Close encounters with satellites
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June 14, 1980, an hour after sunset. It was a beautiful Saturday night in Argentina, and many people were out enjoying the clear skies and warm air. Until suddenly, something out of the ordinary appeared.

Pilots and control tower personnel at Newbery Airport in Buenos Aires reported a glowing object hovering in the sky near the airport. Around the same time, a "circular flying mass" chased a family driving home from a visit to Cordoba. They pulled their car off the road and stopped, and reported that the object descended toward them "with vertical and circular movements, leaving a bright trail of whitish smoke," and then disappeared before their eyes.

Visual descriptions were mostly consistent. "It looked like a full moon but fainter," one pilot said, "and it was surrounded by a sort of halo." At Newbery Field a controller called it "a sort of sphere that was dim in the middle and brighter around the edges."

August 12, 1986, 10 p.m. Hundreds of thousands of people were outside in the eastern half of the United States, looking for Perseid meteors. Many of them had their astronomical instruments and cameras at the ready.

Suddenly a bright, fuzzy spiral, wider than the moon, appeared in the eastern sky, moving from right to left. Sightings occurred from Georgia (Florida was socked in with clouds) to Texas, from Oklahoma City to Quebec, Canada, and all points in between. Descriptions of the object and its motion varied, but a general picture soon emerged. It was called a pinpoint, a moving spiral, a glowing cloud, and "a big ball of fire." The vice president of the Syracuse Astronomical Society in New York said it resembled a "reflection of the moon off a cloud, but it was very iridescent, very vivid." Wayne Madea, an amateur astronomer in northern Maine, saw a bright starlike object emit a luminous, rapidly expanding donut-shaped cloud; through a telescope he saw "a pinpoint of light, like a satellite, traveling with the cloud." In Massachusetts, an amateur astronomer watched the plume perform two full turns in four minutes, painting the spinning spiral as he watched.

Both events, along with countless other similar sightings, left observers stunned and baffled. What had they seen? UFOs?

But some suspected that it was something far less exotic, though still interesting. Richard C. Eaton, a retired engineer in Fayetteville, New York, told a local newspaper he guessed he had seen a cloud that was part of a Japanese rocket launch.

As it turned out, he was right.

Despite the fluid-like or cloud-like texture of the apparitions, the witnesses hadn't really been seeing anything liquid or gaseous. They had been watching "snowstorms" in space, resulting from artificial satellites.

In Argentina, the mysterious object turned out to be the sunlit propellant cloud dumped from the fourth stage of the Soviet rocket that had just carried Kosmos-1188 into orbit. It was moving from southwest to northeast at an altitude of over 500 miles (900 km), lit by the sun to the west. This satellite was in a "Molniya" orbit, ranging between nearly 400 and 25,000 miles (600 and 40,000 km) of Earth to serve as a communications relay or, as in this case, a missile launch warning system.

In the United States and Canada, observers had witnessed a spray of surplus fuel from the used-up third stage of the Japanese rocket. Their altitude was almost a thousand miles (1,500 km), high enough for it to have been sunlit even though the ground below had been dark for more than an hour.

These kinds of events are happening more and more often, and even better, satellites can sometimes be predicted and photographed. Watching artificial satellites, even if they are just dots of light crossing the sky, can be thrilling. Sometimes they flare brightly when solar wings catch the sun. Sometimes they flash periodically as they tumble. Sometimes they fly in formation with other satellites. And just knowing what they are, or even who's on board, is usually enough to make it worthwhile. But when the event is unexpected, satellites can leave many people stunned and even frightened.

Cosmic "dumps"

"Propellant dumps" became a standard operation, as rocket engineers realized that leftover fuel inside spent rocket stages could eventually explode, showering nearby space with hundreds of fragments and thus contributing to the mounting "space garbage" problem. So valves on the propellant tanks come open a few minutes after the last scheduled rocket engine firing, and the liquid sprays into space. As it sprays, it gently pushes back on the rocket, sometimes inducing a slow spin.

The liquid droplets shoot out at speeds of more than 300 feet (one hundred meters) per second. In the vacuum of space, the outer layers instantly evaporate, cooling the remaining material until it freezes. It is these little pieces of ice — some of them crystallized like snowflakes, some of them just tiny fragments — lit by the over-the-horizon sun that people on the ground see. If the rocket is slowly tumbling, as it was in August 1986, the stream paints a spiral in the sky. Sometimes the cloud spreads out in all directions, forming a sphere.

The original liquids often were rocket propellants, but sometimes other fluids were involved. During the first manned Mercury orbital flight in 1962, John Glenn described a cloud of "fireflies" around his capsule, which turned out to be snowflakes from water that was emitted from the craft's cooling system. On Apollo missions, the astronauts dumped urine overboard and marveled at the sight of sunlit yellowish snowflakes (which one spaceman dubbed "the Constellation Urion"). Wastewater from space shuttle missions (and now from the International Space Station) is routinely dumped, and ground observers are often startled to see the shuttle moving across the twilight sky with a "comet tail."

Scott Young, on the staff of the Manitoba Planetarium in Winnipeg, witnessed a water dump in 1999, while helping a class of astronomy students in an observatory. A scheduled pass of the docked shuttle and station (with a Canadian astronaut aboard) was expected. "About two minutes before the predicted time, a round hazy spot rose in about the right spot and started ascending, trailing a hazy contrail behind it," explains Young. "As the spot rose higher, the trail got longer and longer, twenty degrees at maximum. It reminded me of a naked-eye view of Comet Hyakutake from light-polluted skies."

