COMET AUSTIN 1989c1: WHAT WENT WRONG?

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ABSTRACT

This report examines the apparition and behavior of Comet Austin, 1989c1. This comet, discovered in late 1989, was predicted to become an easy naked-eye object in the morning sky during the Spring of 1990. However, the comet did not live up to expectations.

DISCOVERY

"After half an hour of this and on about my tenth scan, I suddenly came to a stop. Something extremely faint had caught my attention. Flicking my eye around the field, I could see that there was something barely visible, forming an equilateral triangle with two stars of about twelfth magnitude. I noted the time on my observing log as 03:52 NZDT (14:52 UT)." **[1]** So went the discovery on December 6, 1989 by Rodney Austin of a comet expected to become one of the brightest comets of the decade.

Rodney Austin was not new to the field of comet discovery. In 1982, following searches totaling 151 hours over 13 years time, he discovered his first comet with a 6-in (15-cm) f/8 refractor on an altazimuth mount. Then, in 1984, he again used this telescope to find his second comet after 43 hours of searching. Both comets became bright and displayed fine tails. Residing in New Plymouth, New Zealand, Rodney works the evening shift at a newspaper, leaving work at 2:30 AM. Comet 1989c1, his third discovery, had taken only 49 search hours spread out over five years. For this, he used an Meade 8-in (20-cm), f/4 Schmidt-Newtonian telescope with a 2X Barlow lens and a 40-mm Clave Plössl eyepiece yielding a field of view of 1°.7 and a magnification of 41X. **[1]**

This being the 29th comet to be recovered or discovered in 1989, a big year for comets, it was designated *1989c1*. It was announced on the International Astronomical Union's (IAU) *Circular 4919*, issued on December 6, 1989. The discovery time was listed as 1989 DEC 06.6 UT. and the position (in 1950 coordinates) was right ascension 00h 48m, declination -62°. The magnitude was listed as +11 and the appearance as "diffuse." **[2]**

This was not the only comet in the sky at that time. Comet Okazaki-Levy-Rudenko (1989r) was then a binocular object in the southern morning sky. Comet Helin-Roman-Alu (1989v) was in the northern evening sky. Finally, Comet Aarseth-Brewington (1989a1) was putting on a fine display in the northern morning sky.

However, Comet Austin was different. When the first version of its orbit was determined, on December 11, Daniel Green of the IAU suggested that it "...may become a moderately bright object in 1990 March and April". **[3]**

ORBIT

Several orbits were calculated for Comet Austin; the precise orbit given here was calculated in late April, 1990. **[4]**

Time of Perihelion = 1990 APR 09.96739 ET
Distance of Perihelion = 0.3497735 AU
[1 AU = 149.,597,870 km; the mean distance of the Earth from the Sun)
Argument of Perihelion = 061°.56934 (1950)
Long. of Ascending Node = 075°.22965 (1950)
Inclination to the Ecliptic = 058°.95559 (1950)
Eccentricity = 1.0002278

It is significant that the eccentricity exceeds 1.0; the hyperbolic shape of the orbit implies that the comet is new to the inner Solar System. It also means that it will not return after it leaves our neighborhood.

At discovery the comet was 2.42 AU from the Sun and 2.35 AU from the Earth. The comet-Sun distance decreased, reaching 2.00 AU on 1990 JAN 05, 1.0 AU on MAR 03; and a close perihelion distance of 0.35 AU on APR 09, when the comet was traveling at 44 miles per second. This distance from the Sun then increased to 1.00 AU on MAY 17 and 2.00 AU on JUL 11. The comet-Earth distance decreased to 2.00 AU on 1990 JAN 24, 1.00 AU on APR 10, and an amazingly short distance of 0.24 AU from MAY 24-27.

