A New Look at Trinitite

This is trinitite—a glass created during the world’s first nuclear explosion at Trinity Site in southern New Mexico on July 16, 1945.

How was it formed?
A Los Alamos scientist has recently challenged the standard explanation—that the intense heat of the explosion melted the sand, turning it into a green glass.

Robb Hermes, a chemist, collects sand. But not any kind of sand. Hermes collects ant sand.

During a tour of Trinity Site, Hermes noticed many ant hills and wondered if they contained trinitite. Later, through official channels, he obtained two small samples.

Hermes showed the samples to a colleague, William Strickfaden, who sorted the sand. It was he who discovered that ant sand did contain trinitite, but in unexpected shapes: mostly small spheres but also droplets, dumbbells, and aerodynamic shapes.

These shapes piqued Strickfaden’s curiosity. What could they mean? Pondering that question together, the two scientists proposed a new theory to describe how trinitite was created.

Hermes and Strickfaden developed their theory using the scientific method, the basis of all research done at Los Alamos National Laboratory.

First, they asked a question:
What do the various shapes of trinitite mean?

Next, they developed a hypothesis:
Trinitite was deposited by a rain of molten droplets, which then puddled on the ground.

They tested their hypothesis with an experiment:
While it was impossible to replicate a nuclear blast, the two scientists conducted high-temperature tests on sand.

They analyzed the results and drew a conclusion:
Trinitite was formed when material melted by the nuclear explosion fell back to the ground as “rain.” This conclusion is supported by the two photos of trinitite shown at left. After falling on the ground, the top surface of the trinitite layer, still being heated by the fireball, developed a smooth surface. The bottom surface, being cooler, retained a record of the first spheres deposited.

Then they communicated their research so others could test their theory independently:
Hermes has published papers and given talks about his theory, stimulating the healthy debate that is a hallmark of the scientific method.

The theory developed by Hermes and Strickfaden—that trinitite was deposited by a rain of molten droplets—is now generally accepted, although it is most likely that trinitite was formed by a combination of thermal events besides “rain,” including some direct melting of the sand.
4 Is there any other process, natural or artificial, that also produces similar spheres?

Hermes, curious, asked himself that question and found that spheres are not rare; they occur commonly from any event that is hot enough to melt or fuse earth.

5 One question leads to another.

Hermes wondered if fused material like trinitite had been created during the Soviet Union’s first nuclear test, Joe-1, in 1949.

It had. The sample Hermes obtained from the site of that test differed externally from trinitite, but he expected its radiological signature to be the same. The Joe-1 device was an exact duplicate of the Trinity Site device.

Yet gamma-ray spectroscopy showed radiological differences between the fused soil from the original American and Soviet test sites. Why?

6 Mystery solved

Upon inquiry, Hermes learned that the Soviets’ original Ground Zero had been used a second time. The sample of fused material was a mixture of soil that had been remelted and remixed with debris from the second test.

The color of fused materials created by nuclear explosions depends on the mineral content of the soil and the equipment vaporized by the blast. For example, copper from the nuclear device or from communication cables lends a slightly reddish color to trinitite. Trinitite’s pale greenish color comes from iron in the sand at Ground Zero.

You can see from this spectrogram that green trinitite has more iron than does red trinitite, while red trinitite is higher in copper.

7 Is trinitite radioactive?

Not all trinitite is equally radioactive; it depends on where in the nuclear explosion it was formed.

Checking a piece of trinitite at Trinity Site, September 1945, using a Geiger counter—an early hand-held radiation detector. Oppenheimer is at extreme right.

Trinitite can no longer be collected from Trinity Site, but samples collected before the ban are often for sale. Do you own a sample of trinitite?

Bill Strickfaden holding a piece of trinitite outside the inner fence at Trinity Site.

The story doesn’t end here

In science, the questions never end. Understanding how trinitite was formed is only a step towards understanding what went on inside the radioactive cloud created during the Trinity test. Many more questions remain to be answered. That’s the challenge of science!

Come to the Bradbury Science Museum to learn more and to see our trinitite samples.

HOURS:
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