of parallel studies. We intend to study: (a) the luminosity function of cluster galaxies (we have b_j magnitudes from the EDSGC) and its relations with the dynamical state of the parent cluster; (b) velocity dispersions and substructure in those clusters with a large enough number of redshifts. These are just some examples of the wealth of scientific information contained in our cluster redshift survey. However, the most exciting results will probably be those we cannot foresee at present, as it has always been the case when new large-scale redshift surveys have been performed.

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Comet Austin Rounds the Sun

R.M. WEST, ESO

Modern astronomers are privileged people. They exert a profession which for many is also their hobby; they receive good support from the authorities; they have the attention of a broad public and they work in a field which in virtually all respects is above political and ecological concerns.

It even appears that they no longer run the risk of being punished when they make imprecise predictions . . . Astronomers nowadays only rarely think of their pitiful eastern colleagues who long ago forgot to predict an eclipse and promptly lost their jobs, heads and lives.

Of course, in the meantime the computations needed to establish the exact time and place of a solar eclipse one hundred years from now have become so accurate that tour organizers may safely start the preparations and book the hotels already now. On the basis of the collective experience gained during several centuries we now master celestial mechanics to a very high degree of perfection and Voyager was guided to within a few kilometres of the aiming point at Neptune, more than 4000 million kilometres away.

Comet Brightness Prediction: A Difficult Art

But such a high degree of perfection is less evident when we turn to the brightness of comets. Indeed, in this field we astronomers have several times been in situations similar to those frequently experienced by our exposed meteorological colleagues, especially before the advent of remote-sensing weather satellites. Why, demanded the angry public, why did we leave our umbrellas at home and got wet when you predicted sunny weather? And why, yes why did you astronomer "experts" say that the comet would become so bright that it could be seen with the naked eye, and then I could hardly find that weak patch of nebulosity in my new expensive telescope, specially bought for this "unique" event?

I do not blame the public reaction, for I have had this experience myself in early 1974 when I tried to locate Comet Kohoutek from a balcony in brightly lit Geneva where I lived at that time. And I had a feeling of "déjà vu" when I searched for Comet Austin in the morning sky from the roof of my home in Munich in late April this year.

In old days, the appearance of comets was always unexpected and it often brought fear to monarchs and other rulers – no doubt that such events were often cleverly interpreted by sly counsellors to their own advantage. These times have passed and in our days the discovery of a new comet, especially one in a near-parabolic orbit and therefore "new" in the sense that it has never before been near to the Sun, rather makes some astronomers worry about how accurate their brightness predictions will turn out to be.

