Close Encounters with Ice Balls of a Second Kind

R. RAST, NASA, Houston, Texas, U.S.A.

The excellent photograph of a possible near miss object *Messenger* **67**, p. 57) allows confident identification. Although Smette and Hainaut mention no colour for the bright, diffuse object, a lithium or barium release would have been noticeably red or green, respectively. The authors consider and then reject such an explanation. They also suggest a re-entering satellite, but the trains sometimes left by these phenomena rarely, if ever, appear circular.

Smette and Hainaut mention that the object was about 15 deg above the horizon, but while appearing to pass above Mars, it was really at only 9 deg elevation. This accurately known position in the sky suggested correlating a pass of some outgassing artificial Earth satellite with the path of the unknown object.

From the available orbital elements of almost 7000 satellites in orbit on January 26, I computed a trajectory for each near 9:05 UTC. Only one matched.

The authors did observe an ice ball, but it was not a cometary nucleus. Space Shuttle Discovery's crew, with German astronaut Ulf Merbold aboard, had just completed a 25-litre Spacelab waste water dump at 8:58 as the orbiter was headed toward South America from over the South Pacific Ocean. The bright condensation of magnitude approximately 1 was not the orbiter itself, since Discovery would have appeared to move at three times the angular speed of the condensation. Instead, the 2-deg-wide, circular nebulosity, backlit at a solar phase angle of 157 deg, was ice crystals which formed as the dumped water – condensed from the crew's respiration and perspiration – froze in space and then slowed due to high drag. The deceleration is directly proportional to cross-sectional area and inversely proportional to mass. Since discrete ice crystals have a much larger area-to-mass ratio than the Shuttle, these individual "satellites" experience a considerable orbit perturbation from the tenuous atmosphere at this altitude. Note also in the photograph accompanying the *Messenger* article how the angular diameter of the bright condensation increases from right to left as it expands, despite actually receding from the camera.

Spacelab's waste water is typically dumped only once per week-long mission. Even the most conservative estimates predict that such an ice ball cannot survive in sunlight without subliming or even remain in orbit for more than a few hours.

Thus, although Smette and Hainaut did not experience some close encounter with a visitor from the outer solar system, they can at least feel privileged to have witnessed a rare and fascinating *artificial comet!*

On the Nature of the Smette-Hainaut Object

I. FERRIN, Department of Physics, University of the Andes, Mérida, Venezuela

1. The Observations

In the *Messenger*, No. **67**, Smette and Hainaut report their observation of a difuse comet-like object of visual angular diameter around 2 degrees, moving 1.1 degrees per 10 seconds of time, in a northernly direction, at dawn (from now on referred to as S-H's Object).

Using the published picture, I measured a photographic diameter of 0.2 degrees. Let us take this value as a lower limit for the angular diameter, and the former value as an upper limit.

In this work I will explore if the above observations are consistent with what we actually know about comets.

If this were a comet, it would be of the greatest importance to calculate its size and orbit, since the object could belong to the group of pygmy comets postulated by Frank et al. (1986).

2. Distance to the Object

We can obtain the distance to a comet, Δ, from its observed angular diameter, ø, using Figure 1, which shows the linear diameter, D, of the coma of many comets compiled by Wurm (1939), fitted with a law:

(1) $D\ [\text{kms}] = 2.4 \times 10^5 \times R^2$

where R = Distance Comet-Sun. Since S-H's Object was near the Earth, R = 1.0 AU, and $D = 2.4 \times 10^5$, if this object was a comet. Then from

(2) $\text{tg}\ ø = D/\Delta$

we obtain $\Delta = 6.9 \times 10^6$ kms if the diameter was 2 degrees, and 6.9×10^7 if the diameter was 0.2 degrees.

3. Escape Velocity

Using this distance, its linear velocity can then be calculated:

(3) $v = w \cdot \Delta$

where w is the angular velocity in the sky. Using w = 1 degree / 10 seconds of time, we find $v = 1.2 \times 10^4$ kms/sec! And 10 times more if the angular diameter is 0.2 degrees. The maximum relative orbital velocity of a parabolic comet and the Earth is about 71.8 = (29.8+42.0) kms/sec. Thus the above velocities are much too large! The comet would have had a very hyperbolic orbit. No comet with such a hyperbolic orbit has been discovered up to now.

This result means that if the object was a comet, then its diameter was 170 times too small for its speed. Or, its speed was 170 times too large for its diameter. In any case we have a discrepancy by a large factor.

4. Comparison with Comet Iras-Araki-Alcock 1983d.

Comet Iras-Araki-Alcock 1983d, was the closest approach of any comet to Earth since 1770 (when that of Comet Lexell took place), and thus it can be used as convenient comparison. On May 11, 1983, it reached an angular diameter of 3.5 degrees in the sky, at a minimum distance to the Earth of Δ = 0.031 AU (Green, 1983).

Its trajectory was very similar to that of S-H's Object, since it was moving in a N-S direction, almost perpendicular to the ecliptic.

Using the above information we obtain $D = 2.8 \times 10^5$ kms for Comet IAA. This value is plotted in Figure 1 as a square. It lies right on top of the calibration by Wurm (1939). Thus this Earth-approacher serves as a good test of our hypothesis.