.34	1.08	02.36 to 05.10	52
17/18	20 43.2	21.07	8.3	1.44	1.12	02.14 to 04.46	51
27/28	21 21.9	25.17	8.6	1.55	1.19	01.54 to 04.20	50
1996 April							
06/07	21 55.9	28.27	8.9	1.67	1.27	01.35 to 03.53	49
16/17	22 25.6	30.52	9.2	1.78	1.36	01.15 to 03.25	50
26/27	22 51.2	32.47	9.4	1.88	1.46	00.55 to 02.56	51
1996 May							
06/07	23 13.1	34.18	9.7	1.96	1.57	00.33 to 02.27	53
16/17	23 31.6	35.33	9.9	2.03	1.69	00.09 to 01.58	56
26/27	23 47.0	36.34	10.1	2.09	1.80	23.43 to 01.30	60
1996 June							
05/06	23 59.4	37.24	10.2	2.12	1.92	23.15 to 01.04	65
15/16	00 08.7	38.02	10.4	2.14	2.04	23.15 to 00.47	70
25/26	00 14.9	38.29	10.5	2.15	2.16	23.17 to 00.48	77
1996 July							
05/06	00 18.0	38.41	10.6	2.14	2.28	22.59 to 01.10	84
15/16	00 17.8	38.36	10.7	2.13	2.39	22.34 to 01.38	92
25/26	00 14.5	38.10	10.8	2.11	2.51	22.06 to 02.07	101
1996 August							
04/05	00 08.3	37.17	10.8	2.10	2.63	21.37 to 02.35	110
14/15	23 59.7	35.55	10.9	2.09	2.74	21.08 to 03.01	120
24/25	23 49.3	33.59	11.0	2.10	2.86	20.39 to 03.25	130

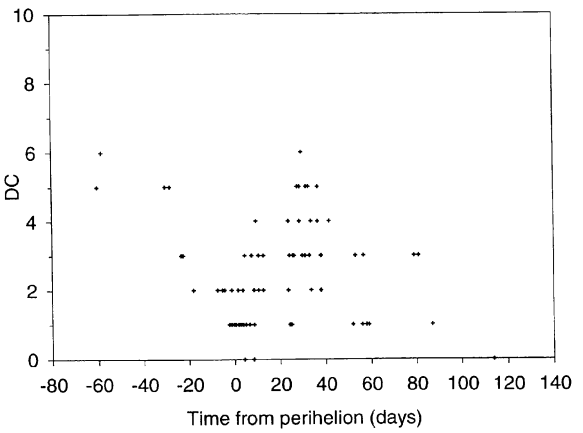

Figure 17. The DC of comet 6P/d'Arrest.

apparition in Delphinus, it reached its most northerly declination in mid-June and then moved quickly SW through Pegasus, Pisces, Aquarius and Cetus during July and August. Its motion slowed and it reached its most southerly point in Sculptor in early October before slowly moving north again.

Herman Mikuz made early CCD observations of the comet with his 0.36m Schmidt–Cassegrain and ST6 combination with V filter, first recording it on May 28.07 when it was 17.2. An image taken two days later was published in *TA*.[20] Werner Hasubick made an early visual observation on June 30.95 estimating it at 13.0 in his 0.44m reflector. By mid-July it had brightened considerably, and Jonathan Shanklin made it 9.8 in 14×100B on July 22.00, with a quite diffuse, 2.5' diameter coma. The comet was imaged by David Strange on July 21/22[21] and by Martin Mobberley on 1995 August 5.05.[22] Peak brightness was reached in late August, though by this time it was low in the sky for UK observers, giving quite large scatter in the magnitude estimates. John Bortle made it as bright as 6.8 in 10×50B on August 29.30 with a 16' diameter coma, while Shanklin made it only 8.6 in 14×100B on August 30.03 with a 10' diameter coma. It slowly faded, though generally only southern hemisphere observers could follow it. Albert Jones made it 9.3 in his 0.08m refractor ×30 on September 22.47 and the last observation was made by Paul Camilleri on November 22.44 when it was 11.5 in his 0.20m reflector ×56, with a totally diffuse, 3' diameter coma.

