

Best wishes, Harold

BRITISH ASTRONOMICAL ASSOCIATION - COMET SECTION

Prospects for 1994

The past year has been a quiet, not to say dull, one, with no bright comets and, remarkably, no discoveries by amateurs. However, the year has not been without interest, the highlight being the discovery of P/Shoemaker-Levy 9, the "string of pearls" comet torn apart by Jupiter's gravity. The final collision with the planet in July will be of intense interest; although hidden from us, the aftermath may well be visible as some disturbance of the cloud-patterns on Jupiter's disc. The other item of interest was the rediscovery of P/Spitaler, not seen since its original discovery nearly a century ago. Apart from the forthcoming collision, there is nothing spectacular in prospect. Two or three of the returning short-period comets may be fairly bright, but none are likely to reach naked-eye visibility. Once again we must urge the patient seekers not to lose heart, but to increase their efforts to find us something worth looking at. * See Late News

P/Schwassmann-Wachmann 1 Three outbursts of this comet were reported in 1993: in February, April and November, magnitudes between $12\frac{1}{2}$ - $13\frac{1}{2}$ being recorded. Continued surveillance is required to ensure that no outbursts are missed. The comet spends the first five months of 1994 in Gemini; after conjunction with the Sun, from September onwards it will be moving slowly in Cancer. Throughout the year, the basic magnitude stays around 18.

P/West-Kohoutek-Ikemura It looks as though the fading noted at the last two apparitions was not entirely due to unfavourable circumstances, but was partly of intrinsic origin. During the first quarter of the year the comet will be well placed in Auriga, but probably no brighter than 12 - 14 magnitude.

Mueller, 1993a This comet, in a retrograde orbit, has been with us for a year, slowly brightening from 15^m to 9^m in November, since when it has faded a little and perhaps become more diffuse; recent estimates are in the $9\frac{1}{2}$ - $10\frac{1}{2}$ range. It begins the year in western Pegasus, but by February it will be too close to the Sun for observation. After crossing the celestial equator in April, it moves steadily southwards; by September it will be in Telescopium, probably no brighter than 15^m .

P/Schwassmann-Wachmann 2 Although it is never very bright this comet has been observed at every return since its discovery in 1929, and at its best may reach 11^m . The present apparition could hardly be more favourable: a perihelic opposition. Well placed, it moves from Gemini into Cancer, later passing into Leo, fading from its peak of 11^m in January to 13 by the end of May. A close encounter with Jupiter in 1997 is due to enlarge the orbit, shifting q out to 3.35 AU and thus putting the comet beyond the range of small instruments. This reverses the changes made in 1921 - 1928 which led to its discovery.

P/Spitaler, 1993r Recovery of this comet after nearly a century in the wilderness is of considerable interest. Discovered in 1890 when Spitaler was looking for Comet Zona, it was making a very favourable apparition, and was rated as 12^m . However, the recovery magnitude of 17.2 given by Scotti indicates that the comet may now be 4 magnitudes fainter than it was originally. If this fading is real, and occurred after the first appearance, it might help to explain the subsequent loss of the comet. The orbit is relatively stable, shallow encounters with Jupiter producing only minor changes; the original orbit was based on 22 observations over a two-month arc, and should have been good enough to ensure recovery. Later attempts to predict returns were well out: Marsden, Buckley and Nakano made predictions for the 1972, 1979 and 1994 returns respectively and were 59, 89 and 116 days early, according to recent calculations by Marsden. The comet is on its way out now, moving through Cetus and Aries, fading from 17^m to 19^m as it approaches Conjunction in July.

P/Encke This famous comet, discovered by Mechain in 1786 and with the shortest known period, is making its 56th observed apparition. Although this is a favourable return, the comet is never very easy to observe, as it stays fairly faint until its final dash to perihelion when it closes rapidly on the Sun and becomes lost in the twilight. There is some evidence of secular fading as it is now generally about a magnitude fainter than at corresponding times in its earlier appearances. At the start of the year the comet will be on the Aquarius-Pegasus border, about 10^m and moving westwards into Capricornus. How bright one sees it depends on how far it can be followed as it nears the Sun, but one cannot expect better than 7^m even when the elongation is down to 25° . This object is designated for special study by the Ulysses Comet Watch project, and it is hoped that observers will make every effort to follow it as far as possible.

