November 17, 1966: Night of Meteors

by WILLIAM SHEEHAN

Ever seen a falling star?

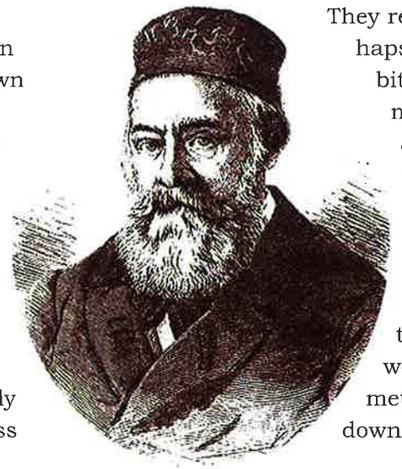
If you live in the country, far from city lights, chances are you've seen quite a few of them. Your odds aren't quite as good if you live in the city. Falling stars, or meteors, are one of the things that never fail to draw a howl of surprise and delight. There is a sudden flash in the night, followed by a bright smoky trail, gone as quickly as it came. What in the world was it?

You're not alone in wondering. People have wondered from earliest times. For thousands of years, no one really knew. Since they are mere flashes, will-o'-the-wisps appearing suddenly and unexpectedly, and vanishing as quickly as they came, meteors are hard to study. As soon as you turn to look at them more carefully — whoosh! They're gone. People used to think that maybe they really were falling stars. Another idea, from the ancient Greek philosopher Aristotle, was that they formed high in the Earth's atmosphere — and thus were airy things, which is why the word "meteor" is similar to "meteorology." But meteors really have nothing to do with meteorology, the study of atmospheric phenomena, or "the weather."

PAGE 11: The author is as eager to see the Leonids storm next month as he was 33 years ago. ABOVE: The author is pictured here at his home in Timaru, New Zealand. RIGHT: A Leonid fireball lights up the sky on November 17, 1966.

How to Catch a Comet's Tail

We now know that meteors are caused by dust particles thrown off by comets. After being thrown off, the particles continue to follow the parent-comet's orbit around the Sun (see sidebar "How We Found Out About Meteors"). In fact they might be regarded as wispy and ultra-thin extensions of the comet's tail. At this stage, they are known as *meteoroids,* and are invisible and harmless. Only when the Earth happens to pass through the same part of space where the meteoroid streams are moving do they become visible — and become meteors as they flash into view, burning up in the Earth's atmosphere at speeds of many kilometers per second. (Since most meteoroids are very small, they usually spend themselves long before they ever reach the ground as meteorites, so there's no need to wear hardhats during meteor showers!)



Wilhelm Tempel

They resemble nothing so much, perhaps, as the tiny ***incandescent*** bits of burning green or red metal thrown off by Fourth-of-July sparklers. Every year or so there are several showers of meteors — nights when ten or twenty an hour, maybe even more, can be seen.

Once or twice in a lifetime, there are colossal showers, world-class events, when the meteors fall fast and thick, like downpours from the heavens. These heavy showers of meteors are called meteor storms, and they're among the great fireworks shows of nature. Some storms have occurred in November of certain years — 1799, 1833, and 1866, for example. They appear to come from a point in the sky in the constellation Leo, the Lion, so they are known as the Leonids (see sidebar "Look for the Radiant!"). Fitting, isn't it? The most ferocious storms of meteors come from the Lion.

Why every 33 years? The particles that give rise to the Leonid storms are those cast off by a small comet, Tempel-Tuttle, which was first spotted just after the American Civil War. (Comets are named for their discoverers — Here's a sure-fire way of achieving astronomical immortality! There were two discoverers of Comet Tempel-Tuttle, Wilhelm Tempel and Horace Tuttle.) Most comets travel around the Sun in very elongated paths. Comet Tempel-Tuttle's is so large that it takes the comet a little over 33 years to travel once around the Sun. Though the Earth crosses Comet Tempel-Tuttle's orbit in November each year, usually it encounters only sparse debris, and so only a few meteors are seen. But if the Earth passes this point in space just after the comet itself has passed through, the particles will not have had time to thin out, and the Earth sweeps through the thickest part of the swarm. This is why the storms should occur once every 33 years. But you cannot really depend on

How We Found Out About Meteors

Denison Olmsted

Much of the anxiety and fear people felt about the dazzling meteor display of 1833 was due to the fact that no one really understood what meteors were. Denison Olmsted (see "The Night It Snowed Fire," page 6) was one of few voices of reason at the time. His basic idea, that meteors were particles traveling in swarms around the Sun, was correct. However, it was another generation before the idea was finally proved and the source of the particles was identified.

The breakthrough idea about meteors came from an Italian astronomer, Giovanni Schiaparelli (1835–1910). His name today is closely associated with the planet Mars, since he was one of the most famous observers of that planet. However, earlier in his career — in 1866, when he was a young director of the Royal Observatory in Milan — he did an interesting piece of detective work based on all the observations of meteors he could find. He calculated their orbital velocities, and found that they were consistently 1.4 times the velocity of the Earth in its elliptical orbit around the Sun. This is an important number, since it is orbital velocity that determines the shape of an orbit. The Earth and other planets move in elliptical orbits not very different from circles; but bodies traveling 1.4 times faster than the Earth move in long, almost-cigar-shaped ellipses. Here was the incriminating evidence Schiaparelli needed. There was only one other type of body studied by astronomers that had this kind of orbit — comets. Schiaparelli, super-sleuth, had found that meteors had the fingerprints of comets all over them.

