From sun to Earth: Tracking a new storm

Space scientists who gathered last week at NASA's Goddard Space Flight Center in Greenbelt, Md., had but one goal: to hone their understanding of a solar eruption that sent a huge cloud of gas hurtling toward Earth last January. In addition to grappling with the earlier data, however, the scientists found themselves dealing with a new event.

On April 7, the day before the meeting began, another large solar outburst blazed forth, blasting Earthward a blob of gas and magnetic energy at a speed of 1.6 million kilometers an hour. Researchers called the resulting storm, which didn't reach Earth's vicinity until 3 days later, relatively mild. There were no reports of problems with spacecraft or electric power outages on Earth. Ground-based detectors, however, measured sizable increases in the energy of electrons in Earth's ionosphere, and sky-watchers as far south as Boston were treated to a dazzling auroral display.

As they had for the January eruption, the researchers relied on an armada of spacecraft to track the disturbance, known as a coronal mass ejection because it originates in the sun's outer atmosphere, or corona (SN: 2/1/97, p. 68). This time, an ultraviolet camera aboard the SOHO spacecraft, which continuously monitors the sun, was in operation, and researchers could view the disturbance deeper in the corona than ever before.

"If the last event was [captured] from cradle to grave, this one was from birth to grave," says Nicola Fox of Goddard.

Like the earlier outburst, which researchers classify as a magnetic cloud, the blob of material ejected on April 7 forced the interplanetary magnetic field around it to point south, allowing it to dump energy efficiently into the oppositely oriented magnetic domain of Earth.

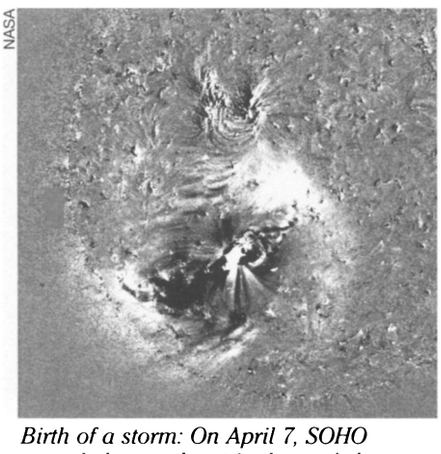
Despite similarities, the April event was much more complex, says Charles C. Goodrich of the University of Maryland at College Park. Researchers predicted, from January's records, that the material would strike Earth's vicinity late on April 9. That night came and went, however, with no sign of the blob's arrival.

Scientists worried that they had miscalculated. In fact, says Fox, the material had plowed into an unusually slow solar wind, the stream of charged particles blowing out from the sun. The expanding blob "had to go through molasses to get to us," Fox says.

In addition, says Goodrich, this material does not qualify as a magnetic cloud because it abruptly switched the direction of its magnetic field and did not show a drop in temperature.

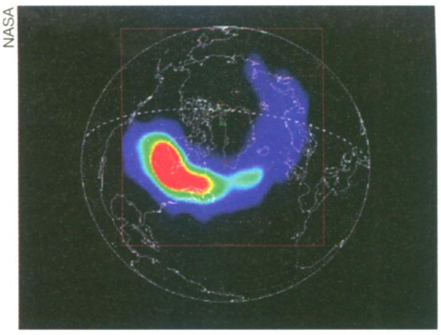
Curiously, he notes, the Wind craft, situated so that it detects solar disturbances about an hour before they get to Earth, recorded two large increases in the density of ionized gas. One increase occurred about 3 p.m. eastern daylight time on April 10 and the other 10 hours later. The researchers are currently examining the ground-based data for evidence of a double signal. Goodrich speculates that the solar outburst may have separated into two independent blobs of gas or that, like an erupting volcano, the sun actually spewed two separate blasts of gas. — *R. Cowen*

NASA



Birth of a storm: On April 7, SOHO recorded an outburst in the sun's lower corona.

NASA

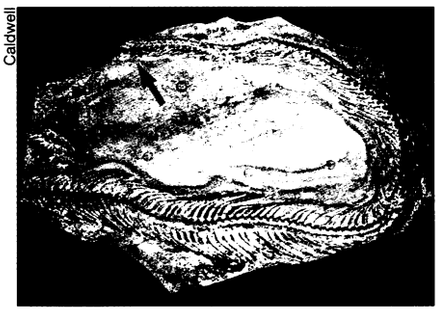


X-ray image of Earth's aurora, taken April 10 by the Polar satellite, shows that the fireworks extended below the Canadian-U.S. border. Red denotes the highest intensity, blue the lowest.

Retelling the tale of a two-legged snake

In 1978, the late geologist George Haas, working near Jerusalem, found the fossil of a sinuous, meter-long creature with two stubby rear legs. He called it a lizard. When Michael W. Caldwell and Michael S.Y. Lee reexamined the bones recently, they came to a different conclusion.

Caldwell



A fossil with rear legs (arrow) hints that snakes evolved from marine lizards.

"It's the missing link between the snake and the lizard," says Lee, a paleontologist at the University of Sydney in Australia. The reclassification challenges the dominant theory that snakes evolved solely from burrowing lizards, since the Israeli fossil represents an aquatic creature. The two scientists posit in the April 17 NATURE that modern snakes descended from giant sea lizards called mosasaurs, which became extinct with the dinosaurs.

Caldwell and Lee did a bone-by-bone comparison between the 97-million-year-old fossil, *Pachyrhachis problematicus*, and other animals. The fossil resembles a snake in that it has mobile jaws and a narrow skull that fully encloses the brain. The fossil's ankles have two distinct bones that in land lizards are fused.

Both the fossil and the mosasaurs have a pelvic girdle and tiny rear limbs. Some living snakes, such as the boa constrictor, contain traces of a pelvis and bony knobs that could be the vestiges of limbs. Even though the fossil's centimeters-long rear legs are fully formed, they were probably too small to serve any purpose, suggesting that over generations the creatures were slowly losing their legs.

Caldwell, a paleontologist at the Field Museum in Chicago, says it's conceivable that two lines of snakes developed, one from burrowing lizards and another from aquatic lizards. For now, he considers both evolutionary theories equally plausible, but he suspects that as scientists find more fossils, the weight of the evidence will tip toward a marine origin. Only two *P. problematicus* fossils have been found, both by Haas and both in the same location. The other one has a crushed skull and pelvis.

Nicholas C. Fraser of the Virginia Museum of Natural History in Martinsville agrees that the reexamined fossil more closely resembles a snake than a lizard. He also says that Lee and Caldwell's argument for a marine origin is persuasive but not conclusive. The link between the early snake and the mosasaurs may be coincidental, he warns. For example, species like bats and pterosaurs share many features, but they evolved independently. — *P. Smaglik*