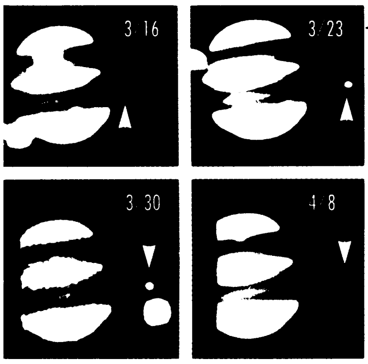
Astronomy

A second new eruption on Io

And they say lightning never strikes twice. While observing in Hawaii in early March, John R. Spencer and his colleagues found a freshly erupting volcano on Jupiter's moon Io (SN: 3/11/95, p.148). When Spencer returned to Lowell Observatory in Flagstaff, Ariz., he continued to monitor Io. The hot spot faded, but to Spencer's surprise, a new eruption appeared.

Unlike the first hot spot, this one sits on the face that Io always keeps turned toward Jupiter. Using a telescope at Lowell, Spencer observed the eruption from March 23 through April 8. On April 15, the hot spot was gone, he told Science News. Spencer says his two discoveries don't mean Io has become more active. Rather, astronomers are viewing Io more often in advance of the Galileo spacecraft's impending visit.



Spencer/Lowell Observ.

Near-infrared images of Jupiter and Io (arrows) show a volcano first seen March 23. Unlabelled bright spots are other Jovian moons.

Shoemaker-Levy: Sorting the debris

When they collided with Jupiter last July, the fragments of Comet Shoemaker-Levy 9 generated soaring plumes of hot material. These fireballs—amalgams of Jovian gases and debris from the comet—rocketed some 3,500 kilometers above the cloud tops before falling back onto the planet.

Which ingredients of the fireballs came from the comet and which from Jupiter? The answer may shed light on the composition of Jovian material normally hidden beneath the cloud tops as well as on the nature of the comet.

Scientists haven't been optimistic about tracing the origin of the debris they detected. But new findings reported at a May meeting of the International Astronomical Union in Baltimore suggest that distinguishing cometary material from Jovian isn't a hopeless task. "The opportunity to separate the comet from Jovian material probably does exist," says David Crisp of NASA's Jet Propulsion Laboratory in Pasadena, Calif.

According to some models, the cometary component of the plumes moved considerably faster than material from Jupiter and therefore rose higher above the planet. The cometary debris would also have taken longer to fall back onto Jupiter than gases ejected from the planet's own atmosphere.

Crisp and his colleagues, using the Anglo-Australian Telescope in Coonabarabran, now believe they have evidence for two distinct kinds of plume material. In observations following several of the impacts, they saw emissions resulting from gases slamming back into the planet. About 6 minutes after impact, they detected methane and ammonia—gases plentiful in Jupiter's upper atmosphere. In contrast, they didn't see oxygen, carbon monoxide, or water for 12 minutes.

The second batch of material could have taken longer to fall back, either because it came from deeper layers of the Jovian atmosphere or because it originated from the comet, Crisp notes. Another team's data, he says, favor the cometary origin.

Viewing an impact from the Canary Islands, Spain, researchers detected several metals found in comets but unknown in Jupiter's upper atmosphere. These detections came 12 minutes after the impact, just like the later detections by Crisp's group. To test more rigorously whether the gases indeed came from fragments of Shoemaker-Levy 9, Crisp plans to measure the isotopic ratios of oxygen, carbon, and hydrogen, which have characteristic values in comets.

Chemistry

Probing prehistoric art to the bone

In the dry heat of southwest Texas, where the Pecos River melds with the mighty Rio Grande, there stands an archaeological site known as White Shaman.

More than 10,500 years ago, hunter-gatherers dwelled along those riverbanks, seeking shelter in shallow limestone caves abutting the water's edge. Performing rituals there, tribesmen decorated their shelter walls with symbolic paintings.

Archaeologists know little about the lives of these migrant people, so they can only speculate about what the paintings mean. Scientists also wonder about the kinds of tools and materials they used, including the ones adapted to artistic purposes.

Marvin W. Rowe, a chemist at Texas A&M University in College Station, and his colleagues have brought DNA analysis to bear on paint samples from the rock art. Using a technique known as polymerase chain reaction, the team made many copies of ancient DNA fragments taken from two pictographs dated between 3,000 and 4,300 years ago. This yielded large amounts of the so-called histone 4 gene.

Genetic sleuthing led Rowe's team to conclude that the paint's binder, or the base holding the pigment, most likely came from the bone marrow of local deer or bison.

"We are certain that the biological material came from an animal in the order Artiodactyla," Rowe reported last month in Anaheim, Calif., at a meeting of the American Chemical Society. "That order contains the family of even-toed ungulates."

Ungulates include such mammals as bison, deer, elk, rabbits, cattle, sheep, goats, and antelopes, which are native to the Southwest. Camels, giraffes, and llamas—also ungulates—seem less likely to have populated prehistoric Texas.

Further DNA study and some common sense have led the scientists to focus on white-tail and mule deer, elk, American bison, pronghorn antelopes, javalinas, and rabbits as candidates for the bone marrow that apparently served as the paint binder. Ancient bison teeth from the nearby Bonfire slaughter site provided benchmark DNA from 12,500 years ago.

"At first, we had no idea what to look for," Rowe says. "So we chose the histone gene because it changes little from one species to another. We then compared the DNA sequences from the rock art with known sequences, looking for a match. This led us to the ungulates."

To ensure that they had truly ancient DNA fragments, not recent contaminations, the researchers amplified some samples tainted with known DNA and others with no added fragments. They also homed in on DNA from mitochondria, which evolves nearly 10 times as fast as DNA from cell nuclei, says Rowe. "Mitochondrial DNA shows wider variation within an order, so it should provide species identification."

This approach also rules out the problem of contamination by bacteria, which have no mitochondria, Rowe adds.

In the absence of other ethnographic information, rock art, Rowe believes, constitutes an important "window into prehistoric thought."

Rowe, Marian Hyman, et al.

Pecos River pictographs reveal humanlike images. Two 1-meter-tall figures (center) stand beside three small ones (left), while a single caricature (right) is struck by a spear. Upside-down persons appear to indicate flight or death.