P/Kojima, 1992z The orbit of this faint object is chaotic, oscillating between the $1/2$ and $3/4$ resonances with Jupiter. An encounter in 1962 reduced q to 1.6 AU and led to discovery in 1970, when the comet reached $13\frac{1}{2}^m$. A further perturbation in 1973 shifted q out to 2.4 AU, where it has remained. The subsequent two apparitions were poor, at 18^m and although the present one is optimum - a perihelic opposition - it will be unlikely to yield better than 15^m at that time. The comet moves slowly in Leo, near Regulus, during the first four months of the year, later moving eastwards into Virgo and fading to 17^m as it closes on the Sun. An encounter with Jupiter in 1996 will reduce q to 2.0 AU.

P/Tempel 2 This comet will be making its 19th observed apparition since its discovery in 1873. In a good year such as 1988 the comet gets to 8^m , but the $5\frac{1}{2}$ -year period means that alternate returns are unfavourable, and such is the case this time. The light-curve is highly asymmetrical; after a late 'turn-on' there is a rapid rise in brightness to perihelion, which continues more slowly for the next two or three weeks, followed by a slow decline until the 'turn-off' steepens the curve. In three of the four perihelia since discovery occurring within a month of the present one the comet has been missed completely and the other one produced a feeble 18^m maximum. Perhaps it would be better to play this one by eye and see what happens - probably on the monitor screen of a CCD camera. The orbit is very stable, one reason why this comet has been a favourite target for cancelled space missions. In 1983 the IRAS satellite detected an extensive dust trail behind the comet.

P/Maury This faint and distant object is unlikely to claim our attention. Discovered at Palomar in 1985, it never got brighter than 16^m . The present return is rather less favourable, and the comet will remain in the region of 17^m as it moves slowly from Capricornus through Aquarius into Pisces, keeping within a few degrees of the celestial equator.

Mueller, 1993p This high-inclination visitor has been brightening slowly since its discovery in 1993 August and will start the year in Aquarius at about 10^m . As it moves southwards, approaching its March perihelion it will enter Sculptor and Phoenix, reaching maximum brightness at about 7^m in April, but of course will then be for southern observers only. It then turns north again and moves rapidly eastwards into Leo in June and Virgo in August as it closes on the Sun, fading to 13^m - 14^m as it does so. This comet is a special target for the Ulysses Comet Watch, and southern-hemisphere observations will be particularly important.

P/Shoemaker-Levy 9, 1993e The story of this unique object is too well known to need repetition here. The comet will of course remain close to Jupiter until its demise. Opposition is on April 30, and the main fragments will collide with the planet during the period July 18 - 23, though the lesser components may extend those limits somewhat. Brightness is uncertain, but the integrated magnitude should be around 14 unless there is fading of some of the units. During the final days Jupiter will be in the southwestern evening sky at an elongation of $100^\circ E$, on the border of Virgo and Libra.

P/Hartley 3, 1993m Even more distant than P/Maury, and equally faint, this comet was discovered at Siding Spring in 1988. The best chance, if it can be called that, to observe it will be in the first quarter of the year when it will be moving eastwards through Aries, but no brighter than 17^m .

P/Tuttle, 1992r This interesting comet was discovered by Mechain in 1790 - poor Mechain seems to have lost out rather in the matter of comet nomenclature. At a good return it reaches 8^m , but unfortunately the present one - the eleventh observed since discovery - could hardly be worse: perihelion occurs on the opposite side of the Sun from the Earth. During the first quarter of the year the comet moves from Cygnus into Andromeda, brightening from 14^m to 12^m ; after superior conjunction it moves in Hydra, fading from 11^m to 14^m .