Giovanni Schiaparelli

Building on this insight, Schiaparelli was able to calculate the orbit followed by the November meteors, and eventually showed that they were moving in Comet Tempel-Tuttle's 33-year orbit around the Sun. He had already shored up his argument by identifying the cometary source of another famous meteor shower, the Perseids, which are seen in mid-August every year. Thus Schiaparelli forged the key link between comets and meteors.

Long ago, comets had frightened people because of their unpredictability, but eventually astronomers were able to show that they followed predictable paths around the Sun. Meteors, too, were frightening. But by harnessing the apparently unpredictable meteors to his calculations, Schiaparelli made meteors subject to the same laws of motion obeyed by planets and comets. Their behavior became predictable. Now that we understand meteors, we need no longer fear them as people did in 1833 — We can simply go out and enjoy them.

W.S.

Incandescent — Emitting visible light as a result of being heated

this. (See "Leonid Lottery," page 18.)

Since comets are thin, wispy affairs, they are easily swayed, pushed, or pulled into slightly different orbits by the gravity of giant planets such as Jupiter and Saturn. Sometimes comets even break up. If Comet Tempel-Tuttle were ever to do so — if it were no longer around to replenish the streams of particles that give rise to the monster storms — the Leonids too would die out. For a long time astronomers thought this might actually have happened to Comet Tempel-Tuttle. It was missing for the better part of a century, and there were hardly any meteors in 1899 and 1933. Fortunately, as Mark Twain might have said, "Reports of Comet Tempel-Tuttle's demise were greatly exaggerated." Astronomers rediscovered it in 1965. The comet was still out there in space, throwing off debris along its path, and this meant there was a very good chance that the Earth's next passage through the thickest part of the swarm, on November 17, 1966, might well bring about another thicket of meteors.

Remembrances of the Last Big Storm

In 1966, I was a twelve-year-old amateur astronomer, well acquainted with past antics of the Leonids, and with the date, November 17, permanently etched into my memory. I counted down the weeks, then the days, all the while my anticipation building — what would I see? Unfortunately, on November 16 things didn't look very promising. The uncertainty of the meteors themselves was one thing, but it was meteorology that seemed likely to defeat me. It happens that in mid-Northern latitudes, November is the cloudiest month of the year, as the ***jet stream*** hurls storm systems across the middle of North America. I was observing from Minnesota, right in the cloudiest zone. On the eve of the great shower, the sky was hopelessly overcast. It seemed I would miss my one chance to view an event not to be repeated for 33 years!

Trail left by a meteor in 1966 demonstrrates high-velocity winds.

The early bird catches the — meteors. Glumly, I set my alarm clock to 5 o'clock and went to bed, fully expecting to see only dismal sheets of gray ***stratus clouds*** when I awoke the next day. I prayed that night for clear skies.

Would you believe it? The sky cleared! When I got up, I was astonished. Stepping outside the house, I found meteors whizzing in the sky all around me. Several were visible at any one time, leaving trails that resembled the spokelike ribs of an umbrella opened up from the dazzling radiant in Leo. Some were huge, spectacularly bright balls of green fire, that made me want to duck. I almost imagined I could feel the heat from some of them! They looked like falling planets, exploding as they fell. One or two were as bright as full Moons!

It was all I could do to count the meteors — at least a thousand in the half hour or so before they began to fade into the glow of dawn, more than I have seen in all the rest of my life. All the while, the shower was only getting better. The droves of meteors I saw from Minnesota were only a buildup to the real peak, which took place over the western United States. There, some lucky observers saw 10 to 20 meteors a second!

Astronomers cannot predict exactly what will be seen on the morning of November 17 or 18, 1999. There are no guarantees. Maybe clouds will interfere; maybe the meteors will fizzle, as they did in 1899 and 1933. On the other hand, you just may see more meteors than you will in the rest of your life, as I did in 1966. In any case, I sure would hate to be among the sleepyheads who don't get up early that morning. Wouldn't you?

William Sheehan is consulting editor for this issue.

Look for the Radiant!

When you look at meteors this November, your first impression will be that they are spraying out from all directions in the sky. However, if you look at a star chart (like the one provided on page 34) and record the location of the trails of all the meteors you see, you will discover that they all seem to converge back to a particular point in the sky. Since the meteors appear to radiate from this point, it is known as the *radiant*.

The November meteors converge back to a radiant in the constellation Leo, so they are known as the Leonids. Another famous shower, which occurs in August each year, has a radiant in Perseus, and is known as the Perseids.

Do all the meteors really come from a single point in the sky, like the streamers from a fireworks explosion? Not really. We now know that this is only an illusion, a simple effect of perspective. The meteors in space are traveling at high speeds along paths nearly parallel to one another. As they approach, their paths seem to diverge from a single point for the same reason that the sides of a long highway appear to do so to an observer (see illustration). At the most distant point from the observer, the edges appear to be near each other. As they approach the observer, they appear to widen. Can you do a mental frame-shift and replace the highway with meteor paths?

W.S.

Jet stream — A high-speed meandering wind current, generally moving from a westerly direction at speeds often exceeding 400 kilometers per hour at altitudes of 15 to 25 kilometers

Stratus clouds — A low-altitude cloud formation, consisting of a horizontal layer of gray clouds