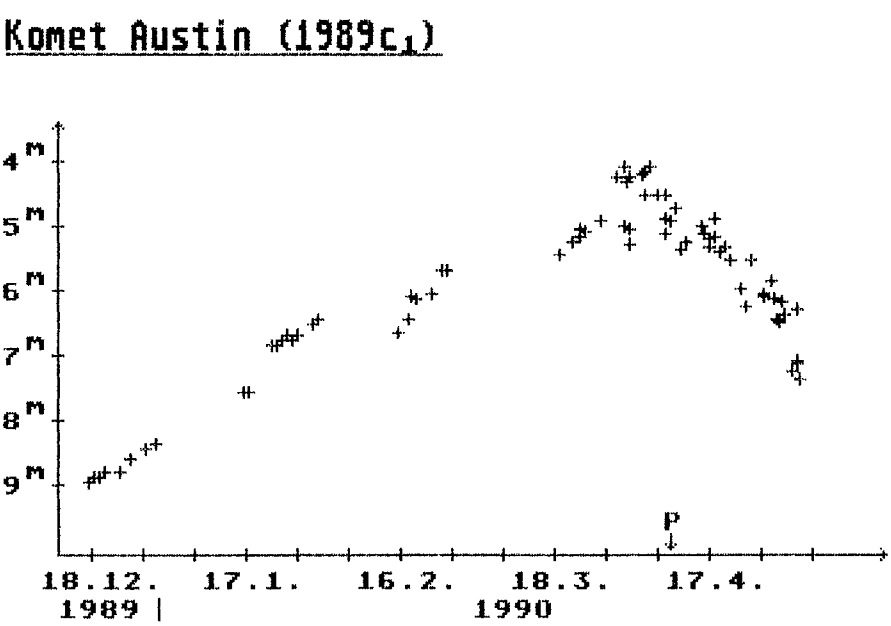

Figure 1: *Heliocentric brightness evolution of Comet Austin, showing the rapid decrease after perihelion. Prepared by Andreas Kammerer (Karlsruhe, Fed. Rep. Germany).*

Figure 2: *Comet Austin, observed on April 20, 1990 by Michael Jäger (Fischamend, Austria). The impressive tail measures more than 4.5 degrees. Exposure time 4 min on Kodak TP 2415 emulsion.*

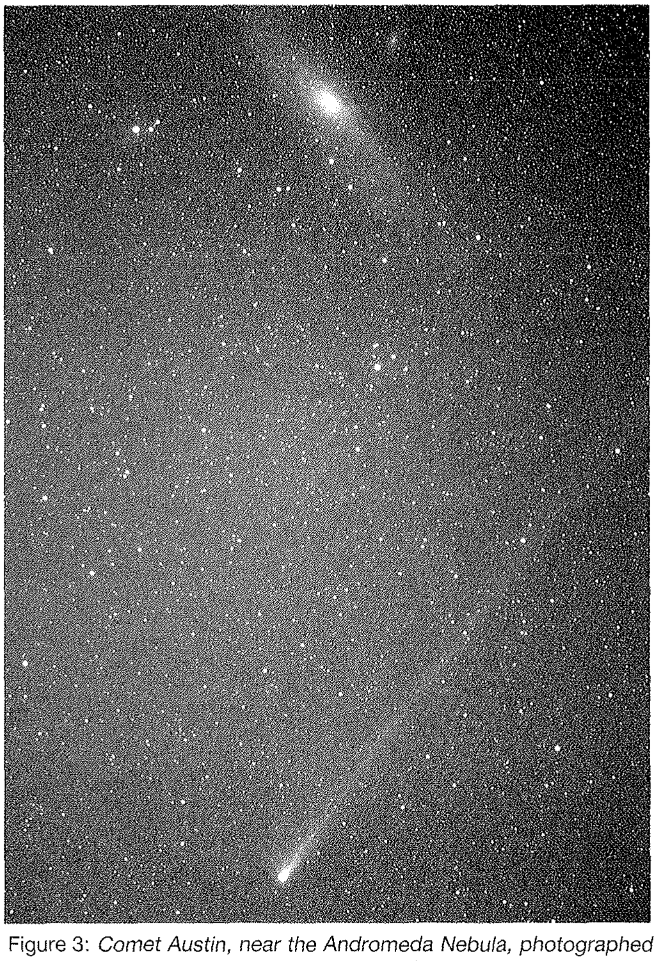

Figure 3: *Comet Austin, near the Andromeda Nebula, photographed on April 24, 1990 by Stefan Binnewies (Bochum, F.R. Germany) 5-min exposure on Agfachrome 1000 RS.*

The problem is particularly intricate when the new comet, as was the case for Kohoutek and Austin, is discovered while it is still quite far from the Sun and already appears unusually bright at this distance. Then the temptation is great to make a simple extrapolation and to predict that the comet will become a really bright object near perihelion.

Why Was Comet Austin Not So Bright?

