THE BRITISH ASTRONOMICAL ASSOCIATION:COMET SECTION

SECTION NEWSLETTER 1991/2

MAY 1991 EDITORIAL D.G.BUCZYNSKI

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I hope to see you all at the annual exhibition meeting.

Denis Buczynski Tel.0524 68530
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From the Director J.SHANKLIN

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Cometary dust also figures in a number of other recent papers. Zahnle & Grinspoon (Nature 348, 8 Nov 90) suggest that anomalous levels of amino acids in the KT boundary layer could have been caused by the slow (104 - 105 years) deposition from cometary dust released from another giant comet. The boundary layer may have been caused by the impact of fragment of the comet perhaps 10 km in diameter, and the subsequent side effects may have killed off the dinosaurs. There is also some evidence for a number of other impacts, spread over several thousand years. If these all came from the same giant comet it would obviate the need for a 'comet shower' from the Oort cloud. Chyba, Thomas, Brookshaw and Sagan (Science, Vol 249, 27 Jul 90) investigate the possibilities of comets providing organic material to the Earth early in its history. They conclude that only small comets less than 100 metres in radius could do this, however there are a lot of unknowns in their arguments so that the amount of material deposited is still an open question.

Jonathan Shanklin

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BAA COMET SECTION - SUBMISSION OF VISUAL OBSERVATIONS G.M.HURST

There has, in recent years, been a dearth of visual observations of comets from UK-based observers, even in a period when record numbers of discoveries are being recorded.

Of course many of these discoveries (or recoveries) are of very faint comets but there remain many objects during the course of the last few years which could be seen visually in modest-aperture telescopes as has been evidenced by a considerable increase in contributions by other European observers.

As a section, we are very keen to rekindle interest in comet observing. I have undertaken the role of Assistant Director of the section and, as you will know, also act as Editor of 'The Astronomer' and its comet section. In an effort to promote further cooperation between the two groups, we are setting up a system whereby observers, whatever their membership, should send visual observations of comets to myself and I would prefer this is on a monthly basis. If, however, you detect sudden unexpected activity in a comet, such a flare in brightness or a tail disconnection, please feel free to ring me on (0256) 471074 as I will wish to circulate news of this type to other section members.

As a prelude to the longer term analysis of comet observations by our Director ( and any volunteers for this task which are welcomed!), results will be published in 'The Astronomer'. Thereafter computer files of the results will be passed to both our Director, Jonathan Shanklin and also to Dan Green who supervises the International Archive of comet observations on behalf of 'International Comet Quarterly'.

The report forms, which have already been distributed to those on our membership list, comprise:

1) Visual Observation Report Form (to be submitted monthly)
2) Telescope Record (to be submitted once annually or where a change of telescope details occurs)
3) Site Record (to be submitted annually or when details change).

If any prospective observer does not have the forms, please send a large SAE to me and I will send you a supply.

To assist you in completion of the report forms, guidance notes are also enclosed. It is very important that as many columns are completed as possible, especially the basis of the magnitude estimate (ie method=MM and sequence used=Source).

If anyone needs help with completion of the forms or any advice on 'how to get started' please ring. We need your help both to rejuvenate the section and to obtain much needed data on comets. I am sure Harold Ridley would also agree that we need more photographic material as well and if guidance is needed in that area please refer to Harold for help.

Guy M Hurst
Assistant Director.

Address for reports:
16, Westminster Close,
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RG22 4PP
E-mail STARLINK/JANET: GMH @
UK.AC.CAMBRIDGE.ASTRONOMY.STARLINK
TELECOM GOLD : 10074:MIK2885
Telex : 9312111261 (TA G)

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E. Helin, K. Lawrence, and P. Rose (Palomar). 0.46-m Schmidt telescope films. Measured by Lawrence. Comet image extremely dense, with a tail fanning to the north-northeast.
R. H. McNaught (Siding Spring). Uppsala Southern Schmidt telescope. Comet strongly condensed; comatic images. IAUC 5213

Orbital elements from MPC 18082:

T = 1992 Jan. 20.2520 ET Peri. = 271.1233
Node = 11.1285 1950.0
q = 1.519618 AU Incl. =95.4743 IAUC 5248

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1991m P/GIACOBINNI-ZINNER
K. J. Meech, Institute for Astronomy, University of Hawaii; and W. Weller, Cerro Tololo Interamerican Observatory, report the recovery of this comet on CCD images obtained using the Hawaii 2.2-m telescope (Feb. 16) and with the prototype wide-field CCD camera being developed by Weller for use on the CTIO Schmidt telescope (Mar. 14 and 15). The February data were reduced by B. Mueller and K. Meech, and the March data were reduced by K. Meech and T. Farnham. The comet appeared stellar with a Mould r magnitude near 22. The indicated correction to the prediction on MPC 14592 is Delta(T) = -0.01 day. IAUC5225

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1991n P/FAYE
S. Nakano, Sumoto, Japan, reports the recovery of this comet by T. Seki, Geisei, as given below. The comet has a small coma. The indicated correction to the prediction on MPC 13042 (ephemeris on MPC 17840) is Delta(T) = -0.01 day.

| 1991 UT | R.A. (1950) | Decl. | m1 |
|---|---|---|---|
| Apr. 16.79861 | 21 59 22.99 | - 4 36 56.3 | 18.5 |
| 19.80816 | 22 04 06.88 | - 4 08 44.5 | 18.0 |