The high inclination - $55\frac{1}{2}^\circ$ - gives the orbit considerable stability, and a moderate approach to Jupiter in 1995 will have little effect. The perihelion distance of 0.998 AU makes possible our encounter with meteoroids from the comet, and Denning originally identified a minor stream from this source. However, the stream made a strong return in 1945 (100 per hour) observed from Czechoslovakia, and became known for a time as Becvar's Stream, though he did not in fact observe it. Since Davies and Almond at Jodrell Bank subsequently determined the orbit and confirmed the association with P/Tuttle, the shower has been known as the Ursids. The 1945 outburst was not repeated until 1986, when once again 100 meteors per hour were recorded. In other years rates have been modest, around 10 - 15 per hour, and there appears to be no extra activity when the parent comet is at perihelion; indeed the two strong displays have occurred when P/Tuttle was near aphelion.

P/Bus, 1993b Another faint one. This apparition is quite favourable, very similar to the discovery apparition of 1981, when it was observed at Siding Spring at $16\frac{1}{2}^m$. The comet spends the first half of the year in southern Leo, close to the celestial equator, moving off into Virgo as it nears the Sun at the end of the year. It should peak at 16^m - 17^m in March. This comet lives dangerously; originally perihelion was beyond Jupiter, but subsequent encounters, particularly that of 1952, reduced q to its present value of 2.2 AU. In 2021 - 2028 a further close approach will increase q to 3.6 AU, possibly putting the comet out of observational range.

P/Reinmuth 2, 1993g Although seen at every return since its discovery in 1947, and now making its eighth appearance, this is not a bright comet and only occasionally gets within range of modest instruments. This is quite a good apparition, as was that of 1987, and once again we can expect a maximum of 13^m . During the first half of the year the comet moves up from Sagittarius into Pisces in the morning sky, later continuing into Aries where it achieves maximum brightness in September, subsequently retreating and fading. The comet librates around the 4/7 resonance with Jupiter and is in a relatively stable phase at present, but severe perturbations await it in the more distant future.

P/Kohoutek This is not the infamous object of 1973, but had its share of notoriety when discovered in 1975, being involved in the imbroglio with P/West-Kohoutek-Ikemura. The orbit is very similar to that of P/Reinmuth 2, and the two comets are at perihelion within a few hours of each other. It is also not very bright, managing at best to struggle up to 13^m . This is not a very good apparition, perihelion occurring close to conjunction, and by the time the comet is clear of the Sun in September it is unlikely to be brighter than 15^m . It will then be in Cancer, moving into Sextans and Crater and fading slowly during the remainder of the year. The orbit is chaotic, librating around the 1/2 resonance with Jupiter; a close encounter in 1972 reduced q from 2.5 to 1.6 AU, leading to discovery, but in 1983 a further perturbation increased q to its present value of 1.8 AU. Like P/Reinuth 2, it is due for drastic changes in the future.

P/Tempel 1, 1993c The discovery apparition in 1867, and the two following ones, were readily observed, but perturbations by Jupiter in 1881 enlarged the orbit and the comet was missed for the next thirteen returns. Further encounters in 1941 and 1953 restored the original value of q , and predictions by Marsden and Schubart enabled Roemer to secure a single image in 1967 which was provisionally assigned to the comet. This was confirmed by recovery in 1972, and all subsequent returns have been observed. The $5\frac{1}{2}$ -year period gives perihelia in January and July, the latter being favourable and applying this year. As the comet moves eastwards through Virgo during the first half of the year it should brighten from 13 - 14^m to 9 - 10^m in May-June. Moving more rapidly southeast into Sagittarius, the comet fades to 14^m by the end of the year. As the comet librates around the $1/2$ resonance with Jupiter the orbit remains fairly stable at present, but the previous cycle of changes will repeat after a few more revolutions.

P/Wild 3 Although this is a favourable apparition, the third observed, the comet is faint and distant and is unlikely to be brighter than 15^m as it moves from Libra into Virgo and back again during the middle months of the year, going south into Sagittarius as it closes with the Sun at the end of June. The orbit has been much modified by Jupiter; a close encounter in 1882 reversed the line of apsides and reduced q from 5.2 to 4.2 AU, and a further approach in 1977 reduced it further to 2.3 AU, leading to discovery in 1980. The orbit will be stable for the next 70 years.