The high inclination allowed the comet to be viewed from both terrestrial hemispheres. Viewing opportunities were also affected by the comet's elongation, or angular distance from the Sun as seen from the Earth. Upon discovery, Comet Austin was 83° from the Sun in the evening sky. Oddly, the comet was found in the evening sky although it was near morning twilight when discovered. That is because Austin was looking in the southwest part of his sky when he found the circumpolar object. From its discovery position it moved northward at about 0°.3/day. It was first picked up by Northern-Hemisphere observers in early January, 1990. Its elongation steadily decreased until, when the comet crossed the equator on MAR 21, it was 25° from the Sun and difficult to observe. The comet passed north of the Sun, as seen from the Earth, and then passed perihelion and into the morning sky during the second week of April. The comet was observed through its minimum elongation of 19° on APR 04.

After entering the morning sky, the comet-Earth distance decreased as the comet's dec-

lination increased to +35° by late April. By the time the comet reached its minimum distance from the Earth in late May, it was more than 100° from the Sun and in the Summer Milky Way. This circumstance was expected to produce a fine display of a naked-eye comet moving at 5°/day through Aquila. By the end of June the comet would have traversed Scorpius and traveled into Lupus.

MAGNITUDE

With the prospect of a potentially bright comet, I assembled a 16-page observer's packet and mailed it to more than two dozen of the A.L.P.O.'s most active comet observers. In addition, the A.L.P.O. *Journal* carried an article announcing the potential of the comet. The result was the receipt of more than 330 magnitude estimates covering over six months of time.

These magnitude estimates were assembled into chronological order by myself and sent to Gary Kronk of Troy, Illinois. Gary, an author and veteran comet observer, analyzed the data to determine the absolute magnitude of the comet. This provides insight into the behavior of Comet Austin.

The *apparent* magnitude of a comet describes its brightness as seen through the telescope. The *absolute* magnitude assumes a standard distance of 1.0 AU from both the Earth and the Sun. Since a comet is rarely at such a distance from both objects at the same time, we use a formula to calculate the absolute magnitude:

m = Ho + 5 log D + 2.5 n log R, where:

m = apparent visual magnitude;
Ho = the calculated absolute magnitude;
D = Comet-Earth distance;
R = Comet-Sun distance;
n = a parameter representing the rate of brightness change as the Comet-Sun distance changes

The history of the comet's apparent magnitude is shown in *Figure 1* (below). This shows that the brightness of the comet varied between magnitude +2 and +11 during the period of observation. It also shows gaps in the time coverage; these were caused by Full Moons (1989 DEC 12; 1990 JAN 11, FEB 09, MAR 11, APR 10, MAY 09 and JUN 08) and bad weather.

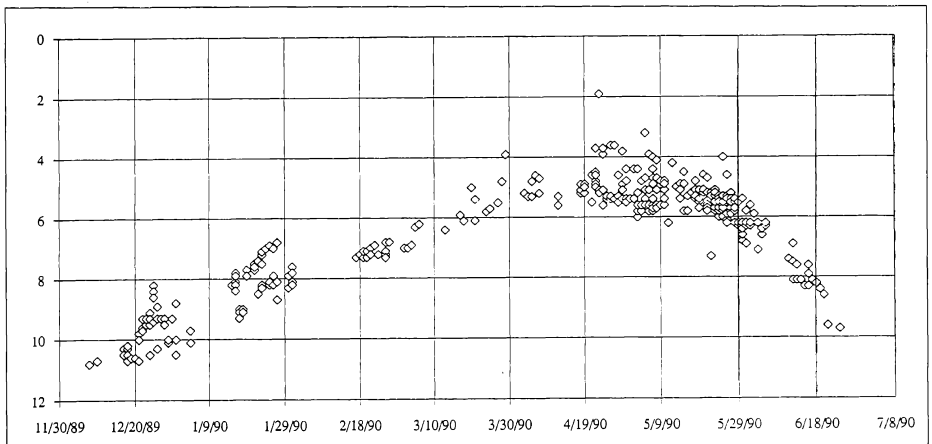

Figure 1. Apparent Visual Magnitude (Corrected) of Comet Austin (1989c1).