Young admits the sight of the expanding cloud made him anxious, until he could see the docked vehicles rise. But the students were puzzled that the "tail" was preceding the presumed source of the dump, the shuttle itself. The swarm of ice particles that results when water is dumped from a shuttle follows a strange path through space, and this has

confused many ground and space observers for years. To prevent the expelled water from recontacting the shuttle, Mission Control usually instructs the crew to direct the stream downward, or even backward against the shuttle's motion through space. Objects moving backward from the shuttle are then going too slowly to maintain their original altitude, so they slip into lower orbits. By momentum conservation laws, they pick up speed along those new paths and quickly pull ahead of the shuttle, staying slightly below it. The stream often appears to move "out the back" of the shuttle, then curves downward and turns back forward.

Even small particles that separate from a satellite in any direction will follow this path. Weak drag from the ultra-thin air at orbital altitudes affects smaller, less dense particles more strongly, and this reduces their forward speed and drops them naturally into lower, faster orbits. John Glenn noticed this baffling motion when he reported that the "fireflies" he spotted around his Mercury capsule during one sunset were preceding him toward the horizon. They were following "orbital mechanics," although it took a while for space experts to realize it.

"Space dumps" and the resulting visual phenomena have been going on since the dawn of the space age, but at first they were accidental, and nobody thought they would be visible from the ground. As a result, observations of the phenomenon were rarely written down, and only then in UFO files. But now that these kinds of cloud-like apparitions have been recognized, the logbooks of many observatories and naked-eye astronomers can reveal a wealth of explainable sightings.

"UFOs" Revealed

One typical case came from the Soviet Union. On November 30, 1964, at 6 p.m. local time (an hour after sunset), at the Shamakhinskiy Observatory in the Caucasus Mountains of Azerbaijan, astronomers M. Gadshiyev and K. Gusev saw an object moving from west to north. The head of this object was twice the diameter of the moon. It looked like a ring with a sharp internal edge and a diffuse outer edge. In the center was a starlike object, which appeared as a point even through a telescope. It left a tail that was visible for more than 15 minutes. While the sighting baffled astronomers then, we now know that it correlates with the launching of the Soviet Zond-2 interplanetary probe. It had blasted off from the Baykonur spaceport an hour earlier, circled Earth once, and fired its last stage engine to break free of Earth's gravity. The apparition seen in Azerbaijan was the post-burn surplus fuel dump.

Other similar instances have never been properly explained. The Japanese H-1 booster that had sparked the eastern U.S. sightings in August 1986 repeated its performance on another launch a year later. As it was completing its first orbit of Earth, the last stage soared through the post-sunset skies of central China and Taiwan. Its propellant was still spraying outward.

Witnesses reported spotting a UFO between about 7:30 and 8:30 p.m. local time. Ground observers reported a glowing object that looked like an oval plate or a comet, with a tail resembling an umbrella. It was orangish in color, and spun clockwise as it flew eastward. News services around the world picked up the story and briefly splashed it across radio, television, and newspapers, all without any mention of the true explanation of the sighting.

Planned Events

These observations had all been accidental, because the space events were unplanned, or followed schedules that weren't available to the general public. But over the years, both spaceflight operations and the skills and ambitions of amateur ground observers improved. And as some satellite launchings became routine, and rocket burns occurred at higher altitudes, the opportunity arose for advance alerts on widely observable propellant dumps. Observers, forewarned by published schedules and armed with home-computer astronomical software, could look toward the portion of the sky where the dump would occur. It wasn't just luck any more.

In the summer of 1999, observers the world over geared up to watch four expected launchings of groups of Globalstar communications satellites aboard Delta rockets. Each would blast off from Cape Canaveral, but the upper stage would be fired much higher in the sky, at an altitude of about 900 miles (1,400 km). After deploying the satellites, the rocket was to dump the rest of its propellant through a depletion burn. It was this cloud that observers were eager to watch, and many interesting reports followed the event.

Experienced observer Ron Lee, writing on the 'See Sat' bulletin board, described what he saw during one launch on July 10. "On time at 10:41:27 UT the depletion burn started. This one was awesome. Soon after the burn started, I made a note that it was turning. At 10:41:56 UT it went between two target stars and I observed the plume easily with the naked eye."

Jake Rees observed another satellite deployment on August 17, 1999, through binoculars near his home in Burbank, California. The predicted view was to the northeast, at an elevation angle of only 11°, but he still saw it. "It certainly would not have been noticed except by someone looking directly at that spot with binoculars," he added. "I had to walk to a street bordering on an athletic field near my house to get a view that close to the horizon. Two guys pulled up in a pickup truck in front of their house just as the cloud appeared. I would have told them what I was looking at but they didn't ask. I guess they just weren't into observing depletion burns."

Daniel Deak in St. Bonaventure, Québec, also watched the depletion burn and dump through binoculars. "What I saw was so impressive! It looked like a horn of plenty roughly parallel to the horizon with its right tip curved to reach the rocket, which was at magnitude four or five." Deak was so intrigued that he then sketched the apparition and posted the image on his Internet home page.

These happy results portend more occasions when predictions of satellite apparitions can be made and disseminated in time for amateur observers to spot them. But most such events will continue to be unexpected, and for most fortuitous observers, unexplainable. Whether by design or by luck, observers who are treated to such spectacles will experience yet another awesome reward for raising their eyes to the skies. X

James E. Oberg observes satellites from his home in Dickinson, Texas.