

## Bronze Age Sardinia shows its metal

More than 7,000 skillfully engineered stone towers and numerous surrounding villages dot the Mediterranean island of Sardinia. These sites, built between about 1800 B.C. and 800 B.C. by members of the Nuragic culture, have yielded a variety of copper, bronze, lead, and iron artifacts. Archaeologists have now uncovered the first extensive evidence for a sophisticated metalworking facility at a Nuragic settlement.

"The existence of a true metal workshop provides convincing proof that the Nuragic people employed advanced metallurgical technologies in Late Bronze Age Sardinia," the researchers assert. Lenore J. Gallin of the University of California, Los Angeles, and Robert H. Tykot of Harvard University describe their find in the fall *JOURNAL OF FIELD ARCHAEOLOGY*.

From 1986 to 1989, Gallin directed excavations at a Nuragic site that consists of a central tower, at least three associated towers, and a large surrounding village enclosed by a stone wall. She and her co-workers uncovered metal slag (waste produced during metal smelting), terra-cotta crucibles containing residues of molten metal, a lead ingot, lead scrap, and more than 200 copper-based artifacts. They also found hundreds of fragments of fire-blackened clay molds and cores; metalworkers apparently made bronze objects by pouring molten material into a mold, allowing it to harden, and then breaking the mold.

Some mold fragments contain incised designs and may have been used to make ornate sword handles and other decorative items, Gallin and Tykot contend. Investigators have also found molds for practical implements, such as hammers and picks.

The molds contain layers of two different clays, a polished form on the inner surface and a porous strip that allowed gases to escape during solidification of molten metal, the researchers say. Chemical analyses suggest that metalworkers sometimes added lead to bronze to improve its casting properties.

Nuragic metalworkers at the site probably manufactured bronze objects from the 12th to the 8th centuries B.C., according to Gallin and Tykot.

## Dating an ancient Russian 'revolution'

Siberia, once renowned as a frigid prison for Soviet dissidents, now proves hospitable to Russian archaeologists studying human prehistory. Their exploration of a site settled by successive waves of ancient peoples indicates that the move from a simple stone-tool culture to a more sophisticated tool technology in central Asia occurred at least 43,000 years ago, about 7,000 years earlier than researchers had thought.

Other investigations have also dated this transition — which signaled revolutionary changes in human thought and behavior — to more than 40,000 years ago in Africa, the Middle East, and Europe (SN: 12/16/89, p.388).

Anatoli P. Derevianko and Valerii T. Petrin, both from the Institute of Archaeology and Ethnography in Novosibirsk, have directed excavations since 1987 at a Siberian site called Kara-Bom. They have identified seven separate occupations of the site, each displaying a distinctive style of advanced stone-tool manufacture. A rich trove of animal bones has also emerged, including the remains of horses, woolly rhinoceroses, bison, yaks, antelope, and cave hyenas.

In 1991, Ted Goebel of the University of Alaska in Fairbanks retrieved charcoal samples from four occupation layers at Kara-Bom. Much of the charcoal probably came from fires or hearths tended by humans, according to Goebel. An advanced radiocarbon-dating technique, which separates and counts carbon atoms of different mass in small samples, yielded charcoal ages in the deepest occupation layer ranging from around 31,000 to 43,000 years old, Goebel, Derevianko, and Petrin report in the August-October *CURRENT ANTHROPOLOGY*.

## Aftermath of a meteor shower

It wasn't the storm that many had hoped for, but it proved to be a spectacular shower. That's the consensus of observers who viewed the heavenly light show staged by the Perseid meteors on the night of Aug. 11.

Researchers had predicted that Earth's annual passage through the dusty debris making up the Perseids might this year

provide an unusually intense meteor shower or even a storm (SN: 8/7/93, p.85). They based their forecast on the proximity of the Perseids' parent body, Comet Swift-Tuttle, which last December made its closest approach to Earth in 130 years.

Although Earth crossed the comet's orbital plane at about 9:15 p.m. EDT on Aug. 11, the number of meteors seemed to peak about two hours later—a puzzling feature also noted in the 1991 Perseid shower, says Brian G. Marsden of the Smithsonian Astrophysical Observatory in Cambridge, Mass.

Because different observers see different numbers of meteors depending on local viewing position and sky conditions, astronomers compare counts by using a standard called the zenithal hourly rate (ZHR). They define this rate as the number of meteors per hour that an average observer would see if the shower appeared to originate from directly overhead and sky conditions were such that the faintest stars visible had a magnitude of 6.5. Peter Brown at the University of Western Ontario estimates this year's peak rate at 350 ZHR, about three times higher than that of the average shower. A Perseid display intense enough to be considered a storm might have a rate 1,000 times higher than that recorded, Brown says.

Marsden adds that astronomers at Wise Observatory in Tel Aviv, Israel, reported an unusually high rate of nearly one meteor every five seconds lasting for about a half hour. But Brown says that all other observers reported rates at least 10 percent lower. Skies over southern France, Malta, and parts of Germany provided particularly good viewing, whereas clouds limited visibility in much of the eastern United States.

While most people observed the Perseids in visible light, David D. Meisel of the State University of New York College at Geneseo and his colleagues viewed it in the infrared. To their surprise, an infrared camera at the University of Rochester's C.E.K. Mees Observatory saw nothing. Meisel speculates that the blank images indicate that the Perseids represent centuries-old — not fresh — debris shed by Swift-Tuttle. Over time, he notes, infrared-emitting materials such as water and hydrocarbons would readily evaporate from the debris.

Although NASA delayed launching a space shuttle to avoid any meteor damage and commanded several space vehicles to point away from the shower, the Perseids seem to have made their mark on spacecraft nonetheless. According to Gregory Lange of NASA's Johnson Space Center in Houston, the Russian Mir space station apparently endured some 60 identifiable "hits" that might be attributed to meteoroids striking the craft. And the European Space Agency reported that on the night of Aug. 11, its Olympus satellite suddenly began spinning uncontrollably, possibly in response to a meteoroid impact. To recover the satellite, flight controllers had to use up the remainder of Olympus' already dwindling fuel supply, which forced the agency to end the mission early.



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*Streak amid star tracks shows Perseid shower. This 10-minute exposure was taken in Oklahoma, about 2:50 a.m. EDT on Aug. 12.*