IAUC5246

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(2060) CHIRON
C.I.Lagerkvist,Uppsala Observatory;A.Fitzsimmons,Queens University of Belfast;and P.R.Magnussen,Queen Mary and Westfield College,communicate: "With regard to the possible cometary outburst of (2060) Chiron reported by Meech on IAUC 5159, we observed this object on the night of 1990 Dec.11-12 with he Faint Object Spectrograph on the 4.2m William Herschel Telescope at La Palma. Four 20 min exposures were obtained through cirrus.Preliminary inspection of the individual spectra (range 350-960nm, resolution 1.0nm,S/N about 40 at 388.3 nm) yields no sign of cometary CN(0-0) emmision." IAUC 5163

(2060) CHIRON
J. Luu, Harvard-Smithsonian Center for Astrophysics; and J. Annis, University of Hawaii, report: "We obtained JHK imaging of Chiron on Mar. 7-8 UT with the University of Hawaii 2.2-m telescope (+ 256x256 NICMOS array) in 0".7 seeing. The images show Chiron to have magnitude J = 15.22 and colors J-H = +0.26 +/- 0.04, H-K = +0.08 +/- 0.04 inside a 3".0-diameter aperture. Within the uncertainties, these colors are consistent with solar colors (J-H = +0.31, H-K = +0.06) and are the same as those determined before activity. Preliminary analysis shows that Chiron has a very faint extended coma in the infrared, with surface brightness 21 mag/arcsec2 at 2".5 from the nucleus. These are believed to be the first infrared images of the coma of Chiron."

IAUC 5211

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CRAF AND PERIODIC COMET TEMPEL 2

A. Cochran, University of Texas at Austin, reports: "The Comet Rendezvous/Asteroid Flyby (CRAF) mission has recently changed target comets from P/Kopff to P/Tempel 2. For mission planning purposes, various types of data from previous apparitions (especially 1988) are needed. There will be a special workshop at the Asteroid, Comets, Meteors 1991 meeting in Flagstaff in June to present and discuss these data. If you have relevant P/Tempel 2 data, please inform me (anita@astro.as.utexas.edu), M. A'Hearn (ma@astro.umd.edu) or P. Feldman (feldman@jhuvms.bitnet). Indicate the type of data, the dates of observations and whether you will attend the workshop in Flagstaff. We also encourage observers to continue to obtain data on P/Tempel 2 when possible."

IAUC 5230

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PERIODIC COMET HALLEY (1986 III)

R. M. West, European Southern Observatory, reports: "CCD images totalling more than 26 hr exposure were obtained in Johnson V under good conditions during seven consecutive nights (Mar. 12.2-18.2 UT) with the Danish 1.54-m telescope at La Silla. The magnitude of the central condensation remains about the same as in mid-February (IAUC 5189, 5196, 5202): Mar. 12.2, 21.9; 13.2, 22.1; 14.2, 22.0; 15.2, 22.1; 16.2, 22.2; 17.2, 21.9; 18.2, 21.8 (5" circular diaphragm); some short-term variation is seen. The total magnitude is about 20. The overall size of the coma is > 30" and the outer contour still resembles a 'bow-shock' parabola, with the same general orientation as reported earlier. However, there are important morphological changes from night to night; e.g., on Mar. 13.2 a condensation was seen extending toward the southwest from the nucleus. On other nights, bands of enhanced surface brightness are present within the coma. It is therefore evident that the current outburst is continuing and observers with access to large telescopes are urged to monitor this unique event." IAUC5175

PERIODIC COMET HALLEY (1986 III)

K. Meech, Institute for Astronomy, University of Hawaii, reports: "Observations of P/Halley obtained on Apr. 12 UT with the UH 2.2-m telescope and the new TEK 1024 CCD system show that the comet has faded considerably. The Mould R magnitude within an aperture of radius 5", centered on the central condensation, is now about 21.5. Coma is visible out to a projected distance of at least 180 000 km. Although the coma shape still appears approximately hemispherical, oriented towards the southeast, the southwest quadrant has faded considerably, creating a wedge-shaped appearance, brightest toward p.a. 90 deg." IAUC 5241

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COMPILED BY D.G.BUCZYNSKI

## Comet Section Report forms

Laser printed master copies of the forms are sent out, and you should use photocopies of these to submit your observations.

### 1. Visual Observation Report Form

Record your name, the name and year identifier of the comet you have observed (eg Levy 1990 c) and the year at the top of the form.

*Month* Month (letters)

*Day.dd (UT)* Day and decimal in UT. eg 18.00 UT (GMT) on the 2nd would be 02.75

*MM* Method used for magnitude estimate. It is very difficult to make accurate, consistent estimates. The same technique as for variable stars is used, however it is necessary to compare like with like, so the in focus comet is compared with out of focus stars, the stars being defocussed till they appear the same size as the comet. This is the sidgwick (S) method; experienced observers may choose to use other methods.

*Total Mag* Reduced total magnitude of the entire coma. If you do not have an atlas or catalogue then identify the comparison stars with a field sketch on an attached sheet.

*Nuclear mag* Magnitude of the nucleus, if present. This time use in focus stars.

*Source* Source for comparison stars. AAVSO star atlas (AA), BAA chart (VB), Sky catalogue 2000 (SC), SAO catalogue (S), Atlas Coeli catalogue (SP), or other source.

*Inst code* Instrument used as a letter - The full details - type, aperture, magnification and f number are recorded on a separate form.

*Coma diam* Coma diameter in minutes of arc. Diameter =
0.25 x (time of transit across a wire) x cos(dec)
or estimate relative to 2 field stars
or estimate relative to eyepiece field width.

*DC* Degree of condensation. from 0 (completely diffuse) to 9 (completely stellar nucleus).