Conventional wisdom suggested that the comet flared in brightness post perihelion, which was in late July, though analysis of the light curve paints a different picture. The standard form of light curve gives a very poor fit, and a better one is obtained using a linear fit to the reduced magnitude. This suggests that the comet's intrinsic brightness peaked about 50 days after perihelion, explaining what has previously been reported as a flare. The coma diameter increased from a few tenths of an arcminute in early June and seems to have peaked at around the time of maximum brightness in late August, with observers reporting it to be around 20' in diameter at this time. The real diameter of the coma appears to have continued increasing until October, peaking at around 600,000km. The DC observations suggest a general decline from around 6 two months prior to perihelion to 0 four months after perihelion.

15P/Finlay

P/Finlay had a very unfavourable apparition with closest approach being just under 2 AU. The comet can approach Mars quite closely and passed 0.06 AU from the planet in 1814 and 1834 and 0.09 AU in 1960.

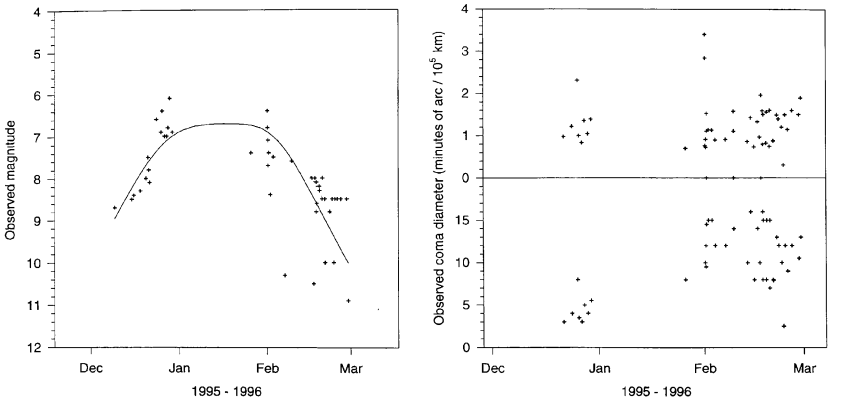

Figure 18. **a)** *(left).* The observed magnitude of comet 45P/Honda–Mrkos–Pajdusakova. The curve is a best fit over the apparition, with no corrections applied. Tick marks indicate the first of each month from 1995 December. **b)** *(right).* The coma diameter of comet 45P/Honda–Mrkos–Pajdusakova. The lower panel shows the observed coma diameter and the upper panel the true diameter in 100,000km. Tick marks indicate the first of each month from 1995 December.

18P/Perrine–Mrkos

The comet was not observed at this return, and it has not been seen since 1968. When discovered in 1896 it was 8th magnitude, the next return was unfavourable but it was only mag 13 in 1909. It was then lost between 1909 and 1955 when it was rediscovered at mag 9. It only reached 17th magnitude in 1962 and mag 13 in 1968, and was fainter than mag 19 in 1975. It seems that the comet is subject to occasional outbursts, so it would be worth keeping an eye on the predicted ephemeris position at future returns.

30P/Reinmuth 1

Karl Reinmuth discovered this comet during the course of a minor planet survey at Heidelberg Observatory in 1928. This was its best return and it reached 12th magnitude, however an encounter with Jupiter in 1937 increased the perihelion distance and it was missed in 1942/43. Since then it has not become brighter than mag 17. The comet was recovered in 1994 and was discussed in the report for that year.[5]

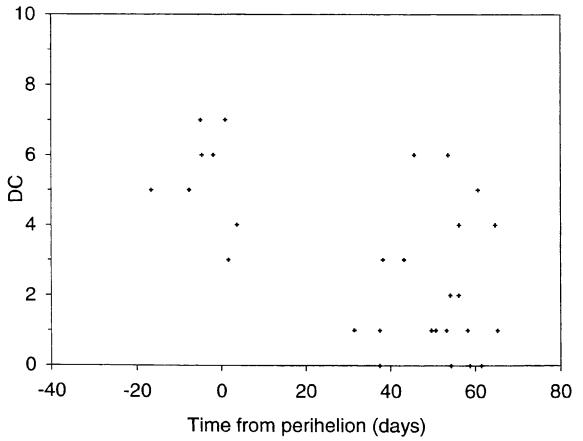

Figure 19. The DC of comet 45P/Honda–Mrkos–Pajdusakova.

41P/Tuttle–Giacobini–Kresak

P/Tuttle–Giacobini–Kresak had an unfavourable apparition, with the solar elongation not exceeding 50°. Its peak magnitude is a little variable and at most good apparitions it normally reaches mag 10 though in 1973 it experienced an outburst and reached 4th magnitude. It was not expected to do very well at this return, with a predicted maximum of around mag 12. There are however suggestions of some sort of outburst as several observers recorded it at 9th magnitude between August 22 and 27, after which it dramatically faded, reaching 11.6 only three days later according to Alexandr Baransky observing with his 0.35m reflector ×70. Unfortunately there are insufficient observations to draw any meaningful conclusions about the light curve.

