Largest melt from lightning strike

A few years ago, two boys discovered what they thought were dinosaur bones near Winans Lake in Michigan. Their parents, examining one 5-meter-long white, green and gray object, agreed with the boys' interpretation and called the Museum of Paleontology at the University of Michigan in Ann Arbor. In 1984, paleontologist Daniel C. Fisher went to investigate. But what Fisher and petrologist Eric Essene found instead was the world's largest known fulgurite — a tube-shaped glob of glass that had formed when lightning struck the ground.

Scientists have known for two centuries that lightning bolts, which can heat the air to 10,000° Kelvin — comparable to the sun's surface temperature — can vaporize and melt any rocks, sand or soil they hit. But Essene and Fisher's study of the Winans Lake fulgurite, published in the Oct. 10 SCIENCE, is among the first quantitative investigations of the chemical and physical processes behind fulgurite formation.

Their studies reveal the presence of two minerals that had never before been found to occur naturally. But more important, the two researchers determined that the Winans Lake fulgurite is one of the most chemically reduced (deoxidized) natural materials known. Moreover, they believe their finding adds a new wrinkle to studies of another ultrahigh-temperature, ultrafast event: the proposed impact of a meteorite or comet on the earth, which may have been responsible for mass extinctions of earth life 65 million years ago (SN: 2/1/86, p.75).

Essene and Fisher found metallic globules embedded in the fulgurite glass. Electron microprobe analysis showed these to be made up of a variety of iron and silicon metal compounds. While purely metallic materials are common in meteorites, they are rarely created on the earth's surface by the normal geologic processes. Usually, they are oxidized or have combined with other elements to form compounds that must be smelted in order for the pure metal phases to be retrieved. But in the Winans Lake fulgurite, the lightning bolt had somehow removed the oxygen from metal oxides in the ground, reducing the metals to a much greater extent than even those found in most meteorites, according to Essene.

Soviet scientists had previously reported finding natural, highly reduced metallic materials, but many skeptical Western scientists suspect the reduced metals are human-made contaminants, according to Essene. Now, in light of the Winans Lake find, the researchers write, "reports of these minerals should not be rejected a priori as requiring impossible geological conditions."

Essene and Fisher's work also has a bearing on studies of meteorite impacts. Because iridium has been found at the geologic boundary between the Cretaceous and Tertiary periods in concentrations exceeding typical iridium levels in the crust, some scientists have speculated that a meteorite had slammed into the earth, spraying the planet with a fine layer of meteoric iridium and other debris. Those scientists have estimated the size of this meteorite by comparing the amount of excess iridium with what is known to occur in meteorites.

But on the basis of their fulgurite studies, Essene and Fisher suggest that much more of the iridium may have come from the earth than is commonly supposed. The researchers found that the Winans Lake fulgurite was enriched in gold; presumably, the metallic melts that were formed by the lightning scavenged the gold from surrounding soils. If highly reduced metallic melts are also formed during impact events, says Essene, then they might collect and concentrate iridium in the same way. The result would be that iridium levels in the impact melts would be much higher than what is normally found on the earth.

"If so," he says, "then the estimate of the size of the [impacting] body is too high, and therefore, perhaps, people may be looking for craters that are too large." In any event, the researchers write that their observations "broaden considerably the range of models that should be considered in investigating the origin and implications of the observed iridium anomalies." — *S. Weisburd*

Graham is confirmed

Last week, 10 months after George A. Keyworth II resigned as presidential science adviser (SN: 12/7/85, p.358), the Senate confirmed William R. Graham to replace him. The electrical engineer was sworn in on Oct. 2. Graham, who was nominated for the White House post four months ago (SN: 6/14/86, p.372), had been NASA's deputy administrator.

A key issue for Graham will be to determine how federal research and development funds will be used, notes Philip Speser, executive director of the Washington, D.C.-based National Coalition on Science and Technology, the only registered lobby of scientists on science policy. The federal budget has seen "a big skewing of R&D funds toward defense," Speser says. As a former defense analyst — at times working on strategic missile or nuclear weapons programs — Graham is expected to be at least sympathetic to defense interests. In fact, the Strategic Defense Initiative is one of the few specific programs he went on record as supporting during his confirmation hearing. □

A dizzying orbit for a binary star

The closer two orbiting bodies are, the faster they go around. Johannes Kepler determined that back in the 17th century, and it's still true. Known periods of binary stars — pairs of stars gravitationally bound to each other and orbiting their common center of mass — range from years for fairly distant pairs to the recently discovered shortest astronomical orbital period on record — 11 minutes.

The 11-minute orbit belongs to a binary system consisting presumably of a neutron star and a white dwarf star orbiting each other at a distance of 80,000 miles, about a third of the distance between the earth and the moon. Catalogued as 4U1820-30 and located about 20,000 light-years from earth, the system is a strong emitter of X-rays. William Priedhorsky of Los Alamos (N.M.) National Laboratory and L. Stella and N. E. White of the European Space Agency (ESA) found the orbiting system in data taken by ESA's orbiting X-ray observatory, Exosat. "We know of no other double star system with stars this close," says Priedhorsky.

Neutron stars and white dwarfs are two possible end stages for the lives of ordinary stars. They result from a star's collapse, or collapse and explosion, and are, by stellar standards, tiny relics of former greatness. Either one is only about 10 miles across. However, the present orbit of 4U1820-30 would fit well inside any ordinary star, and that raises questions about the relation of its constituents to each other at earlier stages when they each would have been hundreds of thousands of miles across.

F. Verbunt of the Max Planck Institute at Garching, West Germany, proposes that the system formed by a kind of stellar cannibalism: A red giant — a star in a late but not terminal stage of life — collided with a neutron star and swallowed it. The neutron star descended into the atmosphere of the red giant, and as it orbited there, it triggered an energy release that eventually blew off the outer layers of the red giant, leaving behind the tiny white dwarf. In other words, the orbit of 4U1820-30 was once inside a red giant star.

Under ordinary circumstances the probability of such a collision would be virtually nil, but to support his supposition, Verbunt points out that 4U1820-30 is located in a globular cluster, one of the very dense clusters of stars that are scattered around the edges of our galaxy. In a globular cluster, where stars are a million times as densely packed as they are in the galaxy at large, such a collision is much more likely. This globular cluster is NGC 6624, located in the constellation Sagittarius. It can be seen with binoculars or a small telescope. — *D. E. Thomsen*