*Tail length* Tail length in degrees or minutes of arc

*Tail PA* Position angle of tail or coma elongation. North is 0°, East is 90°, South is 180°, West is 270°.

*Tail type* Type 1 (narrow gas tail), Type 2 (wide, fan like, possibly curved, dust tail), Type 3 (strongly curved, dust tail, narrower than type 2)

*Sky val* Observing conditions. 0 (impossible) to 9 (Milky way visible down to the horizon.

*Rel* Reliability 1 (good) to 3 (poor)

*LM* Naked eye limiting mag near comet to 0.5

*ZLM* Naked eye limiting mag at zenith to 0.5

*Site* Number or the name of the town or village nearest your observing site. The latitude and longitude are recorded on a separate form.

*Comments* Put a tick here if any other details are recorded on a separate sheet. eg. drawing, magnitude estimate, description etc. The sheet should be clearly labelled with the observers name, comet and date and time of observation.

**2. Telescope Record**

Only one copy of this form need be submitted each year. The instrument letter should be that used for the magnitude estimate, generally you should use as small an aperture as possible, though a light curve will be more consistent if the same instrument and magnification is used throughout the apparition. If you use the same telescope but different magnifications a different letter should be assigned to each.

*Type* Naked Eye (E), Binoculars (B), Newtonian Reflector (L), Cassegrain Reflector (C), Schmidt-Cassegrain (T), Schmidt-Newtonian (S), Refractor (R).

*Aperture* In centimetres, only give the decimals if it is significant eg 7x35B would be 3.5, whilst a 6" reflector would be 15.

*f no* Again only give the decimals if is significant, ie probably when it is faster than f5. This is not given for binoculars or the naked eye.

*Magnification* As determined from the focal lengths of telescope and eyepiece. Above 20 it can be rounded to the nearest 5.

**3. Site Record**

Only one copy of this form need be submitted each year and it only needs to be completed by mobile observers. If you stay put at one site then the details can be recorded on the form for each comet. Sites less than a degree apart can be called the same, and should take the name of the main observing site. It is only necessary to record the latitude and longitude to the nearest 0.1°. The SAO code need only be entered by those whose observatory has an official SAO code, these are normally people engaged in astrometric work.

# PRESS RELEASE

**PR 03/91** 22 February 1991

25 FEB 1991

*For immediate release*

## Dramatic Eruption on Comet Halley Surprises Astronomers

### A most unexpected observation

It was early in the morning of Tuesday, February 12, and ESO astronomers Olivier Hainaut and Alain Smette[1] did not know what to believe. Observing with the Danish 1.54-m telescope at the La Silla observatory, they had just finished a one-hour exposure of a small sky field in the constellation of Hydra (the Water Snake). This work was part of the ESO monitoring programme of famous Comet Halley and the astronomers felt that something was quite wrong.

When this comet passed near the Sun in early 1986, it was a bright, naked-eye object with a spectacular tail. Now, 5 years later, it has moved more than 2140 million kilometres away from the Sun and the sunlight reflected from the 15-kilometre "dirty snowball" nucleus has become so faint that it can hardly be seen, even with large, modern telescopes.

The astronomers were surprised because instead of the faint, tiny spot of light which was all the same telescope could see of Halley in 1990[2], there was now a rather bright and extended "nebula" in the middle of the picture on the computer screen. In fact, this object was almost 300 times brighter than the image of Halley's nucleus was predicted to be.

Could it perhaps be another celestial body, a nebula in the Milky Way or even another comet which happened to be seen in exactly the same direction as Comet Halley ? Or maybe it was just a reflection from a bright star in the telescope optics ?

But a second, shorter exposure confirmed that this nebula was not an artifact and additional images obtained during the following nights showed that this

[1]Both astronomers are on long-term assignment to ESO from Institut d'Astrophysique, Liège, Belgium

[2]see ESO Press Photo 02/90 (26 July 1990), or ESO Messenger **61**, page 18 (September 1990)

ESO, an intergovernmental European Organization, was founded in 1962 to establish and operate an astronomical observatory in the southern hemisphere and to promote and organize cooperation in astronomical research in Europe. Its member states are Belgium, Denmark, France, the Federal Republic of Germany, Italy, the Netherlands, Sweden and Switzerland. The observatory is located in Chile, on La Silla, a mountain of 2,400 m altitude, 600 km north of Santiago. Fourteen optical telescopes with diameters up to 3.6 m are at present in operation. The most recent addition (in 1989) is the 3.5 m New Technology Telescope (NTT), the most advanced optical telescope in the world. There is also a 15 m submillimetre radio telescope (SEST), and a 16 m Very Large Telescope (VLT) is under construction. When ready, towards the end of the 1990s, it will be the largest optical telescope in the world. The Headquarters of ESO, with the scientific and technical divisions, is in Garching (near Munich) in the Federal Republic of Germany.

L'ESO, organisation intergouvernementale européenne, a été fondée en 1962 pour installer et faire fonctionner un observatoire astronomique dans l'hémisphère austral et promouvoir et organiser la coopération dans la recherche astronomique en Europe. Ses Etats membres sont la Belgique, le Danemark, la France, l'Italie, les Pays-Bas, la République Fédérale d'Allemagne, la Suède et la Suisse. L'observatoire se trouve au Chili, sur la montagne La Silla, à 2400 m d'altitude, environ 600 km au nord de Santiago. Quatorze télescopes optiques, dont le plus grand a un miroir de 3,60 m de diamètre, ainsi qu'un radiotélescope submillimétrique de 15 m sont actuellement en service. L'instrument le plus récent (achevé en 1989) est le NTT (New Technology Telescope), un télescope de 3,50 m à nouvelle technologie, qui est le télescope optique le plus avancé du monde. Un télescope géant de 16 m (Very Large Telescope = VLT) est en cours de construction. Lorsqu'il sera terminé, vers la fin des années 90, il sera le plus grand télescope optique du monde. Le siège principal de l'ESO, avec ses départements scientifiques et techniques, se trouve à Garching, près de Munich, en République Fédérale d'Allemagne.

