Dust from long ago made Leonid fireballs

Last Nov. 16, the night came cool and clear on La Palma, an island off northern Africa stippled with hills—and telescopes. Frustrated by problems in setting up a camera to monitor the 1998 Leonid meteor shower, Alan Fitzsimmons of Queen's University in Belfast, Northern Ireland, exited the domed observatory where he was working and looked up. What he saw dazzled him.

More than 100 times brighter than the brightest stars, hundreds of fireballs streaked across the sky. These brilliant meteors—fiery trails generated when dust particles shed by a comet burn up in Earth's atmosphere—arrived more than 16 hours before the shower's expected peak. Researchers now calculate that the fireballs observed that night came from centimeter-size dust grains expelled by Comet 55P/Tempel-Tuttle when it passed by the sun 665 years ago—in September 1333.

The Leonid shower takes place every November when Earth passes through debris spread out along the orbit of Comet Tempel-Tuttle. About every 33 years, when the comet passes nearest Earth, observers see a much heavier shower. Last year, observers did see a large number of meteors but the fireballs were the standout. Their intensity and duration indicate that Earth must have passed through a dense, narrow strand of dust.

The strand has stayed intact for nearly 700 years because of a special relationship between the orbit of the grains and that of Jupiter, assert David J. Asher and Mark E. Bailey of Armagh Observatory in Northern Ireland and Vacheslav V. Emel'yanenko of South Ural University in Chelyabinsk, Russia. They describe their findings in the April 21 MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY.

Tempel-Tuttle is one of several comets whose orbit about the sun is in synch with Jupiter's. For every 14 times that Jupiter swings around the sun, Tempel-Tuttle makes 5 passes. This relationship, called a resonance, also holds true for large dust grains thrown off by the comet and allows Jupiter's gravity to corral the large grains ejected at different times into distinct, narrow strands. Smaller grains disperse because they are pushed around by the pressure exerted by sunlight.

Asher and his colleagues calculated the motion of dust grains ejected by the comet during its last 42 passes by the sun. They found that an arc of dust from 1333 crossed Earth's orbit at the hour last November when the fireball number peaked.

Dust trails associated with other comets in a resonance with Jupiter may show similar fireball activity, Bailey says. Moreover, some strands of dust might stay intact for up to 50,000 years, long after Jupiter has lured the parent comet into another orbit. Indeed, he notes, the solar system may contain numerous "orphan strands" capable of generating fireballs without evidence of any comet.

Donald K. Yeomans of NASA's Jet Propulsion Laboratory in Pasadena, Calif., says the researchers have demonstrated "that a resonance with Jupiter can preserve the . . . strand of large particles over hundreds of years." He adds, however, that their argument "would be more compelling" if they could calculate the intensity of fireball activity for previous approaches of the comet. —*R. Cowen*

Fitzsimmons

A fireball streak from the 1998 Leonid shower.

Parasites make frogs grow extra legs

In the great mystery of what's causing deformities among frogs in North America, two new research papers make a parasite, once just a minor suspect, look a lot more suspicious.

For the first time, laboratory tests have shown that a parasitic trematode, a flatworm, can cause tree frog abnormalities ranging from six extra legs to no hind legs at all, say Pieter T.J. Johnson of Claremont (Calif.) McKenna College and his colleagues. In the April 30 SCIENCE, they finger *Ribeiroia* as the villain in ponds in Santa Clara County, Calif.

"This is the first study that has isolated the cause of deformed frogs," Johnson argues. He doesn't expect parasites to be the answer everywhere, however.

In the same issue of SCIENCE, another team says that a survey of nearly 400 frogs with extra legs, mostly tree frogs from the Pacific Northwest, reveals a malformation pattern typical of parasite damage. Led by Stanley K. Sessions of Hartwick College in Oneonta, N.Y., the researchers maintain that the pattern rules out another suspect, a group of chemicals called retinoids.

Reports of occasional deformed frogs date back centuries, but alarm ignited in 1995, when Minnesota schoolchildren found deformities in almost half the leopard frogs they caught. So far, abnormalities have turned up in 36 amphibian species from 42 states. Scientists have been exploring three major suspects: pollutants such as retinoids, ultraviolet light, and parasites.

While doing an undergraduate project in 1996, Johnson focused on deformed *Hyla regilla* frogs in four ponds. Collected eggs developed normally in the lab, so he ruled out genetic factors. Water tests detected no obvious pollutants, and he noticed that a troubled pond flowed into one with normal animals.

Checking 35 local ponds, he found that only his 4 had both tree frogs and a snail notorious as a flatworm host. In the laboratory, *Alaria* trematodes caused no frog deformities but *Ribeiroia* did.

Retinoid researcher David M. Gardiner of the University of California, Irvine ranks Johnson's work as "really important because it brings parasites up to the level [of the other hypotheses]." Commenting on the Sessions paper, Gardiner says that he's not convinced deformity patterns can pinpoint parasite damage, however.

The new work doesn't faze James G. Burkhart from the National Institute of Environmental Health Sciences in Research Triangle Park, N.C. He studies pollutants in deformity hot spots (SN: 10/11/97, p. 230). Among potential causes nationwide, "I've never excluded parasites," he says. "That just happens not to be what we have" in Minnesota and Vermont.

Nor will the parasite work dampen interest in UV and pollutant research at the Environmental Protection Agency's Duluth, Minn., office, says Gerald T. Ankley. "It would be premature to say that we've solved the problem." —*S. Milius*

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Tree frogs may have sprouted extra legs in California because of flatworms.