Florida's Fantastic Fulgurite Find

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Beautiful, fragile, and elegant, fulgurites are nature's own hidden works of art. Created by cloud-to-ground lightning strikes, fulgurites are the long, hollow, glass tubes that form as a lightning bolt burns through and melts the soil underground, which then quickly solidifies into the delicate tubes.

"The world is full of them," notes University of Florida professor Martin A. Uman, one of the world's foremost lightning experts. "All you have to do is go to any beach and start digging."

But when Uman's lightning research team went digging for fulgurites in 1996, one thing they didn't expect to find was a world record just below the sandy soil of their research site in northern Florida. What they uncovered, with painstaking pale-

ontological care, was the world's largest, longest fulgurite ever excavated - one that forked into three branches: the first over 14 feet long, the second more than 16, the third about eight feet.

In fact, the Guiness Book of World Records recently recognized the fulgurite for its unique length, and the find has sparked an ongoing quest for even larger, longer, more spectacular fulgurites.

Most people don't dig for fulgurites, however. In fact, as Uman observes, few people know what a fulgurite is, which isn't surprising. There's little known scientifically about these mysterious subterranean creations of lightning strikes.

Above vs. Below

Most research into lightning has focused on its above-ground aspects. And for good reason. Aside from its sometimes deadly effects on people (it is the second-leading storm-related killer), Uman notes that above-ground lightning produces lots of chemicals in the atmosphere, such as various forms of nitrogen oxide that would not be there otherwise. Lightning-produced "fixed-nitrogen" is a source of plant fertilizer worldwide.

Lightning is also a preferential predator on tall trees, which can help to determine the composition of forests. In addition, lightning produces fire that regenerates particular types of trees by producing an environment in which seeds can regenerate. Some scientists believe that lightning made the chemicals in the atmosphere in the primordial soup out of which life climbed.

"So lightning does a lot above ground," he says. "But what it does in the ground we've only just begun to really explore. Maybe what it does is really important."

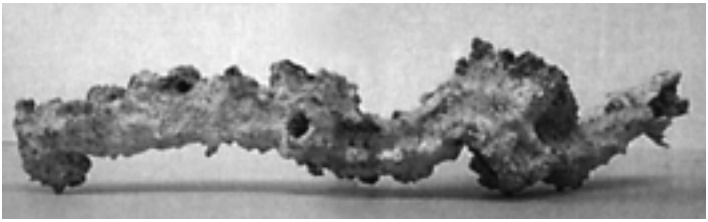
Uman, chairman of the university's Department of Electrical and Computer Engineering, conducts his research at Camp Blanding, near Starke, Florida. Since 1994, the university has maintained a lightning research facility at the location by agreement with the U.S. Army National Guard. The facility was established to study how lightning strikes affect electrical power lines both above and below ground. In one square kilometer at Camp Blanding, Uman and other researchers stage

All photos courtesy of University of Florida Lightning Research Laboratory.

The world's longest excavated fulgurite, as seen during an early stage of excavation.

30 or more triggered lightning strikes a year and study the effects of another three or four natural lightning strikes in that same area.

The research has shown that lightning can strike underground power systems directly because the strike keeps moving below the surface. In Florida's sandy soil, lightning makes a path about



An excavated nine inch section of a natural fulgurite.

an inch in diameter and generally makes a beeline for the power lines or other metal in the ground.

Under certain conditions, those below-the-surface bolts make fulgurites.

A Curiosity Becomes an Obsession

"We started digging the fulgurites out of curiosity," Uman remembers. But the fulgurites have since become a fascinating distraction for the scientists as they research how to protect underground and over head power lines. "They're beautiful," he says. "They've become an obsession."

What Uman and other researchers have confirmed is that lightning is composed of current spikes interspersed with long-flowing currents and is variable from strike to strike.

"We've seen fulgurites like soda straws. Others are one to two inches in diameter like heavy glass...like the current kept flowing and melting sand in a bigger and bigger area. Obviously, different current characteristics were involved in making fulgurites."

Does every lightning strike create a fulgurite? "Probably not," he speculates. "We've tried wet and dry earth to understand what the characteristic of the soil needs to be to make a fulgurite." Sometimes lightning blows sand up but doesn't make a fulgurite," Uman says. "Lightning eats soil and tries to make liquids and glass. Probably, the harder packed the earth is the better chance you have for a fulgurite."