P/Harrington At discovery in 1953 the comet was 15^m with a 3' tail, but the next four returns were poor and two of them were missed. In 1987 favourable circumstances enabled visual observations at 13^m to be made; this year things are slightly better and the comet may be a little brighter. During the first half of the year the comet will brighten from 17^m to 14^m as it moves from Sagittarius into Aquarius. Well placed in Cetus in September, it should be 12^m-13^m, fading back to 14^m by the end of the year. The orbit is somewhat chaotic but is in a fairly stable phase at present; only minor changes should occur during the next half century.

P/Brooks 2 This well-known object will be making its 14th observed apparition. In 1886 it experienced a hair-raising encounter with Jupiter, passing inside the orbit of Io. Like the present P/Shoemaker-Levy 9, it was tidally disrupted and the orbit was drastically altered. It is not known how many fragments were originally produced, but at discovery in 1889 the nucleus was triple. The two fainter components soon fizzled out, the major one surviving as the present comet and becoming an 8^m object with a 15' tail. As is often the case, the first apparition after encounter was unusually bright, and since 1889 the comet has not been brighter than 10^m, with only a few minutes of tail. Circumstances this time are a little less favourable than in 1987, and the comet will probably be slightly fainter. Following a similar path to P/Tempel 1, it will move from Sagittarius through Aquarius into Cetus, reaching peak brightness of 13^m in October. The orbit is fairly stable now, remaining so for the next couple of centuries.

P/Russell 2 The discovery apparition of 1980 was favourable and the return of 1987 even more so, but nothing better than 16^m was recorded. This year is not too good, and 17^m is the probable maximum brightness when, in June, the comet is well south in Hydra. The orbit is pretty stable for longer than will concern us.

P/Borelly This reliable comet, discovered in 1905, will be making its 12th observed apparition - only two have been missed. At the optimum return in 1987 it was recorded at 7 $\frac{1}{2}$ ^m, with a tail 15' long. This time is rather less favourable, but still good, and we may expect 8 $\frac{1}{2}$ - 9^m when the comet reaches maximum brightness in November - December. During the first half of the year it moves from Sagittarius through Sculptor into Cetus, brightening from 18^m to 13^m. Continuing northeastwards it passes through Orion and Canis Minor into Cancer, coming to maximum near the Cancer-Lynx border as the year closes. It should be under observation well into 1995 as it moves into Ursa Major. In spite of

several moderate approaches to Jupiter, the orbit undergoes only minor changes, and the comet should be with us for a very long time yet.

P/Whipple, 1993n The orbital history of this comet is a good example of the chaotic nature of many cometary orbits. Originally much larger, lying between Jupiter and Saturn, successive perturbations by the former reduced q from 6.5 to 2.5 AU, its value at discovery in 1933. A further encounter in 1981 increased it again to 3.1 AU, and after a few more revolutions it will be extended to 3.8 AU. The comet has never been very bright; the discovery magnitude of 13 has not been bettered since, and is unlikely to be. The present apparition is unfavourable, and as the comet moves from Ophiuchus through Aquarius into Pisces during April to October, it will brighten slowly from 17-18^m to perhaps 15 - 16^m.

(2060) Chiron (P/Chiron) This ambiguous object is well placed during the first few months of the year, being at opposition at the end of February and moving slowly between northern Sextans and southern Leo. It should be close to 16^m, within range of observers with CCD cameras. As it is approaching perihelion there may well be a modest increase in brightness if the coma develops. Astrometry would not come amiss, as the orbit needs running update.

Late News A sudden flurry of discoveries has occurred just as these notes were ready for press. Nothing to get excited about, though - all faint, two of them getting fainter.

P/Kushida-Muramatsu, 1993t Discovered 1993 December 8, at 16^m. The comet is leaving both the Sun and the Earth now, and will slowly fade.

P/Mueller 5, 1993s Discovered 1993 November 20 at Palomar, 17^m - 18^m, and will remain in this range of brightness throughout 1994.

McNaught-Russell, 1993v A southern object in January, moves rapidly north. Brightest in March - April as it moves through Taurus and Gemini, but is intrinsically faint, and will only be 11^m - 12^m, even though it passes 0.5 AU from the Earth. Crosses northern circumpolar sky, quickly fading to 18^m in August.