ESO, eine zwischenstaatliche europäische Organisation, wurde 1962 mit dem Ziel gegründet, ein astronomisches Observatorium in der südlichen Hemisphäre zu errichten und zu betreiben und die Zusammenarbeit auf dem Gebiet der astronomischen Forschung in Europa zu fördern. Die Mitgliedsstaaten sind Belgien, die Bundesrepublik Deutschland, Dänemark, Frankreich, Italien, die Niederlande, Schweden und die Schweiz. Das Observatorium befindet sich in Chile auf dem 2400 m hohen Berg La Silla, etwa 600 km nördlich von Santiago. Vierzehn optische Teleskope mit Spiegeldurchmesser bis zu 3,60 m sowie ein 15-m-Submillimeter-Radioteleskop sind hier zur Zeit in Betrieb. Das 1989 fertiggestellte 3,5-m-NTT (New Technology Telescope) ist das fortschrittlichste optische Teleskop der Welt. Ein 16-m-Riesenteleskop (Very Large Telescope = VLT) befindet sich im Bau. Nach seiner Fertigstellung, Ende der 90er Jahre, wird es das größte optische Teleskop der Welt sein. Der Hauptsitz der ESO, mit seinen wissenschaftlichen und technischen Abteilungen, befindet sich in Garching bei München.

nebula moved in the same direction and with exactly the same speed as Comet Halley. There was no longer any doubt: *it is indeed Halley which has undergone a tremendous outburst !*

This observation has caused a certain upheaval among cometary scientists, because no comet has ever been found to have an outburst this far from the Sun. Nor is such an event predicted by any current theory. So whatever happened to Comet Halley ?

## What does a cometary nucleus look like ?

Close-up observations of Comet Halley's nucleus by several spacecraft took place in March 1986, in particular by the European Space Agency's Giotto, and it is now known that a cometary nucleus mainly consists of water ice, mixed with dust grains of different sizes. Some of these grains are mineral, but chemical analysis by Giotto's instruments clearly showed that many of them are carbon-rich and therefore contain organic compounds. The amazingly dark surface of Halley's nucleus (it reflects only 4 % of the infalling sunlight) most probably harbours a lot of organic material in the form of a thin crust of dust grains. The structure of Halley's nucleus has sometimes been likened with a chocolate-covered ice cream of avocado-shape, albeit 15 kilometres long and 6 kilometres across. Another frequently used picture is that of a dirty snowdrift in spring-time, slowly melting at the wayside.

As the orbital motion of a comet brings it nearer to the Sun, the dark surface on its nucleus increasingly absorbs the Sun's rays and the temperature steadily rises. The ices on the surface and below the crust begin to sublimate and a cloud of gas is formed around the nucleus; at the same time dust grains begin to fall out. A dense cloud (the "coma") soon shrouds the nucleus. Shortly thereafter one or more tails are formed when the gas molecules are pushed outwards by the fast particles in the solar wind and the dust grains are lost behind as the comet moves on in its orbit.

Close to the Sun, a comet's brightness may change from time to time, due to the sudden, explosive release of large quantities of gas and dust from the nucleus. Such outbursts take place from big vents on the surface, in the form of fast-flowing jets of dust and gas. But this activity gradually ceases, as the comet moves away from the Sun and the temperature of the surface decreases. After a while, everything freezes, no more gas and dust is lost and the remaining material in the surrounding cloud soon disperses into space, leaving the "naked"

nucleus behind.

### How can Halley's recent outburst be explained ?

Until the present event, Comet Halley behaved exactly as described above. Already in 1988, there was only a thin cloud left around the nucleus, in 1989 the cloud was still there, but even fainter, and in 1990, only the nucleus could be seen. And so, Halley was declared asleep and few astronomers, if any, believed that anything different from a tiny light point would be observed before the time of its next return in the year 2061.

Because of their extreme faintness, it has so far been possible to observe only two other comets at more than 2000 million kilometres from the Sun[3], and Halley is the only comet which has ever been observed to have an outburst at this large distance. Moreover, a preliminary analysis of the structure of the cloud around the nucleus (see the photo which accompanies this Press Release) indicates that the current outburst must have lasted a certain time. Since there is no obvious difference between the images obtained over a 5-day period, the surrounding cloud must be continuously replenished with new material from the nucleus. We see the comet and its surrounding cloud "from behind", as it moves away from us, towards the outer reaches of the solar system.

At the time of the observation, Halley was about midway between the planets Saturn and Uranus. At this large distance, the sunlight is very faint and the temperature on the surface of the nucleus is only around −200 °C, so cold that the snow, ice and dust must be frozen solid. It is therefore not a simple matter to explain the outburst of Halley.

There appear to be three possibilities: 1) a collision with another small, unknown body, 2) the release of a large amount of energy, stored in some way in the interior of the nucleus, or 3) the interaction with highly energetic particles in the solar wind.

Concerning the first possibility, very little is known about the population of small bodies in the outer solar system. There may be more than now thought, but the chance of hitting the relatively small nucleus of Halley seems extremely remote. Moreover, it is not clear how such a catastrophic event could lead to the apparently steady outflow, observed at this moment.