There is also a practical reason to learn more about how and why fulgurites form. Each year, Florida averages about 10-15 lightning strikes per square kilometer, which is one of

The talents of geologists Dan Cordier and Mike Stapleton are much in demand during the delicate excavation process.

the highest rates in the nation. Underground power lines, of which there will be more as Florida's population grows, are susceptible to damage from lightning. Often only the insulation of the power line is damaged, and months will pass be-

fore the line fails from deterioration due to the chemicals in the earth.

Uman and his team are researching the best way to treat the soil after installing a power line so the line won't be damaged. They do this by adding conductive materials to the soil so that the lightning flows over a large area rather than focusing on the line and producing damage.

On the Camp Blanding square kilometer allotted to lightning strikes, video monitors help research team record and mark natural spring and summer lightning strikes for later excavation in the winter months.

Whenever there's a natural lightning strike on this square kilometer of ground, "we mark it and eventually get around to digging it out (for fulgurites)," Uman notes, "We've already excavated a few 10-foot ones and a few five-foot ones," he explains. "The length depends on the local water table...how far down the fulgurite goes."

"Lightning wiggles around some" when it strikes, seeking the water table, which in the Camp Blanding area of Florida ranges from 4 to 20 feet below ground in the summer.

Fulgurites could be created in a lab with artificial lightning, he notes, "but they would be no longer than four or five inches. You really need high voltage to make a long spark. Lightning makes a spark about 10 miles long."

Dan Cordier, a geologist with the team, explains that "we look for strikes that look like they will have better returns. Positive strokes tend to have more energy associate with them, so hopefully, they'll make a bigger, longer, stouter fulgurite."

Once excavation is begun, Cordier's talents are much in need. A former member of the university's geology department, Cordier supervises the digs and brings his paleontological skills to help preserve and remove the stringy fulgurites.

"If a normal citizen tries to dig one of these out of the ground," Uman says, "they would destroy is because fulgurites are so fragile. It takes experts who are skilled at working with special tools and are used to digging up fossil bones. It's definitely an art."

Another view of the world-record fulgurite.

An Unexpected World Record

Researchers didn't expect a world record when they started digging at the site of one of the summer 1996 strike points. They expected a fulgurite typical for the area, perhaps three to five feet long.

"We started to get pretty excited when we discovered we were moving tons and tons of dirt by hand," Cordier recalls. "It branched out into three branches, which is pretty unusual. We hadn't seen that before."

One branch of the fulgurite went down into the soil at a 45° angle, then ran laterally across the water table. They had to use a backhoe from Camp Blanding to assist in the dig. And still the pit grew and grew.

Cordier worked into the night, using head lamps, hoping to beat the rain expected the next day. The fulgurite was carefully separated into sections and covered in plastic materials used in paleontological digs. Each section was then measured with geological instruments for reconstruction.

"We used standard excavation techniques developed in paleontology," Cordier explains. "That was our approach in the beginning and it's worked fairly well."

One key difference in this dig is that most fossils are found laying laterally in the soil, but the branches of this world-record fulgurite were mostly vertical.

Cordier and a team composed of Mike Stapleton, Keith Rambo, Vladimir Rakov, and Uman removed the fulgurite with the idea of reassembling it for display later on. They knew they had something very unique even as it was being uncovered, preserved, and removed.

"We were totally amazed when we found it," Cordier remembers.

"We found out there's very little done in terms of scientific excavation of fulgurites. There are collectors that go out and shake dirt and pull out as big of pieces as they can," he says, "but they don't have the goal to extract them scientifically in a controlled environment for the purpose of exhibiting them as a natural history phenomenon."

A wind-blown triggered lightning strike, staged at the Camp Blanding lightning research facility. More than 30 triggered lightning strikes are staged there each year, allowing scientists to study how lightning strikes affect power lines both above and below ground.

Of course, any dig is a gamble. "Just like fossils," Cordier says, "when you start digging in the ground, you don't know whether you're going to come up with the world's best or the world's most nothing.

In this case, the world's longest fulgurite is looking for a home — a museum with enough display space for the full fulgurite, in all its glory.

For those interested in the University of Florida's lightning research and its fulgurite discoveries, more information is available on the facility's Web site <www.eel.ufl.edu/~lightning>

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