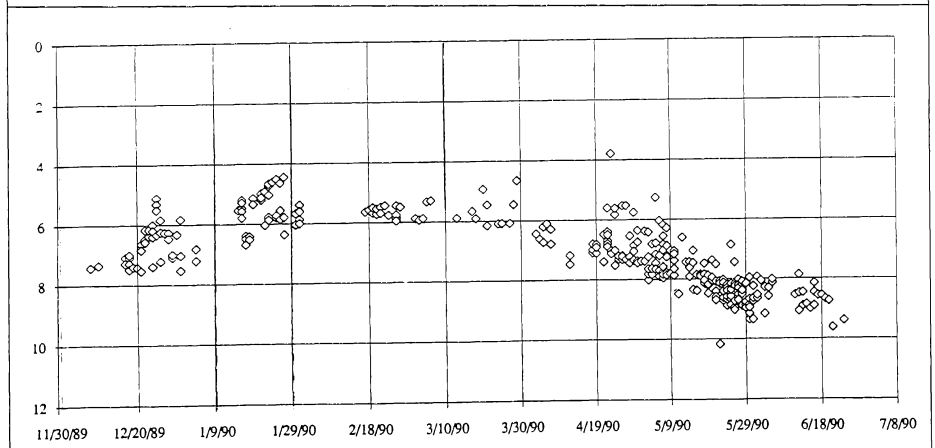

Figure 2. Absolute Magnitude of Comet Austin (1989c1).

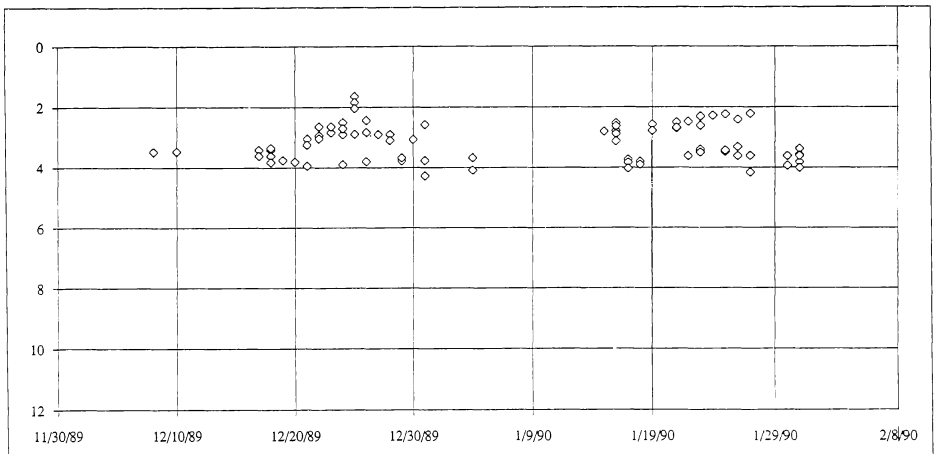

Figure 3. Comet Austin (1989c1): Pre-Perihelion Absolute Magnitude—Part I.

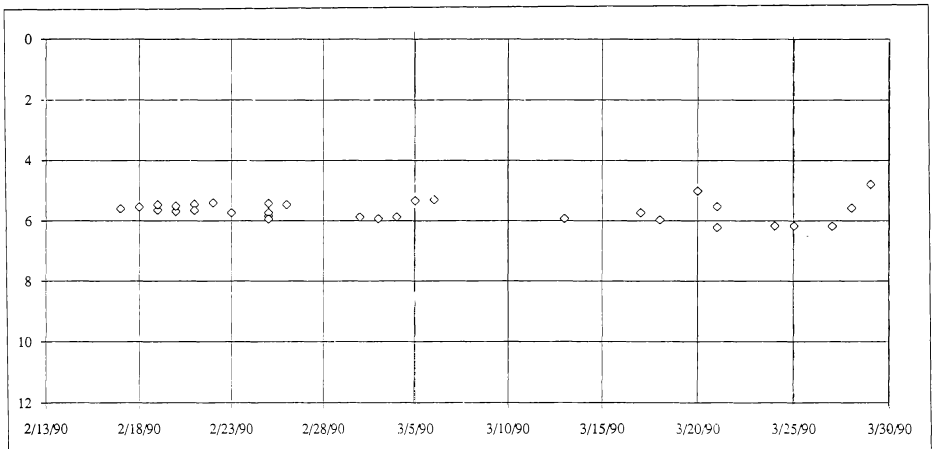

Figure 4. Comet Austin (1989c1): Pre-Perihelion Absolute Magnitude—Part 2.