[3]Comets Cernis (1983 XII) and Bowell (1982 I), both of which are "new" comets and therefore, contrary to Comet Halley, move in open orbits and will not again visit the inner solar system.

In a similar way, virtually nothing is known with certainty about the inner structure of cometary nuclei. About half a dozen theories have been proposed about the chemical and physical properties of the ice-dust mixture, but none of them can easily explain how large quantities of heat or mechanical energy can be stored during the approach to the Sun and then released after such a long time.

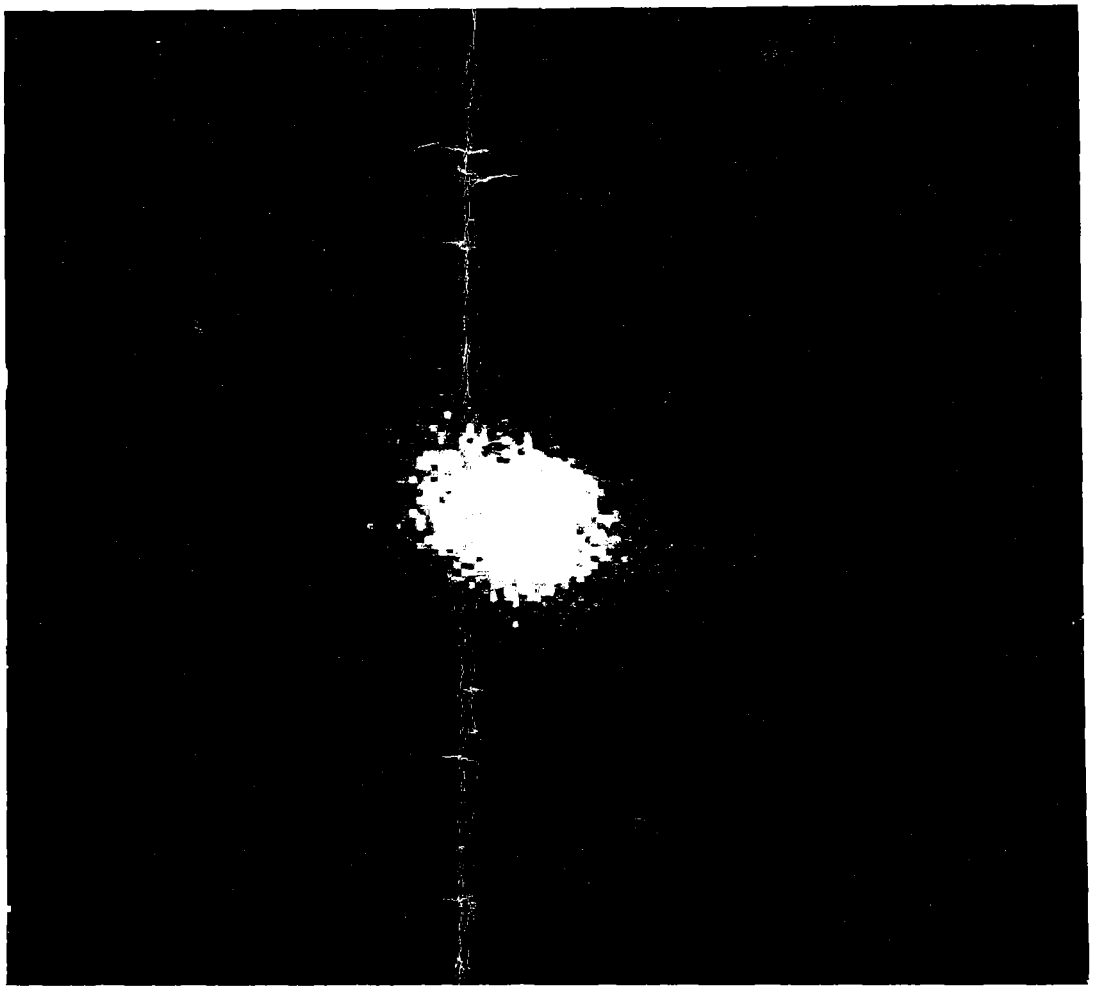
And thirdly, even though the Sun is presently in a phase of maximal activity and emits large amounts of energetic particles at frequent intervals, it is very doubtful whether they would carry enough energy to heat the surface of Halley's nucleus to produce the observed, spectacular effect at this large distance from the Sun.

### Observations of Halley will be intensified

Two things are clear, however. Astrophysicists with special interest in comets will now have to rethink their theoretical models of cometary nuclei. And Halley has once again shown that it deserves to be the most famous comet of them all.

An intensified Halley observing schedule is being implemented at ESO and the comet is now monitored as often as other telescope commitments allow. Photometric observations by ESO astronomer Edmond Giraud with the ESO/MPI 2.2-m telescope have shown that the colour of Halley's coma is very similar to that of the Sun. This strongly indicates that the cloud mostly, if not exclusively, consists of dust grains that reflect the sunlight. This was confirmed by Alain Smette, who obtained a spectrum of Halley with the 3.5-m New Technology Telescope in the early morning of February 22; a first inspection did not show any emission lines which could be attributed to gas in the coma. This NTT observation constitutes an absolute record in cometary astronomy: never before has a spectrum been successfully obtained of a comet at such a large distance from the Sun.

ESO has officially announced the discovery of Halley's surprising outburst in Circular 5189 of the International Astronomical Union and other observatories will soon join in the watch.