When Austin was discovered in early December 1989, more than four months before perihelion, it was well outside the orbit of Mars, and already of magnitude 11. This is unusually bright at this distance. If it would behave like most periodical comets, it could be expected to reach magnitude 0 near perihelion in early April; indeed, the brightness increase in December and most of January seemed to confirm this trend. The first doubts arose in February when it appeared to become rather diffuse and in mid-March it was evident that Comet Austin was falling behind the predicted brightness. In the end, it stalled around magnitude 4.5–5.0 at maximum, with about magnitude 5 in late April, the time when it was ideally suited for observations from the Northern Hemisphere. The heliocentric brightness change (i.e. the brightness the comet would have at 1 A.U. geocentric distance) is shown in Figure 1. An asymmetry around the perihelion is clearly visible – the brightness falls more rapidly off after the perihelion.

There are probably two reasons for this. First, several of the "new" comets discovered during the past decades have been unusually bright at large heliocentric distances, possibly because there were small deposites of various ices (H_2O, CO_2, . . .) on the surface of their "dirty snowball" nucleus. This layer evaporates already at large distance and forms a temporarily dense coma around the nucleus. But the deposites are soon exhausted and then the coma becomes thinner and more diffuse, and the brightness stalls.

The second is the lack of dust in some comets, and this is probably the most important reason in the case of Comet Austin. The visual brightness of a comet is largely determined by the amount of dust in the coma, which effectively reflects the infalling sunlight. When more dust comes out of the nucleus, then there will be more in the coma, and the comet will be brighter. We do not know yet why some comets are more "dusty" than others; it could be a real difference in composition, or it could simply be that in some comet nuclei, the dust "pockets" happen to be nearer the surface and therefore more readily replenish the coma via "dust jets".

Whatever the reason, it is clear that we cannot with confidence predict a comet's brightness without knowing the size, structure and composition of its nucleus in some detail. For periodical comets, experience has taught us that they behave more or less the same way at each return and that straightforward extrapolations are reasonably secure, as was the case with Comet Halley in 1986. But "new" comets are also new to us, and we have no observational means to study their nuclei in detail. For the time being, we can only treat them in a statistical way, hoping that they will behave "normally".

However, comets are real individualists, and we must endeavour to base our brightness estimates on the best possible observations. In particular, the approximate amount of dust can be judged from infrared observations and

