Abraham Loeb suggests online February 15 at arXiv.org. The gamma rays could have come from a gas fountain fueled by infalling debris from the parent star.

But before the theorists get too worked up, researchers need to figure out if what Fermi saw had anything to do with LIGO's black holes. "We're definitely not saying we saw an [electromagnetic] counterpart," Connaughton says. It could be just a coincidence. During nearly 67 hours of observation in September, Fermi saw 27 similar gamma-ray bursts. The only way to be certain is to wait for more LIGO detections. "If it's real, it's not going to be a one-off," she says.

LIGO's debut detection appeared during a engineering run in September; researchers are analyzing LIGO data accumulated during the four months that followed, and another science run is planned for later this year. The team is optimistic about its chances of finding more events. LIGO could have sensed a collision between two 30-solar-mass black holes out to about 6 billion light-years away. Given that researchers found one (so far) in 16 days of data, and assuming that's a typical couple of weeks in the universe, then researchers estimate that between two and 53 similar collisions occur per cubic gigaparsec per year. (One cubic gigaparsec is the volume of a sphere roughly 4 billion light-years across.)

If those estimates are correct, scientists think LIGO could have detected up to about 10 more similar collisions in its first four months of operation, and possibly will record hundreds once the facility is running at full sensitivity. And that's not including collisions of black holes with different masses, smashups of neutron stars or any other cosmic calamities that could rattle spacetime.

As more collisions are found, astronomers should get a better handle on where binary black holes form. "We may find they're all in the local universe and none in the early universe," Kalogera says. And that would tell researchers something about how massive star formation has changed throughout cosmic history. "We have high expectations now for a bigger sample in the near future." ■

HUMANS & SOCIETY

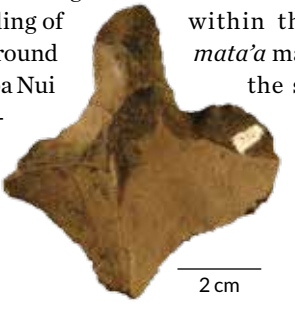
Easter Islanders made tools, not war

Artifacts challenge idea that violence led to Rapa Nui collapse

BY BRUCE BOWER

Sharpened stones previously viewed as spearpoints wielded by warring Easter Islanders actually served as general-purpose tools, researchers say.

Early European visitors to Easter Island, or Rapa Nui, wrote in the late 1700s that the islanders carried spears topped with sharp, triangular pieces of glassy lava, or obsidian. In the last 20 years, some researchers have suggested that fighting among spear-bearing groups — following the leveling of resource-rich palm forests around 1550 — largely destroyed Rapa Nui civilization before Europeans arrived.



Obsidian artifacts from Easter Island, including this one, served as tools for planting and other daily activities, a new study finds.

But instead the islanders probably used the alleged spearpoints in a variety of ways that had nothing to do with killing, say archaeologist Carl Lipo of Binghamton University in New York and colleagues. These sharp rocks, known as *mata'a*, would have been useful for tasks such as cutting sweet potato plants into pieces for cultivation, cutting bananas off trees, stripping bark for rope and cutting ritual designs into people's skin, perhaps to create tattoos, the scientists report in the February *Antiquity*.

Evidence of versatile uses for *mata'a* "adds to our understanding of how ancient Rapa Nui society flourished until well after initial European contact in 1722," says anthropologist Mara Mulrooney of the Bernice Pauahi Bishop Museum in Honolulu. Recent research suggests that farming on the island continued long after palm forests had been cleared (*SN: 1/25/14, p. 9*).

Mata'a had no standardized shape and rarely sported long, spearlike tips, Lipo's team finds. These tools must have been fashioned with nonviolent purposes in mind, the scientists contend.

That conclusion rests on shape and size measurements taken from photographs of 423 *mata'a*. Most artifacts are in museums on Rapa Nui or in Hawaii. There are no precise age estimates for the finds, but *mata'a* date to before Europeans reached Rapa Nui, Lipo says.

A statistical analysis identified no consistent tool shape among these finds. *Mata'a* feature narrow stems and wide blades, but vary considerably within that format. Neither did Lipo's group detect a distinctive set of spear-shaped *mata'a* within the larger sample. Even *mata'a* made from rock gathered at the same Rapa Nui obsidian quarries — of which five existed — and fashioned at the same toolmaking locations lacked signature forms.

Microscopic studies published 20 years ago suggested that scratches, polish and chipping on *mata'a* resulted from woodworking, Lipo adds.

Previous research indicated that obsidian tools resembling *mata'a* were used to cut up root crops, carve wood and perform other daily tasks on the Melanesian island of New Britain several thousand years ago.

Robin Torrence, an archaeologist at the Australian Museum in Sydney who codirected the work in New Britain, says Lipo's new study can't definitively rule out the use of *mata'a* as weapons. Although *mata'a* don't look like spearpoints, she says, "these stone implements would be very dangerous if used as axes or clubs in close-combat fighting."

Lipo considers that scenario unlikely. While any sharp-edged stone can be used on occasion to hurt others, no remains of hilltop forts or other defensive structures linked to warfare have been found on Rapa Nui, he says. *Mata'a* "were sharp rocks on sticks designed not as lethal weapons but for peaceful purposes." ■

C. LIPO, FATHER SEBASTIAN ENGLERT ANTHROPOLOGICAL MUSEUM/RAPA NUI