The Dramatic Eruption on Comet Halley

# The Dramatic Eruption on Comet Halley

The photo shows the enormous outburst of Comet Halley, as observed by ESO astronomers Olivier Hainaut and Alain Smette with the Danish 1.54-m telescope at La Silla on February 12 - 14, 1991. At this moment the comet was about 2140 million kilometres from the Sun and 2002 million kilometres from the Earth. The image is a combination of eight individual exposures with a total exposure time of just over 7 hours.

Comet Halley's nucleus is completely hidden within a diffuse dust cloud (the "coma") that is seen as a bright light point at the centre. From here, dust is dispersed into surrounding space; the parabolic shape of the faint, outer contour and the arc-like structure are thought to result from the complex motions of the individual dust particles. The central part of the dust cloud measures more than 30 arcseconds (300,000 km projected) across, but faint contours can be followed much further out.

Technical information: Johnson-V filter; composite of eight CCD frames with total exposure time 7h 2m 58s; North is up and East is to the left; 1 pixel = 0.464 arcsecond; field size: 153 × 153 pixels, i.e. 71 × 71 arcseconds or ~ 700,000 × 700,000 km at the distance of Halley. The telescope was set to follow the comet's motion (directed at 72° West of North) and several star trails crossed the image of Halley. The projected direction to the Sun is 15° West of South. To produce this photo, the frames were individually cleaned with the ESO IHAP image processing system.

This photo accompanies ESO Press Release 03/91 and may be reproduced, if credit is given to the European Southern Observatory.

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Cometary dust also figures in a number of other recent papers. Zahnle & Grinspoon (Nature 348, 8 Nov 90) suggest that anomalous levels of amino acids in the KT boundary layer could have been caused by the slow (10⁴ - 10⁵ years) deposition from cometary dust released from another giant comet. The boundary layer may have been caused by the impact of fragment of the comet perhaps 10 km in diameter, and the subsequent side effects may have killed off the dinosaurs. There is also some evidence for a number of other impacts, spread over several thousand years. If these all came from the same giant comet it would obviate the need for a 'comet shower' from the Oort cloud. Chyba, Thomas, Brookshaw and Sagan (Science, Vol 249, 27 Jul 90) investigate the possibilities of comets providing organic material to the Earth early in its history. They conclude that only small comets less than 100 metres in radius could do this, however there are a lot of unknowns in their arguments so that the amount of material deposited is still an open question.

Jonathan Shanklin

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BAA COMET SECTION - SUBMISSION OF VISUAL OBSERVATIONS G.M.HURST

There has, in recent years, been a dearth of visual observations of comets from UK-based observers, even in a period when record numbers of discoveries are being recorded.

Of course many of these discoveries (or recoveries) are of very faint comets but there remain many objects during the course of the last few years which could be seen visually in modest-aperture telescopes as has been evidenced by a considerable increase in contributions by other European observers.

As a section, we are very keen to rekindle interest in comet observing. I have undertaken the role of Assistant Director of the Section and, as you will know, also act as Editor of 'The Astronomer' and its comet section. In an effort to promote further cooperation between the two groups, we are setting up a system whereby observers, whatever their membership, should send visual observations of comets to myself and I would prefer this is on a monthly basis. If, however, you detect sudden unexpected activity in a comet, such a flare in brightness or a tail disconnection, please feel free to ring me on (0256) 471074 as I will wish to circulate news of this type to other section members.

As a prelude to the longer term analysis of comet observations by our Director ( and any volunteers for this task which are welcomed!), results will be published in 'The Astronomer'. Thereafter computer files of the results will be passed to both our Director, Jonathan Shanklin and also to Dan Green who supervises the International Archive of comet observations on behalf of 'International Comet Quarterly'.

The report forms, which have already been distributed to those on our membership list, comprise:

1) Visual Observation Report Form (to be submitted monthly)
2) Telescope Record (to be submitted once annually or where a change of telescope details occurs)
3) Site Record (to be submitted annually or when details change).

If any prospective observer does not have the forms, please send a large SAE to me and I will send you a supply.

To assist you in completion of the report forms, guidance notes are also enclosed.It is very important that as many columns are completed as possible, especially the basis of the magnitude estimate (ie method=MM and sequence used=Source).

If anyone needs help with completion of the forms or any advice on 'how to get started' please ring. We need your help both to rejuvenate the section and to obtain much needed data on comets. I am sure Harold Ridley would also agree that we need more photographic material as well and if guidance is needed in that area please refer to Harold for help.

Guy M Hurst
Assistant Director.

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16, Westminster Close,
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TELECOM GOLD : 10074:MIK2885
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COMET NEWS FROM THE IAUC's 5164-5248
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DISCOVERIES,RECOVERIES,ELEMENTS ETC.

1991a P/METCALF-BREWINGTON
ELEMENTS MPC 17596
EPOCH=1991 Jan 24.0 ET
T= 1991 Jan 5.7531 ET Peri.=208.1401
e= 0.593667 Node =187.0616 1950.0
q=1.592142 AU Incl.=13.0335
a=3.918315 AU n =0.1270735
p=7.756 years

Prediscovery images found by M.Tanaka (Fukushima-ken,Japan) on photographs taken on 1991 Jan 5.5 UT,showing the comet at mag about 15,thereby suggesting that a significant outburst took place within two days of Brewington's discovery. IAUC 5168

Astrometry by H.B.Ridley (Eastfield Observatory 984)
1991 01.13.76389 00 23 53.76 -05 01 54.6
1991 01 17.76667 00 34 39.00 -04 14 26.5
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1991b COMET ARAI
Prediscovery images of this comet (m1 about 10) were found on films exposed 1990 Dec. 23 by T. Ohtsuka and T. Kojima, Tatebayashi, Gunma, Japan. IAUC 5170

