Close Encounters with Ice Balls of a Second Kind

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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

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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) $D\ [kms] = 2.4 \times 10^5 \times R^2$

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) $tg\ ø = D/\Delta$

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.

The motion of IAA was then of the order of 2 degrees per hour. Object S-H was moving at 2 degrees per 20 seconds of time. This is a factor of 180 larger, which could be accommodated if the object were roughly 180 times nearer. But then its size would have been roughly 180 times larger than IAA, in which case it should have covered the whole sphere, and not 2 degrees as seen.

If it were 180 times nearer than Comet IAA, its distance would be 2.6×10^4, a value smaller than the coma size by a factor of 10! Thus we would be submerged in the comet's coma, and there would be a glow over the whole sky! The photograph would look like a very diffuse central condensation, trailing over the sky, and not as sharp as shown in the published image.

In other words, we get the same discrepancy. Speed and diameter are inconsistent if the object was a comet.

5. Other Hypotheses

The object could be the remains of the exhaust of a Soviet rocket. Several cases have been known of the 3rd stage of a Soviet rocket separating over Chile, producing spectacular clouds of geometric forms (Noel, 1985; Morales, 1989).

The object could have been a "round cloud" or a "round haze". When the atmosphere is very stable, or in laminar flow, as it frequently happens in Chile, it can support round clouds, or round hazes, a spherically symmetric region of saturated water vapour. They do not last for long, but look remarkably as comets. They are even transparent, since bright stars can be seen through them.

I have seen two of them, one of about 1–2 degrees in diameter. The other one was of 5 degrees of diameter. I remember it distinctly because it was located on top of comet Halley, with the rest of the sky completely clear (a good example of the way nature sometimes behaves)! It lasted for about 15 minutes and then went away. If such a round cloud is located at 10 kms from the observer, at dawn, it may look remarkably as a comet. Its speed can be calculated from Equation 3, and comes out to be 60 kms/h depending if the diameter is 2 degrees or 0.2 degrees. This is compatible with the surface winds on Earth.

Thus this hypothesis can be tested. If S-H's Object was a cloud in the Earth's atmosphere; then the wind should have been moving toward the N, at between 6–60 kms/h. This information should be available in the meteorological office. Notice that this assumes that the surface wind is the same as the wind at the object's altitude, which might not be the case.

Additional information could be gained from a study of the image structure in the published picture. If the object was a comet the image structure should show a trailing central condensation, decaying slowly in brightness outward. This does not seem to be the case from a cursory analysis of the image. However a more detailed study is required.

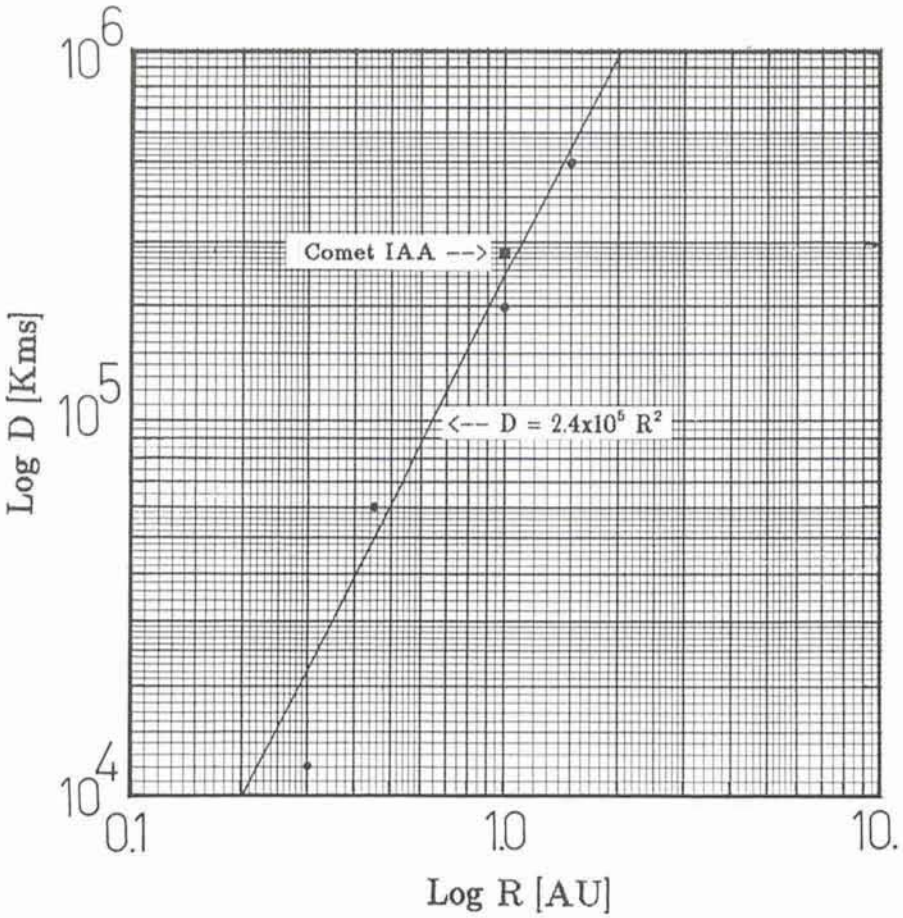

Figure 1: *Diameter of cometary coma as a function of distance to Sun (Wurm, 1939).*

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Unidentified Object Over Chile Identified

The unidentified flying object (UFO) seen from Chile between 2:15 and 2:21 UT on January 24 (*The Messenger* **67**, p. 56) was correctly assessed by author Hainaut as the upper stage of a rocket. However, it was not re-entering, but "exiting" to a higher orbit.

An hour earlier, the Commonwealth of Independent States (CIS) had launched Cosmos 2176 on a three-stage rocket from Plesetsk (2300 km northwest of Baikonur). Typically, the strap-ons and stage zero impact within CIS borders. The first stage places the payload and second stage into a transfer orbit of roughly 200 by 600 km. After separation, the first stage remains in the transfer orbit and the second stage fires while heading north-east off the west coast of South America, before completing one revolution of the Earth.

Until now there was speculation whether this type of UFO seen by Chileans was the first stage venting unburned fuel or the second stage firing. The fine photographs and description provided by La Silla astronomers indicate that, at least in this case, the latter