45P/Honda–Mrkos–Pajdusakova

This comet made its 9th observed return since discovery in 1948 (it was missed in 1959). The comet was at perihelion on Christmas Day and in conjunction 20 days later. A few observers managed to see it before perihelion, under near impossible conditions with the comet only a few degrees above the horizon during evening twilight. More observers managed to locate it as it pulled away from the Sun after conjunction, though conditions were still difficult. It was observed by the coronagraphs of the SOHO satellite near perihelion. During December the comet moved west through Sagittarius, reaching conjunction in Capricornus. After conjunction it moved rapidly NE back into Sagittarius and through Scutum, Ophiuchus, Serpens, Boötes and reached Coma in late February. Section observations span the period between T–17 and T+65.

Graham Wolf picked the comet up on December 9.40, making it 8.7 in his 0.18m reflector ×23, with a DC of 5. It brightened to reach a broad peak, Charles Morris recording it at 6.8 in 20×80B on December 28.09. Prior to conjunction it was generally reported as being well condensed with a coma diameter of 4'. After conjunction it was very diffuse and much larger. John Bortle recovered it on January 26.45 estimating it at 7.4 in 20×80B with a diffuse coma of diameter 8'. It faded quite rapidly, and on February 19.14 Jose Aguiar made it 8.2 in 11×80B. By the end of the month it was very difficult to observe, Jonathan Shanklin making it 10.9 with a large diffuse coma in 14×100B on February 29.20.

Despite the dramatic change in appearance, the actual coma diameter changed little across the apparition, remaining at around 100,000km. The apparent change reflects what was a relatively close approach to the Earth of 0.17 AU on February 5. The comet will make further much closer approaches in 2011 (0.06 AU) and 2017 (0.08 AU).

At present the MPC only lists eight approaches closer than 0.06 AU, and five of these are by periodic comets.

The HST imaged the comet in 1996 February.[22] The observations suggest an elongated body with a mean nucleus radius of about 300 metres. About 11% of the surface is active and it produces 86 tonnes of dust per day.

54P/de Vico–Swift

P/de Vico–Swift was magnitude 7 when discovered in 1844, but has been severely perturbed by Jupiter and in its present orbit will not get brighter than mag 17. It was not observed at this apparition and indeed has only been observed once this century.

58P/Jackson–Neujmin

This comet made its 5th observed return having been missed at returns between discovery in 1936 and 1970. The circumstances were similar to the discovery apparition when it reached a photographic magnitude of 12. The comet was near opposition at perihelion and remained at a good elongation throughout its period of visibility. Section observations cover the period from T–63 (August 4) to T+77 (December 22). The comet was moving SW from August to October, passing through Aquarius and Capricornus. It reached its most southerly point in late October in Sculptor and then moved NW through Cetus.

The comet was imaged by Martin Mobberley on 1995 July 22.99.[23,24] This observation, together with others made by Japanese and Czech observers, showed that the old orbit was in error by 100″, mostly in right ascension. Visual observations began on August 4.93 when Werner Hasubick sighted the comet at 15.0 in his 0.44m reflector. Brian Manning imaged it on September 2.9.[25] It steadily increased in brightness and peaked in late November. Paul Camilleri estimated it at 10.3 on November 21.43 in his 0.20m reflector ×56. Charles Morris was the last to observe it, making it 11.0 in his 0.26m reflector ×67 on December 22.12. Generally the coma was recorded as being a few arcminutes in diameter with a DC of around 2.

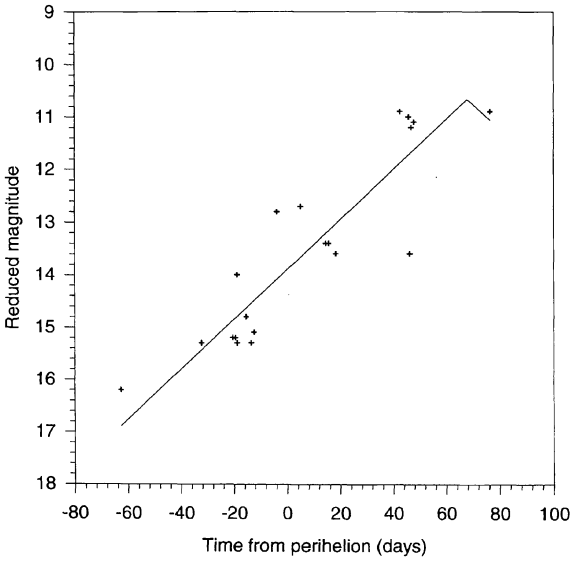

Figure 20. The reduced magnitude of comet 58P/Jackson–Neujmin. The curve is a best fit over the apparition, with corrections for aperture and observer applied.