Astrometry by H.B.Ridley (Eastfield Observatory 984)
1991 01.14.89028 08 28 49.45 +32 25 44.8
Orbital elements by S. Nakano, Sumoto, Japan, from 59 observations 1990 Dec. 23-1991 Feb. 13, taken from MPC 17791:

T = 1990 Dec. 10.8829 ET Peri. = 337.6292
e = 0.990387 Node = 114.8257 1950.0
q = 1.434119 AU Incl. = 70.9787
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1991c P/SWIFT-GERHELS
S. Nakano, Sumoto, Japan reports the recovery of this comet by T.Seki, Geisei. The comet was diffuse with a central condensation, m1 =16.5. The indicated correction to the prediction on MPC 13045 (ephemeris on MPC 16449) is Delta(T) =+0.06 day. IAUC 5164
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1991d SHOEMAKER-LEVY
Carolyn S. Shoemaker, Eugene M. Shoemaker, and David H. Levy report their discovery of a comet, as follows:

| 1991 UT | R.A. (1950) | Decl. | m1 | Observer |
|---|---|---|---|---|
| Jan. 22.42569 | 9 38 45.73 | - 2 01 18.2 | 15.5 | Shoemaker |
| 22.45469 | 9 38 44.45 | - 2 01 01.1 | | " |
| 28.76094 | 9 34 05.39 | - 0 53 19.4 | 15.5 | McNaught |

C. S. Shoemaker, E. M. Shoemaker, and D. H. Levy (Palomar). 0.46-m Schmidt telescope films. Comet diffuse with strong condensation and possible hint of a tail.

R. H. McNaught (Siding Spring). Uppsala Southern Schmidt telescope. Comet strongly condensed. IAUC 5175

Preliminary parabolic orbital elements by S. Nakano, Sumoto, Japan, from 8 observations Jan. 13-29:

T = 1991 Dec. 29.106 ET  Peri. = 74.500
Node = 144.461  1950.0
q = 2.24936 AU  Incl. = 77.082  IAUC 5177

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1991e P/SHOEMAKER-LEVY

C. S. Shoemaker, E. M. Shoemaker, and D. H. Levy report their discovery of a comet, with the following positions available:

| 1991 UT | R.A. (1950) | Decl. | m1 | Observer |
|---|---|---|---|---|
| Feb. 7.34149 | 9 20 10.76 | +13 28 17.8 | 16.5 | Shoemaker |
| 8.26041 | 9 19 28.22 | +13 29 53.0 | | " |
| 8.33216 | 9 19 24.04 | +13 30 00.6 | | Larson |

C. S. Shoemaker, E. M. Shoemaker, and D. H. Levy (Palomar). 0.46-m Schmidt telescope films. Comet moderately diffuse, with hint of a tail to the northwest. Measured by J. Mueller.

S. Larson (University of Arizona, Catalina Station). 1.5-m telescope encoders. Cousins R CCD images show a 1' tail in p.a. 298 deg.

Preliminary orbital elements by B. G. Marsden, Center for Astrophysics, from 11 observations Feb. 7-11:

T = 1991 Feb. 26.886 ET  Peri. = 199.128
e = 0.23326  Node = 303.295  1950.0
q = 2.87363 AU  Incl. = 5.155
a = 3.74787 AU  n = 0.135840  P = 7.26 years  IAUC 5184

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1991f SHOEMAKER-LEVY

C. S. Shoemaker, E. M. Shoemaker, and D. H. Levy report their discovery on Palomar 0.46-m Schmidt films of yet another comet, as given below. The object is diffuse with a faint tail in p.a. about 280 deg. IAUC 5185

| 1991 UT | R.A. (1950) | Decl. | m1 |
|---|---|---|---|
| Feb. 9.455 | 12 09.5 | + 2 31 | 17 |
| 11.272 | 12 08.8 | + 2 43 | |

T = 1990 Oct. 8.420 ET  Peri. = 312.435
Node = 146.434  1950.0
q = 1.61325 AU  Incl. = 6.594  IAUC 5187

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1991g McNAUGHT-RUSSELL

Robert H. McNaught, University of Adelaide, reports his discovery of a comet on a U.K. Schmidt Telescope plate taken by Kenneth S. Russell. The object is moderately condensed with a 1' tail in p.a. 185 deg. The confirmation on Feb. 13 is by McNaught with the Uppsala Southern Schmidt.

| 1991 UT | R.A. (1950) | Decl. | m1 | |
|---|---|---|---|---|
| Feb. 12.66106 | 11 09 35.31 | -22 53 42.8 | 16.5 | |
| 12.70273 | 11 09 33.08 | -22 53 15.7 | | |
| 13.62034 | 11 08 41.87 | -22 43 05.1 | | IAUC 5187 |

Preliminary parabolic elements from 8 observations, Jan. 26-Feb. 15:

T = 1990 Oct. 14.427 ET  Peri. = 320.384
Node = 161.034  1950.0
q = 4.77030 AU  Incl. = 113.386  IAUC 5188

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1991h P/TAKAMIZAWA

J. V. Scotti, University of Arizona, reports his recovery of this comet with the Spacewatch telescope at Kitt Peak. There is a tail about 30" long in p.a. 285-290 deg. The observations indicate a correction of Delta(T) = -0.5 day to the prediction on MPC 13045:

Orbital elements by B. G. Marsden, Center for Astrophysics, from 117 observations 1984-1991, mean residual 1".2:

Epoch = 1991 Aug. 12.0 ET
T = 1991 Aug. 17.88914 ET  Peri. = 147.64304
e = 0.5746123  Node = 124.25069 1950.0
q = 1.5896944 AU  Incl. = 9.48335
a = 3.7370488 AU  n = 0.13643033  P = 7.224 years

IAUC5192

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1991i P/KOWAL

J. V. Scotti, University of Arizona, reports his recovery of this comet with the Spacewatch telescope at Kitt Peak. On Feb. 21 )T, there was a 15" coma and a 29" tail in p.a. 297 deg; on Feb. 21.428, m2 = 21.1. On Feb. 22, there was a 40" tail in p.a. 295 deg; on Feb. 22.391, m2 = 20.7. The comet is some 3 deg from the predicted elements on MPC 14593, which require substantial corrections in both T and omega.