H.B.Ridley,
Eastfield Observatory
1993, December 22

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Comets in 1994

6

Comet	Prov. desig.	T	Brightest		Moon		
			Mag.	Month	Elong.	New	Full
P/Schwassmann- Wachmann 1	-	1989 Oct.26.7	18(12)	Jan.	170W	Jan.11	
P/Kushida - Muramatsu	1993t	1993 Nov. 4.5	16	Jan.	145W		Jan.27
P/West-Kohoutek- Ikemura	1993o	Dec.25.3	12-13	Jan.	130W	Feb.10	
Mueller	1993a	1994 Jan.12.9	11-12	Jan.	45W		Feb.26
P/Schwassmann - Wachmann 2	-	Jan.23.9	11	Jan.	170W	Mar.12	-
P/Spitaler	1993r	Jan.28.2	17	Jan.	95W		Mar.27
P/Encke	-	Feb. 9.5	7	Jan.	45E	Apr.11	
P/Kojima	1992z	Feb.18.0	15	Feb.	150W		Apr.25
P/Tempel 2	-	Mar.16.8	12?	Apr.	35E	May 10	
r/Maury		Mar.19.1	17-18	July	105E		May 25
Mueller	1993p	Mar.26.2	7	Apr.	60E	June 9	
P/Shoemaker-Levy 9	1993e	Apr. 1.3	14?	Apr.	c180		June23
P/Hartley 3	1993m	May 20.4	17-18	Jan.	100W	July 8	
P/Tuttle	1992r	June27.0	11	Aug.	30E		July22
P/Bus	1993b	June28.1	16-17	Mar.	170W	Aug. 7	
P/Reinmuth 2	1993g	June29.7	13	Sep.	135W		Aug.21
P/Kohoutek		June29.9	15	Sep.	35W	Sep. 5	
P/Tempel 1	1993c	July 3.3	9-10	May	135W		Sep.19
y/Wild 3		July21.2	15	May	170W	Oct. 5	
P/Harrington		Aug.23.2	12-13	Sep.	135W		Oct.19
P/Brooks 2		Sep. 1.1	12-13	Oct.	150E	Nov. 3	
P/Russell 2		Oct.27.4	17	June	150W		Nov.18
P/Borelly		Nov. 1.5	8-9	Dec.	125E	Dec. 2	
P/Whipple	1993n	Dec.22.4	15-16	Sep.	160W		Dec.18
P/Mueller 5	1993s	1995 Feb. 8.1	17	Dec.	100E		
(2060)Chiron(P/Chiron)	c	1996 Feb.12	15-16	Feb.	180		
McNaught-Russell	1993v	1994 Apr. 1.4	11-12	Mar.-Apr.	60E		

Short-Period Comets at Perihelion in 1995

P/Comet	T 1995	q AU	P yrs	Previous Apparitions		
				N	First	Last
Hueller 5	Feb. 8.1	3.95	14.39	-	1993s	-
De Vico-Swift	Apr. 9.5	1.93	7.32	3	1844I	1965VII
Finlay	May 5.0	1.04	6.76	11	1886VII	1988IX
Clark	May 31.2	1.55	5.51	4	1973V	1989XX
d'Arrest	July 27.4	1.35	6.51	16	1678	1989II
Tuttle-Giacobini- Kresak	July 28.6	1.07	5.46	7	1858III	1990II
Reinmuth 1	Sep. 3.3	1.87	7.31	8	1928I	1988VI
Schwassmann - Wachmann 3	Sep. 22.7	0.93	5.34	3	1930VI	1990VIII
Jackson-Neujmin	Oct. 6.6	1.38	8.24	4	1936IV	1987VIII
Longmore	Oct. 9.3	2.40	6.98	3	1974XIV	1988XVIII
Perrine-Mrkos	Dec. 6.0	1.29	6.77	5	1896VII	1968VIII
Honda- Mrkos - Pajdusakova	Dec. 25.9	0.53	5.27	8	1948XII	1990XIV

N = Number of observed apparitions.