The comet's absolute magnitude is shown in *Figure 2* (p. 172). Kronk calculated a mean absolute magnitude of +7.13±1.04 and an "n" of 1.56. **[5]** However, the absolute magnitude value in *Figure 2* is far from being a straight line. Indeed, it appears to have three distinct segments, as is demonstrated in the next three figures.

Figure 3 (upper, above) shows an absolute magnitude plot for the period 1989 DEC 07 through 1990 JAN 21. These 83 observations indicate that the comet was behaving well, with an absolute magnitude of 3.15±0.54. and an "n" of 5.70. **[5]** This was the cause for optimism about the comet's future performance; the comet was bright for its distance, and it was brightening rapidly as it approached the Earth and Sun.

Figure 4 (lower, above) shows the comet's behavior between 1990 FEB 16 and MAR 29. By then the comet's rate of brightening had slowed ("n" = 1.76) and the comet's absolute magnitude had dimmed (+5.63±0.27). **[5]** According to Kronk:

"For the first two months of visibility the comet was brightening very quickly. If the comet had continued brightening at the pace indicated, it would have reached magnitude -3.3 around April 11. However, something happened between January 31 and Feb. 16 (a period of no observations mainly because of moonlight), and the comet's activity rates were scaled down. Although the figures for the coma diameter and degree of condensation are widely scattered throughout the apparition, it does appear that the coma was smaller and less condensed when observations resumed on February 16. This period of low-key activity continued until around the end of March. The comet's activity levels increased as April began, but it was too late for a spectacular show." **[5]**

Figure 5 (p. 174) shows the post-perihelion observations, as well as 1990 APR 03-08 observations, which Kronk added because they fit in better there than elsewhere. These estimates produced an absolute magnitude of +7.99±0.41 with an "n" of 3.30. **[5]**

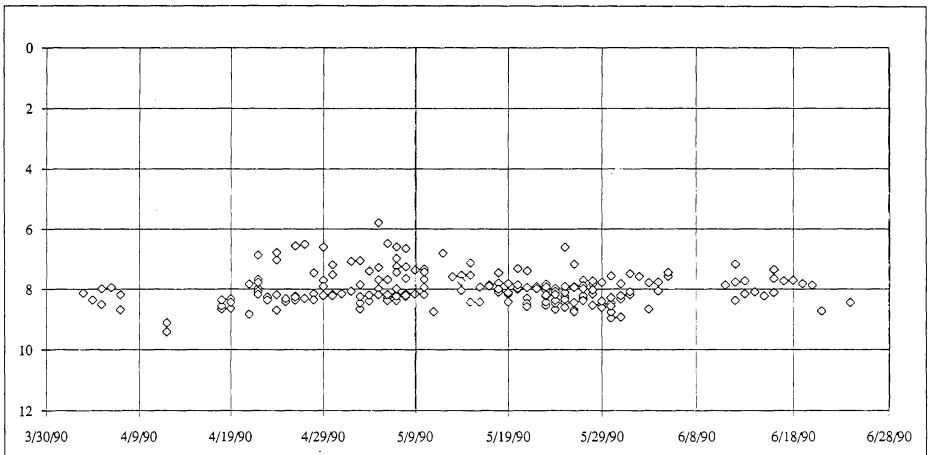

Figure 5. Comet Austin (1989c1): Post-Perihelion Absolute Magnitude.