The following orbital elements by B. G. Marsden, Center for Astrophysics, are from 15 observations 1977-1991, mean residual 0".6:

Epoch = 1977 Jan. 17.0 ET
T = 1976 Dec. 29.87462 ET  Peri. = 172.07929
e = 0.2355957  Node = 28.46465 1950.0
q = 4.6563967 AU  Incl. = 4.38877
a = 6.0915364 AU  n = 0.06555621  P = 15.035 years

Epoch = 1992 Feb. 28.0 ET
T = 1992 Mar. 10.35418 ET  Peri. = 174.42915
e = 0.2328662  Node = 28.11994 1950.0
q = 4.6691224 AU  Incl. = 4.38495
a = 6.0864516 AU  n = 0.06563837  P = 15.016 years

IAUC5195

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1991j P/HARTLEY 1

Carolyn and Eugene Shoemaker and David Levy discovered another comet on a pair of films obtained with the 0.46-m Schmidt at Palomar on Mar. 12. The object was diffuse but condensed with a tail > 1' long in p.a. 285 deg. Bad weather at Palomar prevented convincing follow-up there, but observations elsewhere are shown below:

| 1991 | UT | R.A. (1950) | Decl. | m1 | Observer |
|---|---|---|---|---|---|
| Mar. | 12.48888 | 14 16 12.59 | +12 46 06.8 | 16.5 | Shoemaker |
| | 12.51893 | 14 16 11.92 | +12 45 55.8 | | " |
| | 16.050 | 14 14.9 | +12 20 | 17 | Dintinjana |
| | 16.70903 | 14 14 30.59 | +12 16 34.7 | | McNaught |

C. S. Shoemaker, E. M. Shoemaker, and D. H. Levy (Palomar).

B. Dintinjana and H. Mikuz (University of Ljubljana). 0.25-m f/12 telescope. 15" coma. Three CCD frames show expected motion.
R. H. McNaught (Siding Spring). Uppsala Southern Schmidt telescope. Poor focus.

B. G. Marsden, Harvard-Smithsonian Center for Astrophysics, notes that the object is located some 16 deg from the nominal prediction for P/Hartley 1 (1985 VII) on MPC 13045. A correction of Delta(T) approximately +20 days reduces the residuals to no better than 12', and there is a differential residual of more than 1' between Mar. 12 and 16. However, the comet made a close approach to Jupiter in 1988 Feb., and a new linkage by Marsden eliminates this discordance and satisfies 15 observations 1985-1991 with mean residual 1".1. The minimum separation from Jupiter was 0.36 AU.

Epoch = 1985 June 24.0 ET

T = 1985 June 11.6526 ET  Peri. = 174.1332
e = 0.512079  Node = 40.3750  1950.0
q = 1.539774 AU  Incl. = 24.9278
a = 3.155786 AU  n = 0.1758097  P = 5.606 years

Epoch = 1991 May 24.0 ET

T = 1991 May 17.6839 ET  Peri. = 178.7489
e = 0.450686  Node = 38.2600  1950.0
q = 1.818390 AU  Incl. = 25.7201
a = 3.310291 AU  n = 0.1636458  P = 6.023 years

IUAC5209

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1991k P/MRKOS

On Mar. 17 Antonin Mrkos, Klet Observatory, reported his discovery of a rapidly moving object. Films taken at Palomar by E. Helin et al. show the object to be somewhat diffuse, and Mrkos later described the object as diffuse with central condensation. Available observations:

| 1991 UT | R.A. (1950) | Decl. | m1 | Observer |
|---|---|---|---|---|
| Mar. 16.95628 | 12 44 29.36 | - 2 47 07.9 | 15 | Mrkos |
| 16.97017 | 12 44 27.13 | - 2 48 00.8 | | " |
| 17.03753 | 12 44 16.12 | - 2 52 20.0 | 15 | " |
| 17.04517 | 12 44 14.79 | - 2 52 52.2 | | " |
| 17.98406 | 12 41 43.03 | - 3 53 58.3 | | " |
| 17.99170 | 12 41 41.72 | - 3 54 28.3 | | IAUC 5212 |

Improved orbital elements from MPC 18081:

T = 1991 Mar. 18.9902 ET  Peri. = 180.4239
e = 0.550370  Node = 0.9778  1950.0
q = 1.408729 AU  Incl. = 31.3609
a = 3.133087 AU  n = 0.1777237  P = 5.546 years  IAUC 5248

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19911 HELIN-LAWRENCE

Eleanor F. Helin and Kenneth J. Lawrence report their discovery of a comet, as follows:

| 1991 UT | R.A. (1950) | Decl. | m1 | Observer |
|---|---|---|---|---|
| Mar. 17.40191 | 13 32 10.92 | + 8 52 13.4 | 15 | Helin |
| 17.42483 | 13 32 08.94 | + 8 52 15.7 | | " |
| 19.69248 | 13 29 19.55 | + 8 56 41.2 | 15 | McNaught |