The standard form of light curve gives a very poor fit, and a better one is obtained using a linear fit to the reduced magnitude. This suggests that the comet's intrinsic brightness peaked about 70 days after perihelion.

71P/Clark

Michael Clark of Mount John Observatory, New Zealand discovered this comet on a variable star patrol plate in June 1973. At discovery the magnitude reached 13, but alternate returns are unfavourable and it is then 5 magnitudes fainter, though it has not been missed. An encounter with Jupiter in 1954 put it into its present orbit, which is such that it can approach quite closely to Mars, passing within 0.09 AU in 1978. This was the comet's fifth return since discovery and it was a relatively favourable apparition, but was too far south for observation from the UK. The comet was recovered in 1994 and was discussed in the report for that year,[5] though since then additional data has come to light and revised magnitude parameters are given here.

73P/Schwassmann–Wachmann 3

Professor A. Schwassmann and A. A. Wachmann of Hamburg Observatory discovered this, their 3rd periodic comet, on minor planet patrol plates taken on 1930 May 2. Initially of magnitude 9.5 it brightened to nearly mag 6, thanks to a very close approach to Earth (0.062 AU) on 1930 June 1. The initial orbit was a little uncertain and the comet wasn't found at the next or succeeding apparitions until 1979. The comet passed within 0.9 AU of Jupiter in 1953, and 0.25 AU in 1965. In August 1979, Michael Candy reported the discovery of a comet on a plate taken by J. Johnston and M. Buhagiar while searching for minor planets; this had the motion expected for P/Schwassmann–Wachmann 3, but with perihelion 34 days later than in a prediction by Brian Marsden. Missed again at the next return, it has been seen at the last two returns. The comet wasn't expected to become brighter than 12th magnitude at this return, but much to most astronomers' surprise the comet was found to be exceptionally bright with a tail in September and October 1995. The comet was recovered in 1994 and was discussed in the report for that year,[5] although again some later observations have come to light and slightly revised magnitude parameters are given here.

77P/Longmore

Andrew Longmore discovered the comet as a 17th magnitude object on a UK Schmidt plate taken by P. R. Standen in June 1975. The comet was put into its discovery orbit by a close encounter with Jupiter in 1963. With a perihelion distance of 2.4 AU it has not become brighter than at discovery. The comet was recovered in 1994 and was discussed in the report for that year.[5]

Other comets under observation

29P/Schwassmann–Wachmann 1

This annual comet has frequent outbursts and seems to be more often active than not, though it rarely gets brighter than mag 12. It was at opposition in Cancer in early February and observable until June. It was then in conjunction until October, and observable for the rest of the year in Sextans. This comet is an ideal target for those equipped with CCDs and it should be observed at every opportunity. Herman Mikuz was alone in continuing with his program of observation and recorded outbursts to 13th magnitude in January, March and October.

32P/Comas–Sola

The comet was observed by James Scotti with the Spacewatch telescope on August 2.4 when it was near 20th magnitude with a coma diameter of 6″ and a tail 36″ long. [*IAUC* 6199, 1995 August 3]. The comet was nearing opposition, but did not reach perihelion until June 1996.

81P/Wild 2

Alan FitzSimmons and M. Cartwright imaged the comet with the 1m Kapteyn telescope at La Palma at the end of August. It had an R magnitude of 22 and was near stellar in appearance. [*IAUC* 6217, 1995 August 30]. It was not due to reach perihelion until May 1997.

95P/Chiron

Maurice Gavin imaged Chiron on March 21.99 and March 23.03.[26] CCD magnitudes of Chiron would be of particular interest as observations show that its absolute magnitude varies erratically. V magnitudes are best for inter-comparisons, but even unfiltered estimates can be of use.