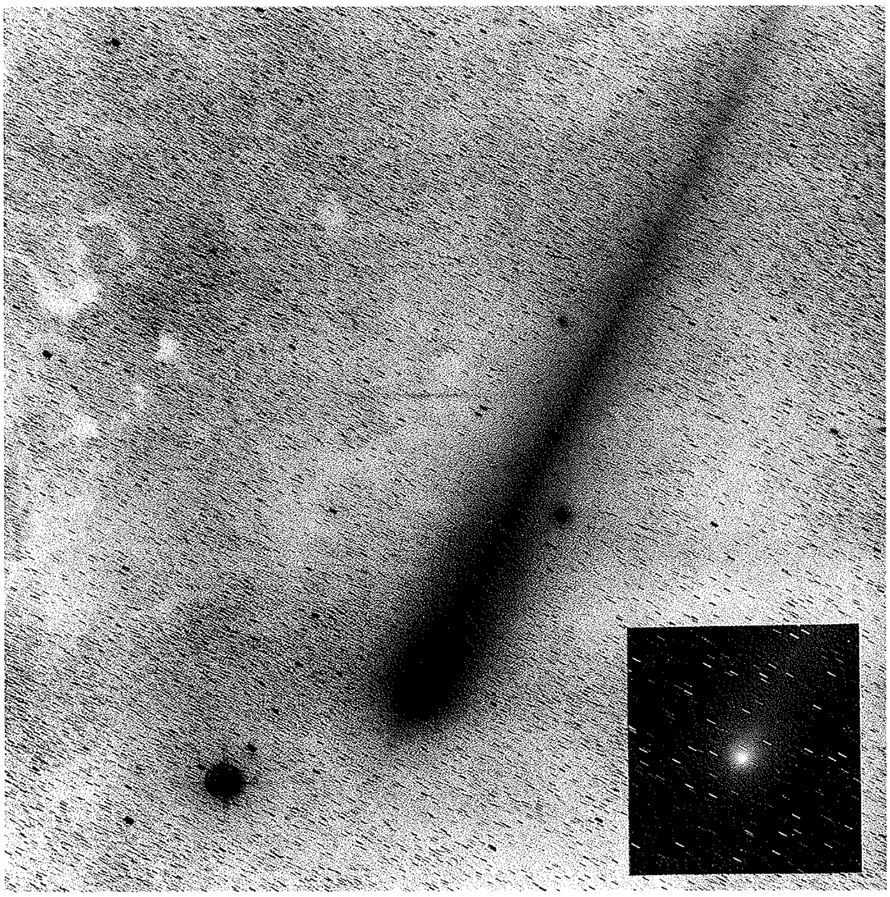

Figure 4: *Comet Austin is here seen on a 10-min B exposure (IIa-O + 66 385), obtained by Guido Pizarro with the 1-m ESO Schmidt on June 5.39, and photographically enhanced by Hans-Hermann Heyer, ESO-Garching. Of particular interest is the so-called "neck-line" structure which is seen as a 1.5-arcmin wide, straight dense structure, stretching at least 2.6 degrees (to the plate border) within a broader, diffuse and rather faint envelope. A much weaker sunward spike can be followed in the opposite direction to about 30 arcmin distance from the nucleus. Both features represent sunlight reflected in dust particles ejected from the comet, and are visible when the Earth crosses through the comet's orbital plane. They were predicted by M. Fulle (Trieste) and L. Pansecchi (Bologna) in April 1990 (IAU Circular 4991). The insert shows the region around the nucleus.*

we ought to take such measurements more into account in the future.

Observations of Comet Austin

All of this should not hide the fact that Comet Austin was still a relatively bright comet with a fine tail and a good study object for both professional and amateur astronomers. Many photometric and spectroscopic observations were performed with large telescopes and quite a few amateurs took impressive photos; two are shown here (Figures 2 and 3). While this comet may have been another "flop" for the general public, it was a good opportunity to make use of the means and methods from the Halley campaign.

Observations at La Silla began in late May, when Comet Austin crossed the celestial equator and again became accessible from the southern hemisphere. There was too little time to prepare a detailed summary for this *Messenger* issue, but it is expected to bring more information in one of the next issues. In the meantime we reproduce here one of the first photos (Figure 4) taken with the ESO 1-m Schmidt telescope in early June.

We know for sure that a really bright comet will appear again sometime – statistically there are about 4 to 5 such objects per century. But we cannot predict when this will happen . . .

A Delicate Postscriptum

Maybe we astronomers should learn to better resist the pressure of those media who want sensations. When we make an – admittedly not very accurate! – prediction of a comet's maximum brightness, say, as magnitude 0 ± 2, many journalists have a built-in tendency to overlook the plus-sign; it is a safe bet that you will read in the press that the comet is expected to reach "–2 mag or possibly brighter" and become as bright as the brightest planets. And when the comet after all only reaches magnitude 2, then we are asked why we were off by 4 magnitudes . . .

Acknowledgements

I am grateful to Werner Celnik (Berlin), Jürgen Linder (Durmersheim), Andreas Kammerer (Karlsruhe), Michael Jäger (Fischamend) and Stefan Binnewies (Bochum) for information and photos.

Asteroids: A Key to Understand the Evolution of the Solar System

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1. Introduction

Asteroids are believed to be remnant planetesimals from the crucial period of planetary formation and are mostly located in the transition region, separating the terrestrial planets from the jovian ones. There the planetary formation process was interrupted at an intermediate stage owing to an unknown mechanism, probably associated with the gravitational influence of the massive proto-Jupiter.

Asteroid eccentricities and inclinations were pumped up, thereby increasing collision velocities, and transforming