Theorists grapple with high-flying sprites

Physicists are struggling to explain recently discovered forms of atmospheric fireworks so colorful and bizarre that regular lightning looks drab in comparison.

Pilots and other observers have long reported seeing fleeting flashes above thunderclouds, but scientists did not succeed in measuring such apparitions until this summer. From two airplanes, Davis D. Sentman and colleagues at the University of Alaska at Fairbanks pinpointed where and when the bursts appear (SN: 8/6/94, p.87). At a meeting of the American Geophysical Union in San Francisco last week, researchers unveiled theories to explain the phenomena, dubbed red sprites and blue jets.

Sprites are brief, blood-colored blobs that flash in the mesosphere at altitudes of 50 to 90 kilometers. The much rarer blue jets last longer, shooting up from the tops of thunderclouds in a narrow column that fans out at the top like the waterspout of a whale. The blue beams occur in the stratosphere, spanning a range of altitudes from 20 to 50 km. Ordinary lightning is restricted to the troposphere, at altitudes of less than 20 km.

Because measurements from the aircraft detected sprites and jets above thunderstorms, most theories link the upper-atmosphere flashes to changes caused by lightning.

Earle R. Williams of the Massachusetts Institute of Technology notes that sprites typically occur after the strongest kind of cloud-to-ground lightning, which transports positive charge downward in currents that can exceed 100,000 amperes. According to calculations by Williams, positive lightning temporarily strengthens the electric field *above* clouds to the extent of causing "dielectric breakdown," or a giant spark in the mesosphere. He used a simple laboratory experiment to simulate upward discharges.

In a similar model, Umran S. Inan of Stanford University suggests that the enhanced electric field resulting from lightning can cause sprites without dielectric breakdown. The large ephemeral field should energize electrons in the mesosphere, causing them to crash into nitrogen, which then emits red light, he says.

Yuri Taranenko and Robert Roussel-Dupré of Los Alamos (N.M.) National Laboratory focus on energetic electrons stripped from air molecules by cosmic rays. In their model, the electric field above clouds accelerates such electrons upward, causing them to rip even more electrons free. The cascade of electrons bombards nitrogen molecules, which emit blue light in the stratosphere and red light in the mesosphere, they suggest.

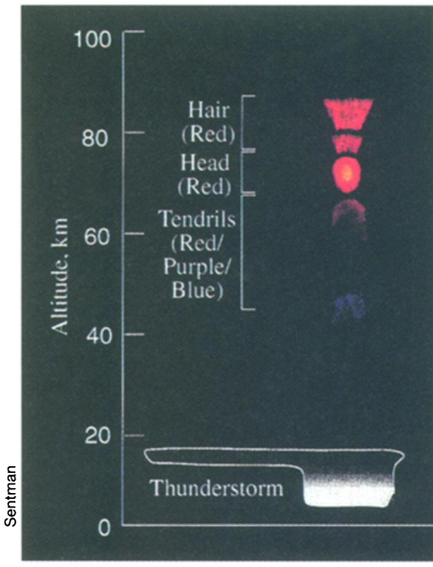
"We think we have a very believable explanation for the upward discharges," says Taranenko. In defense of the theory, he notes that fast-moving electrons can produce gamma rays, which satellites have recently observed coming from Earth's atmosphere.

Other scientists have suggested that electromagnetic pulses from lightning could travel up into the mesosphere and cause discharges at high altitudes.

According to Sentman, the quest to explain sprites and jets is just beginning: "There are still problems with all of these explanations."

Inan and others note that they require more measurements, especially of the light frequencies emitted by sprites and jets. Sentman and his colleagues tried to collect such information last summer, but they attached a critical piece of equipment upside down. The team plans to search for above-cloud flashes in February, during flights over the Andes.

Sprites and jets are not as noticeable as ordinary lightning, because they emit weaker light and are hidden above clouds.



Anatomy of a sprite.

Researchers do not know whether sprites and jets play an important role in the atmosphere, but they speculate that such phenomena could harm high-altitude planes. — *R. Monastersky*

Scientists link new herpesvirus to cancer

A newly discovered human herpesvirus may cause Kaposi's sarcoma (KS), a treatable cancer that often strikes people who have AIDS, creating bluish-red patches on their skin, researchers report.

Only in the past 10 years or so have investigators determined that some viral infections lead to forms of cancer in humans. So far, their list of suspects remains quite short — three viruses have definitely been linked to malignancy.

"This is the first laboratory evidence we have that KS may be due to an infectious agent," says Patrick S. Moore, an epidemiologist with Columbia University and the New York City Department of Health. Moore and his colleagues published their results in the Dec. 16 SCIENCE.

The findings "are interesting; they are exciting," says Bernard Roizman of the University of Chicago. However, no one can accurately assess their significance until researchers find out whether the virus actually causes KS, he cautions. Scientists know of eight other human herpesviruses but have linked only six to diseases, Roizman says.

Moore and his colleagues detected a very small segment of the new herpesvirus' DNA by comparing the DNA sequences in an AIDS patient's healthy tissue with sequences in that patient's cancerous tissue. To locate the infecting virus' DNA, they "subtracted out" from the KS sample any DNA that also existed in the normal tissue, explains coauthor Yuan Chang, a pathologist at Columbia.

The researchers then found the herpesvirus segment in KS tissue from 25 other AIDS patients. They failed to find it in 33 out of 39 samples of non-KS tissue from AIDS patients or in any tissue samples from 85 volunteers who had neither KS nor AIDS.

The fragment closely resembles a stretch of DNA in the Epstein-Barr virus, Moore notes.

Moore and his colleagues have also looked for the herpesvirus in KS samples from people who don't have AIDS. An unpublished study by the group may show that the virus is not unique to AIDS patients. "The results are very interesting," asserts Moore, who hints that these non-AIDS patients are indeed infected with the new herpesvirus. The team is examining tissue from people who later developed KS, to see if they had the virus before the onset of symptoms. Finding the virus in such samples would further indicate that it causes KS, Moore argues.

Considerable evidence existed prior to their study that an infectious agent contributes to KS, the researchers note. For example, people with normal immune systems rarely develop the disease. Also, KS occurs much more often in gay and bisexual AIDS patients than in heterosexual AIDS patients.

"KS may be associated with specific sexual practices among gay men with AIDS," the authors note.

If the herpesvirus does contribute to KS, antiviral agents may prove helpful in treating it, Moore says. Researchers may someday develop tests that detect the virus in patients at risk of developing KS, he adds. — *T. Adler*