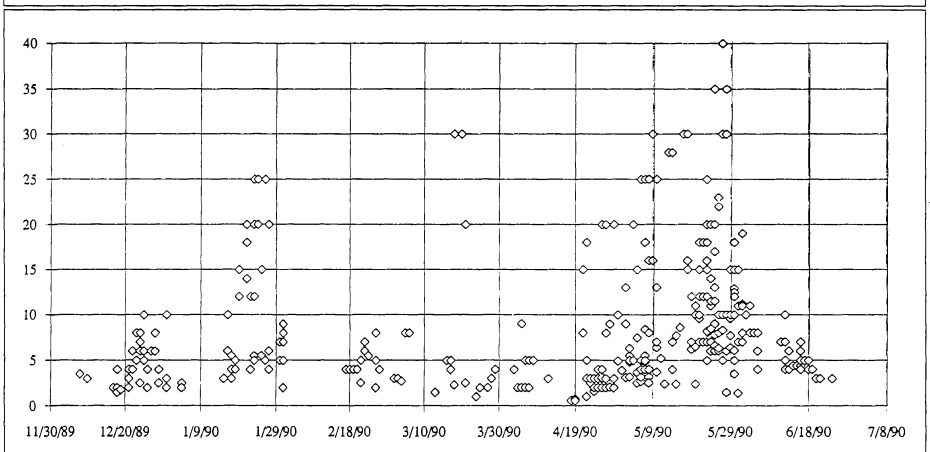

Figure 6. Comet Austin (1989c1): Coma Diameter Estimates (in arc-minutes).

So Comet Austin appeared to run into trouble while its solar distance was decreasing from 1.56 AU to 1.27 AU. This resulted in it becoming 6 magnitudes fainter in mid-April than predicted. According to Kronk, "Comet Austin came close to becoming one of the most memorable comets of the century." **[5]**

APPEARANCE

Every comet differs in appearance from every other comet. Many observers described the appearance of the comet. Paul Camillera reported it as "egg-shaped" two weeks after discovery. Camillera was the first to report a tail on the comet, this being on 1990 JAN 15 with the comet 1.8 AU from the Sun. One or more tails were reported by most observers for the next five months. Jose Guilherme de Souza Aguilar of Brazil reported a "parabolic-shaped" coma on MAR 5. Tim Kenyon saw a bright knot in the tail, 0°.5 from the coma, on MAR 17. Twelve days later he observed a "tear-shaped coma brighter toward Sun, near stellar nucleus with equally bright 3' long spike. Blue in color." On APR 19, Robert Modic reported the coma to be green-white in color. On MAY 06, Jost Jahn saw three tails and two spikes extending from the coma. Two weeks later Modic also observed spikes.

Comet Austin was visible to the naked eye for some observers from 1990 MAY 05 (Aguilar) - MAY 25 (Jahn). It was visible in binoculars for about five months. *Figure 6* (above) shows estimates of the apparent coma diameter of Comet Austin. *Figures 7-13* (pp. 175-176) are a sample of the many visual and photographic observations received of this comet.

Finally, this report would not be possible without the observations of the individuals listed in *Table 1* (p. 175).

FOOTNOTES

1.) Austin, Rodney. "The Discovery of Comet Austin 1989c1."
2.) *IAU Circular 4919*, issued Dec. 6, 1989 by Daniel Green.
3.) *IAU Circular 4921*, issued Dec. 11, 1989 by Daniel Green.
4.) *IAU Circular 5001*, issued Apr. 27, 1990 by Daniel Green.
5.) Letter from Gary Kronk to Don Machholz, October 28, 1992).

Table 1. Observers of Comet Austin (1989c1).