Other comets

Karen Meech uses large telescopes to image distant comets to see if they are still active. She managed to catch comet Shoemaker (1987 H1) twice in 1995 when it was over 18 AU from the sun. In January she used the 10m Keck 1 telescope in collaboration with Olivier Hainaut, to take a series of exposures totaling nearly five hours. The exposure shows stars down to mag 29.5 and when the frames are co-added to follow the comet's motion a faint tail some 500,000km long is visible. The tail probably consists of large dust particles emitted when the comet was at least 12 AU from the sun. The driving force could not have been water for the comet to be active this far out and something more volatile such as carbon monoxide seems likely.[27]

A 15th magnitude comet announced as D/1931 R1 on *IAUC* 6161 [1995 April 13] was discovered by Reinder Bouma to be an image of 84P/Giclas [*IAUC* 6168 1995 May 5]. The images were found on Lowell Observatory archive plates by David Levy and measured by Brian Skiff in the late 1980s. The comet was discovered in 1978 by Henry Giclas of the Lowell Observatory and last returned in 1992.[3]

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References

1 Shanklin J. D., 'The Comets of 1990', *J. Brit. Astron. Assoc.*, **106**(2), 86 (1996)
2 Shanklin J. D., 'The Comets of 1991', *J. Brit. Astron. Assoc.*, **107**(4), 186 (1997)
3 Shanklin J. D., 'The Comets of 1992', *J. Brit. Astron. Assoc.*, **108**(2), 90 (1998)
4 Shanklin J. D., 'The Comets of 1993', *J. Brit. Astron. Assoc.*, **108**(6), 305 (1998)
5 Shanklin J. D., 'The Comets of 1994', *J. Brit. Astron. Assoc.*, **109**(4), 191 (1999)
6 Shanklin J. D., 'Comet Analyses', *J. Brit. Astron. Assoc.*, **105**(6), 291 (1995)
7 Goodman N. J. *(ed.)*, BAA *Handbook*, 1995
8 Nakano S. *(ed.)*, ICQ *Handbook*, 1995
9 Shanklin J. D., *Comet Section Guide* (1995)
10 Marsden B. G., *Catalogue of Cometary Orbits*, 10th, 11th & 12th edns, IAU CBAT (1995, 1996, 1997)
11 Shanklin J. D., 'Comet Levy 1990c', *J. Brit. Astron. Assoc.*, **105**(6), 295 (1995)
12 Shanklin J. D., 'Comet Shoemaker–Levy 1991a$_1$', *J. Brit. Astron. Assoc.*, **106**(1), 19 (1996)
13 Buckley R. J., 'The missing comets', *J. Brit. Astron. Assoc.*, **87**(3), 226 (1977)
14 James N. D. *(ed.)*, 'The Great Comet of 1997', *The Astronomer Special Publication* (1997)
15 James N. D., 'Comet P/1995 S1 (De Vico)', *J. Brit. Astron. Assoc.*, **105**(6), 280 (1995)
16 Hernandez F., James N., Mobberley M., 'Comet P/1995 S1 (de Vico)', *The Astronomer*, **32**, (378), (1995)
17 Hernandez F., 'Comet de Vico', *The Astronomer*, **32** (379), (1995)
18 Mikuz H., 'Comet C/1995 Y1 (Hyakutake)', *The Astronomer*, **32** (382), (1996)
19 Mobberley M. P., 'Comet C/1995 Y1 (Hyakutake)', *J. Brit. Astron. Assoc.*, **106**(2), 103 (1996)
20 Mikuz H., 'Comet 6P/d'Arrest', *The Astronomer*, **32** (374), (1995)
21 Strange D., 'Comet 6P/d'Arrest', *The Astronomer*, **32** (376) (1995)
22 Lamy P. L. *et al.*, 'Hubble Space Telescope observations of the nucleus of Comet 45P/Honda–Mrkos–Pajdusakova and its inner coma', *Icarus*, **140**(2), 424, (1999)
23 Mobberley M. P., 'Two faint summer comets (58P, 6P)', *J. Brit. Astron. Assoc.*, **105**(5), 215 (1995)
24 Mobberley M. P., '58P/Jackson–Neujmin', *The Astronomer*, **32** (376) (1995)
25 Manning B. G., 'Comet 58P/Jackson–Neujmin', *The Astronomer*, **32** (377) (1995)
26 Gavin M., 'Chiron in Leo', *The Astronomer*, **31** (372), (1995)
27 'Tracking a Far-Out Comet', *Sky & Telesc.*, **94**(2), 24 (1997)

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