Jose Guilherme de Souza Aguilar	Brazil	20×50 binoculars
Paul Camillera	Victoria, Australia	20-cm reflector, 20×80 binoculars
Michael Clark	Western Australia, Australia	25-cm reflector.
Carl Hergenrother	New Jersey, USA	15-cm reflector, 10×60 binoculars
Qian Ru Hu	Shanghai, China	7×50 binoculars
Chen Dong Hua	Gulangyu Xiamen, China	11-cm reflector, 7×50 binoculars
O'Yang Tian Jin	Hu-Bei, China	13-cm reflector
Jost Jahn	Bodenteich, W. Germany	20-cm reflector, 10×50 binoculars
Tim Kenyon	Arizona, USA	25-cm reflector, 7×35 binoculars
Gary Kronk	Illinois, USA	33-cm reflector, 20×80 binoculars
Robert Modic	Ohio, USA	20-cm reflector, 10×50 binoculars
Gary Nowak	Vermont, USA	20-cm reflector, 20×100 binoculars
Andrew Pearce	Western Australia, Australia	20-cm reflector, 20×80 binoculars
Don Pearce	Texas, USA	33-cm reflector.
Jim Pryal	Washington, USA	11×80 binoculars
James Richardson	California, USA	10×50 binoculars
Kermit Rhea	Arkansas, USA	10×50 binoculars
Paul Robinson	West Virginia, USA	10×50 binoculars, 11×80 binoculars
Will Sager	Texas, USA	7×50 binoculars
David Seargent	New South Wales, Australia	25-cm reflector, 15×80 binoculars
Gregory Shanos	Rhode Island, USA	20-cm, f/10 Schmidt-Cassegrain
Karl Simmons	Florida, USA	14×100 binoculars, 7×50 binoculars
Yiang Hong Tao	China	8-cm refractor
Jean-Francois Viens	Quebec, Canada	11-cm reflector, 10×50 binoculars
John West	Texas, USA	7×50 binoculars
Zhou Xing-ming	Xinjiung, China	15-cm refractor
Yuan Yi-Yang	Zhejiung, China	10-cm refractor, 5-cm refractor
Bodok Zsigmiond	Czechoslovakia	25×100 binoculars

Selected Drawings of Comet Austin (1989c1)

The orientations of these drawings are indicated on the drawings themselves. The originals were *negative* sketches (comet and stars dark, sky white) and here have been converted to *positive* views and also have had their contrasts exaggerated for reproduction. Seeing is expressed in the A.L.P.O. Seeing Scale ("S"; from 0 for worst to 10 for perfect). Transparency will be in either the A.L.P.O. 0-5 scale ("T"; 0 for worst to 5 for perfect); or, if *preceded* by a "+" symbol, the limiting magnitude.

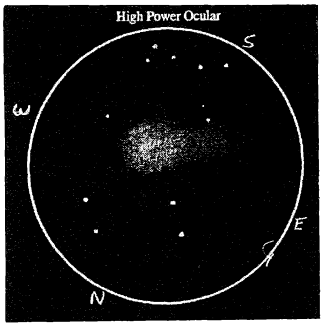

Figure 7. (left) Don C. Pearce, 1990 JAN 22, 01h15m UT. 33.3-cm (13.1-in) Newtonian, 115×. S = 5+; T = 5. The field diameter is 43 arc-minutes. Comet visual magnitude estimated as +9.0.

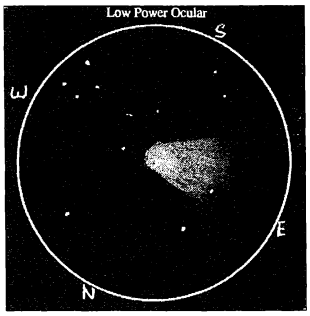

Figure 8. (left) Don C. Pearce, 1990 FEB 25, 01h30m UT. 33.3-cm (13.1-in) Newtonian, 62.5×. S = 7; T = 5+. The field diameter is 1°.04. Comet visual magnitude estimated as +7.6

(Continued on p. 176)

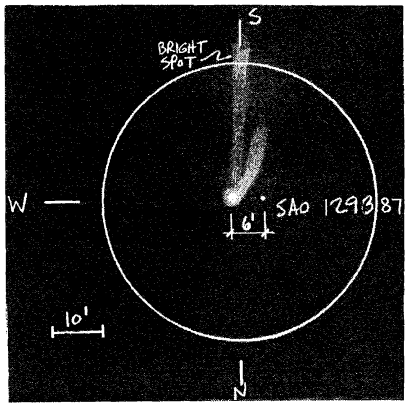

Figure 9. (above) Tim C. Kenyon, 1990 MAR 17, 02h30m-02h45m UT. 25.4-cm (10.0-in) Newtonian, 70×. S = 7, T = <+2 (near horizon). Scale indicated in lower left of drawing. Comet visual magnitude estimated as +6.3.

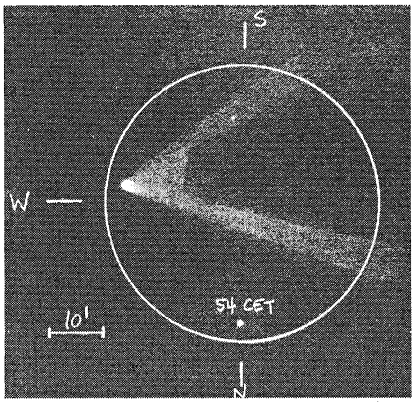

Figure 10. (left) Tim C. Kenyon, 1990 MAR 29, 02h45m UT. 25.4-cm (10.0-in) Newtonian, 70X. S = 3; T <+2? (near horizon). Scale indicated in lower left of drawing. Comet visual magnitude estimated as +4.3.

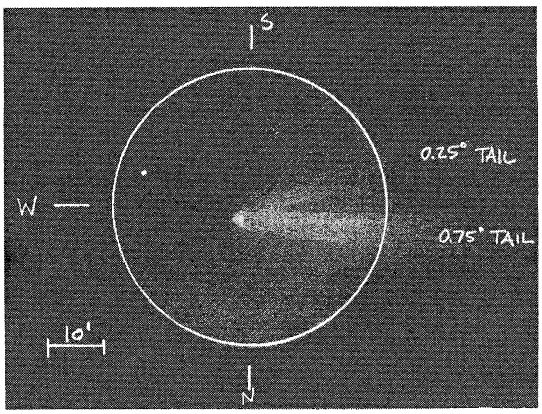

Figure 11. (left) Tim C. Kenyon, 1990 APR 03, 02h30m-02h55m UT. 25.4-cm (10.0-in) Newtonian, 70X. S = 6; T = +3 (near horizon). Scale indicated in lower left of drawing. Comet visual magnitude estimated as +5.6.

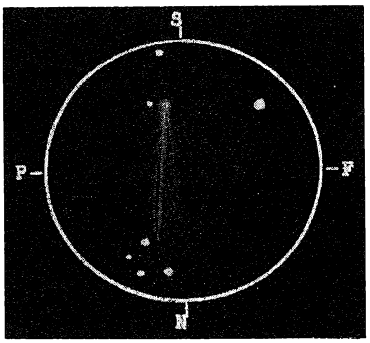

Figure 12. (left) James Richardson, 1990 APR 21, 11h40m-11h50m UT. 10X50 binoculars with ~ 5° field. S = 7; T = 4. Comet visual magnitude estimated as ~+4.5.

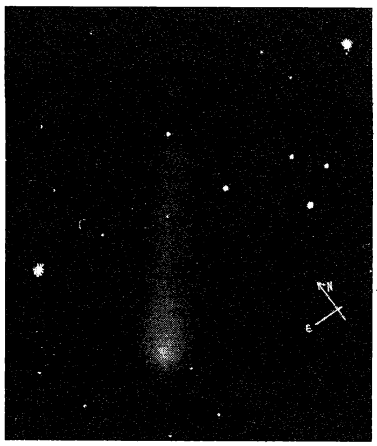

Figure 13. (right) Paul Robinson, 1990 JUN 01, 07h UT. 11X80 binoculars; the illustration is about 1°.8 in height. T = +5.5. Comet visual magnitude estimated as +5.7.